Project Work

Subject: Biology

Class: XI

Chapter: Chemical Coordination and Integration

Theme: Diabetes Mellitus

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Introduction

Diabetes is one of the most epidemic diseases. As per the current survey, in India, more than 62 million people are diagnosed with this non curable disease.

Types of Diabetes

Based on the hypo-secretion of two different hormones, two types of diabetes occur in the organisms that are, **diabetes insipidus** and **diabetes mellitus**.

Diabetes insipidus is a **hypothalamic disorder** that occurs due to the **hypo-secretion of** ADH (Antidiuretic hormone or Vasopressin) in the body.

Another type of diabetes, **diabetes mellitus** is a **pancreatic disorder** that occurs due to the **hypo-secretion of insulin** in the body.

Diabetes mellitus is characterised by:

- Hyperglycemia (High level of blood glucose)
- Glycosuria (Presence of glucose in urine)
- Polyuria (Increased volume of urine due to the presence of excess glucose in the body)
- Polydipsia (Excessive thirst)
- Polyphagia (Excessive appetite)

Types of Diabetes mellitus

Diabetes mellitus is primarily of two types: **Type I (Insulin dependent diabetes mellitus, IDDM)** and **Type II (Non-insulin dependent diabetes mellitus, NIDDM)**.

Type I diabetes is juvenile-onset diabetes that occurs at young age. It occurs when pancreas stops producing

insulin either due to autoimmune response or viral attack on it.

Some of its common causes are:

- **Poor Diet:** Improper nutrition may reduce the immunity and hence; increase the risk of autoimmune diseases and pancreatic infections.
- **Infection:** Any kind of pancreatic infection in pancreas may disrupt the production of insulin.

In the absence of insulin, the body cells do not get the required amount of glucose to produce energy in the form of ATP (Adenosine triphosphate). Initially, this condition is sympomised by **nausea and vomiting**, while in later stages, it leads to **ketoacidosis** in which the body starts breaking down the muscle and adipose tissues to produce energy, thereby causing rapid loss of weight.

In this type of diabetes, since the pancreas is incapable of producing insulin, the affected people need to take insulin injections or tablets. Therefore, type I diabetes is also called insulin-dependent diabetes mellitus (IDDM).

On the other hand, type II diabetes is adult-onset diabetes that occurs in people who are above the age of 40. It is an inherited recessive autosomal disorder.

Some of its common causes are:

- **Hereditary:** Type II diabetes is an inherited recessive autosomal disorder. If both the parents are diabetic, there is much greater risk of contracting the disease.
- **Age:** Though the case of type II diabetes is rising in children, it is more common in people who are above the age of 40.
- **Obesity:** Being overweight causes increased insulin resistance. This condition leads to diabetes.
- **Poor Diet:** Improper nutrition, like intake of low protein and fiber diet, increased intake of refined products, may cause diabetes.
- **Sedentary Lifestyle:** People with sedentary lifestyle have greater risk of contracting diabetes as compared to those who undergo regular exercise regime·
- **Stress:** Any kind of stress may show clinical signs of this disease.
- **Hypertension:** It had been reported that there is high systolic pressure is directly related to diabetes.

It occurs when the body produces insulin, but cannot utilise it efficiently. This condition is known as **insulin resistance**.

Some of its common symptoms are:

- **Increased Fatigue:** Due to inefficiency of the cell to metabolise glucose, reserved fat of the body is metabolised to obtain energy. Since breakdown of

fat requires more energy as compared to glucose, it leads to fatigue.

- **Polyuria:** Production of urine increases due to the presence of excess glucose in the body. Body eliminates excess sugar from the blood by excreting it through urine. In this condition, along with the sugar, a large amount of water is excreted out of the body, which leads to dehydration.
- **Polydipsia:** As the concentration of glucose increases in the blood, our brain receives signal to dilute the blood. In its response, we feel thirsty.
- **Polyphagia:** Since there is a lack of insulin in the body, the body cannot utilise the glucose to produce energy in the form of ATP. Lack of energy makes us feel hungry.
- **Weight Fluctuation:** Factors like polyuria, glycosuria, etc., may lead to weight loss.
- **Irritation:** Since there is inefficient supply of glucose to the brain, we feel irritated and agitated.
- **Infections:** When the level of blood sugar fluctuates in the body, it leads to suppression of the immune system, which can be characterised by occurrence of various infections like skin infections, UTI, etc.
- **Poor Wound Healing:** High blood sugar resists the flourishing of WBCs, which are the soldiers of the body. When these cells do not function properly, wound healing is delayed.

In this type of diabetes, since body produces insulin, the affected people need not to take insulin from outside. Therefore, type II diabetes is often called non-insulin-dependent diabetes mellitus (NIDDM).

However, in some cases like low sensitivity of body to insulin and beta cell of pancreas failure, we need to take insulin from outside source even in case of type II diabetes.

Monitoring of diabetes by medical device: Glucometer

Type II diabetes mellitus is extremely common. Now-a-days, a medical device, called **glucometer**, is used for instant detection of hyperglycemia. This device determines the approximate concentration of glucose in the blood.

A glucometer uses a test strip containing glucose oxidase enzyme. When the blood sample is put on the test strip, the enzyme reacts with glucose present in the blood sample.

When the strip is inserted into the glucometer, the flux of the reaction generates an electrical signal, which can be calibrated by a digital reading appearing on the screen.

The more is the glucose concentration in the blood sample, the higher is the digital reading.

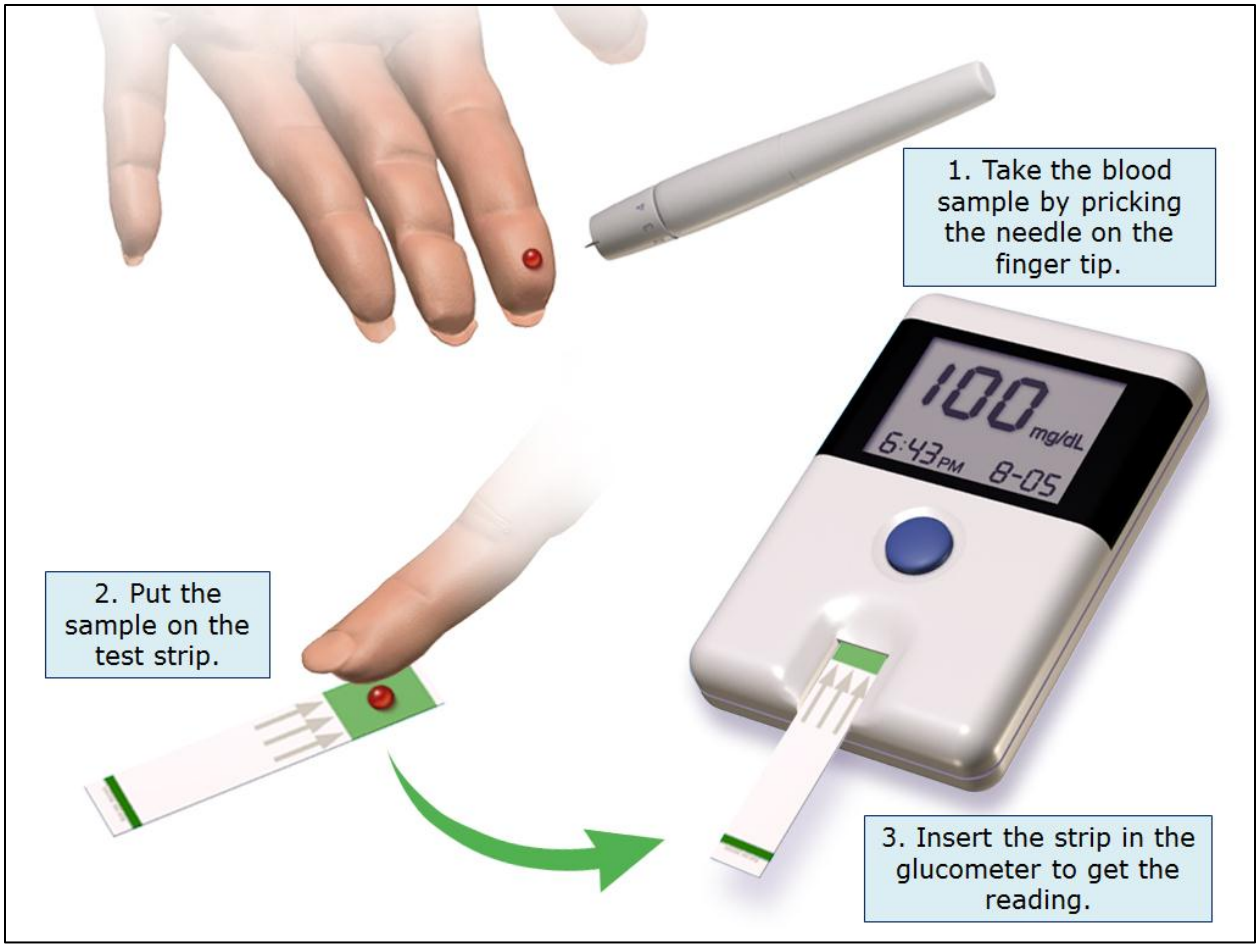

Figure 1: Working of Glucometer

Effect of regular exercise and diet on diabetes mellitus

Though diabetes mellitus is incurable, we can control the concentration of glucose in the blood by following regular exercise regime and proper diet.

Presentation

Before Following Strict Diet and Exercise Regime

- **Family 1:**

Family Member	Diagnosis of Diabetes Mellitus	Potent Cause(s)	Type of Diabetes Mellitus	Fasting Blood Sugar (mmol/ L)	Post-prandial (PP) Blood Sugar (mmol/L)
Maternal Grandmother (65 yrs.)	Diabetic	• Overweight • High BP	Type II	7.5	11.8
Maternal Grandfather (68 yrs.)	Pre-diabetic	• Fatty diet • Overweight	Type II	6.3	8.0
Paternal Grandmother (71 yrs.)	Diabetic	• Poor diet • Sedentary lifestyle • Overweight	Type II	7.7	12.3
Paternal Grandfather (79 yrs.)	Diabetic at the age of 15	Virus attack on pancreas	Type I	7.6	11.9
Mother (36 yrs.)	Non-diabetic	NA	NA	5.6	7.2
Father (41 yrs.)	Pre-diabetic	Overweight	Type II	6.8	10.8
1st Child (15 yrs.)	Non-diabetic	NA	NA	5.2	6.9
2nd Child (11 yrs.)	Non-diabetic	NA	NA	3.9	8.4

- **Family 2:**

Family Member	Diagnosis of Diabetes	Potent Cause(s)	Type of Diabetes Mellitus	Fasting Blood Sugar (mmol/	Post-prandial (PP) Blood

				L)	Sugar (mmol/L)
Maternal Grandmother (62 yrs.)	Pre-diabetic	High BP	Type II	6.5	9.6
Maternal Grandfather (65 yrs.)	Diabetic	• Obesity • Sedentary lifestyle	Type II	8.1	12.0
Paternal Grandmother (68 yrs.)	Non-diabetic	NA	NA	5.9	7.4
Paternal Grandfather (71 yrs.)	Diabetic	• Poor nutrition • Obesity	Type II	8.8	13.2
Mother (34 yrs.)	Non-diabetic	NA	NA	5.8	6.8
Father (38 yrs.)	Diabetic	• Obesity • Sedentary lifestyle	Type II	7.3	11.5
1st Child (12 yrs.)	Non-diabetic	NA	NA	5.0	6.4
2nd Child (8 yrs.)	Non-diabetic	NA	NA	4.8	9.0

- **Family 3:**

Family Member	Diagnosis of Diabetes	Potent Cause(s)	Type of Diabetes Mellitus	Fasting Blood Sugar (mmol/L)	Post-prandial (PP) Blood Sugar (mmol/L)
Maternal Grandmother (71 yrs.)	Pre-diabetic	• Fatty diet • Overweight	Type II	6.4	8.6
Maternal Grandfather (78 yrs.)	Diabetic	• Obesity • High BP	Type II	8.7	13.1
Paternal Grandmother (75 yrs.)	Non-diabetic	NA	NA	5.7	7.7
Paternal	Diabetic	• Poor	Type II	8.9	13.4

Grandfather (81 yrs.)		Nutrition • Overweight			
Mother (38 yrs.)	Diabetic	• Obesity • Sedentary lifestyle	Type II	7.9	12.0
Father (41 yrs.)	Diabetic	• Obesity • Sedentary lifestyle	Type II	7.3	11.5
1st Child (18 yrs.)	Non-diabetic	NA	NA	5.7	7.1
2nd Child (15 yrs.)	Non-diabetic	NA	NA	5.5	6.6

- **Family 4:**

Family Member	Diagnosis of Diabetes	Potent Cause(s)	Type of Diabetes Mellitus	Fasting Blood Sugar (mmol/ L)	Post-prandial (PP) Blood Sugar (mmol/L)
Maternal Grandmother (55 yrs.)	Non-diabetic	NA	NA	5.9	7.4
Maternal Grandfather (57 yrs.)	Non-diabetic	NA	NA	6.1	7.8
Paternal Grandmother (58 yrs.)	Pre-diabetic	• Poor Nutrition • Overweight	NA	6.6	8.9
Paternal Grandfather (61 yrs.)	Non-diabetic	NA	NA	6.0	7.3
Mother (34 yrs.)	Non-diabetic	NA	NA	5.8	7.2
Father (36 yrs.)	Non-diabetic	NA	NA	6.0	7.6
1st Child (8 yrs.)	Non-diabetic	NA	NA	4.8	9.1
2nd Child (3 yrs.)	Non-diabetic	NA	NA	5.5	8.2

- **Family 5:**

Family Member	Diagnosis of Diabetes	Potent Cause(s)	Type of Diabetes Mellitus	Fasting Blood Sugar (mmol/ L)	Post-prandial (PP) Blood Sugar (mmol/L)
Maternal Grandmother (50 yrs.)	Non-diabetic	NA	NA	5.8	7.2
Maternal Grandfather (52 yrs.)	Pre-diabetic	• Poor Nutrition • High BP	Type II	6.6	8.1
Paternal Grandmother (54 yrs.)	Pre-diabetic	• High BP • Overweight	NA	6.9	8.9
Paternal Grandfather (56 yrs.)	Non-diabetic	NA	NA	5.9	7.3
Mother (30 yrs.)	Non-diabetic	NA	NA	5.4	6.9
Father (35 yrs.)	Non-diabetic	NA	NA	5.7	7.1
1st Child (4 yrs.)	Non-diabetic	NA	NA	5.7	8.6
2nd Child (3 yrs.)	Non-diabetic	NA	NA	5.4	8.5

After Following Strict Diet and Exercise Regime for Two Months

- **Family 1:**

Family Member	Diagnosis of Diabetes	Improvement in Health, If Any	Type of Diabetes Mellitus	Fasting Blood Sugar	Post-prandial (PP)

	Mellitus			(mmol/ L)	Blood Sugar (mmol/L)
Maternal Grandmother (65 yrs.)	Diabetic	• 2 Kg reduction in weight • Slight Control on BP	Type II	7.0	11.2
Maternal Grandfather (68 yrs.)	*Non-Diabetic*	Proper diet	Type II	5.9	7.6
Paternal Grandmother (71 yrs.)	Diabetic	• Proper diet • Activeness	Type II	7.4	11.8
Paternal Grandfather (79 yrs.)	Diabetic at the age of 15	Virus attack on pancreas	Type I	7.4	11.3
Mother (36 yrs.)	Non-diabetic	NA	NA	5.4	7.1
Father (41 yrs.)	Pre-diabetic	Overweight	Type II	6.5	10.4
1st Child (15 yrs.)	Non-diabetic	NA	NA	5.2	6.6
2nd Child (11 yrs.)	Non-diabetic	NA	NA	3.3	8.2

- **Family 2:**

Family Member	Diagnosis of Diabetes	Potent Cause(s)	Type of Diabetes Mellitus	Fasting Blood Sugar (mmol/ L)	Post-prandial (PP) Blood Sugar (mmol/L)
Maternal Grandmother (62 yrs.)	Pre-diabetic	Slight Control on BP	Type II	6.2	9.2
Maternal Grandfather (65 yrs.)	Diabetic	• 1 Kg reduction in weight • Activeness	Type II	7.4	11.7
Paternal	Non-	NA	NA	5.4	7.2

Grandmother (68 yrs.)	diabetic				
Paternal Grandfather (71 yrs.)	Diabetic	• Proper diet • 3 Kg Reduction in weight	Type II	8.2	12.7
Mother (34 yrs.)	Non-diabetic	NA	NA	5.4	6.4
Father (38 yrs.)	Diabetic	• 1.5 Kg reduction in weight • Activeness	Type II	6.9	11.0
1st Child (12 yrs.)	Non-diabetic	NA	NA	4.7	6.1
2nd Child (8 yrs.)	Non-diabetic	NA	NA	4.6	8.5

- **Family 3:**

Family Member	Diagnosis of Diabetes	Potent Cause(s)	Type of Diabetes Mellitus	Fasting Blood Sugar (mmol/L)	Post-prandial (PP) Blood Sugar (mmol/L)
Maternal Grandmother (71 yrs.)	Pre-diabetic	Proper diet	Type II	6.1	8.1
Maternal Grandfather (78 yrs.)	Diabetic	• 2.5 Kg reduction in weight • Slight Control on BP	Type II	8.4	12.8
Paternal Grandmother (75 yrs.)	Non-diabetic	NA	NA	5.4	7.4
Paternal Grandfather (81 yrs.)	Diabetic	• Proper diet • 2 Kg Reduction in weight	Type II	8.2	12.8

Mother (38 yrs.)	Diabetic	• 1.5 Kg reduction in weight • Activeness	Type II	6.7	11.0
Father (41 yrs.)	*Pre-Diabetic*	• 1 Kg reduction in weight • Activeness	Type II	6.9	11.0
1st Child (18 yrs.)	Non-diabetic	NA	NA	5.4	6.9
2nd Child (15 yrs.)	Non-diabetic	NA	NA	5.3	6.4

- **Family 4:**

Family Member	Diagnosis of Diabetes	Potent Cause(s)	Type of Diabetes Mellitus	Fasting Blood Sugar (mmol/ L)	Post-prandial (PP) Blood Sugar (mmol/L)
Maternal Grandmother (55 yrs.)	Non-diabetic	NA	NA	5.4	7.0
Maternal Grandfather (57 yrs.)	Non-diabetic	NA	NA	5.8	7.2
Paternal Grandmother (58 yrs.)	*Non-diabetic*	• Proper diet • 2 Kg Reduction in weight	NA	6.1	7.8
Paternal Grandfather (61 yrs.)	Non-diabetic	NA	NA	5.8	7.1
Mother (34 yrs.)	Non-diabetic	NA	NA	5.5	6.9
Father (36 yrs.)	Non-diabetic	NA	NA	5.6	7.3
1st Child (8 yrs.)	Non-diabetic	NA	NA	4.6	8.9

2nd Child (3 yrs.)	Non-diabetic	NA	NA	5.3	7.9

- **Family 5:**

Family Member	Diagnosis of Diabetes	Potent Cause(s)	Type of Diabetes Mellitus	Fasting Blood Sugar (mmol/ L)	Post-prandial (PP) Blood Sugar (mmol/L)
Maternal Grandmother (50 yrs.)	Non-diabetic	NA	NA	5.5	7.0
Maternal Grandfather (52 yrs.)	Pre-diabetic	• Poor Nutrition • High BP	Type II	6.2	7.9
Paternal Grandmother (54 yrs.)	Pre-diabetic	• High BP • Overweight	NA	6.6	8.3
Paternal Grandfather (56 yrs.)	Non-diabetic	NA	NA	5.5	6.9
Mother (30 yrs.)	Non-diabetic	NA	NA	5.1	6.3
Father (35 yrs.)	Non-diabetic	NA	NA	5.3	6.8
1st Child (4 yrs.)	Non-diabetic	NA	NA	5.5	8.3
2nd Child (3 yrs.)	Non-diabetic	NA	NA	5.1	8.1

Conclusion/ Summary

After performing the survey on 40 people that did not follow a strict diet and exercise regime, we have found that:

- 10 are diabetic (1 with type I and 9 with type II),
- 07 are pre-diabetic and,
- 23 are non- diabetic (Out of 23, 10 are children who are at risk of contracting the disease in adulthood if they do not control their diet and undergo regular exercise and workout).

After letting all of them undergo a strict diet and exercise regime for two months as per their age groups, we have found that:

- 09 are diabetic (1 with type I and 8 with type II),
- 06 are pre-diabetic and,
- 25 are non- diabetic.

So, after two months of regular exercise and proper diet, we have found that the number of diabetic and pre-diabetic patients have reduced by one. Hence, number of non-diabetic patients has increased by two.

- From this survey, it can be clearly inferred that type I diabetes is rare, while type II diabetes is extremely common.
- A general observation says that about 90-95% of people suffer from type II diabetes; in which 80% are overweight.

- Regular exercise and proper control on diet have proven to be fruitful to diabetic as well as non-diabetic people.
- These healthy habits have helped them to:
    - bring the level of blood glucose to pre-diabetic range in diabetic patients,
    - bring the level of blood glucose to normal range in pre-diabetic patients and, increase the fitness of non-diabetic patients by boosting their immunity.

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