

BSc Health and Social Care

Introduction to Physiology

BMHP5023

Component 1: Written Assignment

Case Study 1

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1. Introduction

Diabetes mellitus is a chronic health disorder causing the body to have a problem controlling the level of glucose in the blood commonly referred to as blood sugar (Shaikh *et al.*, 2022). The cells of the body need a lot of glucose as energy. Yet, the blood glucose level should not exceed an appropriate level to facilitate normal body functions. Diabetes occurs when the body is unable to produce enough insulin or it is not able to utilize insulin well. Insulin is a pancreatic hormone that assists glucose to travel in the blood into the body cells (Rao and Tejomurtula, 2024).

Diabetes can be divided into two categories. *Type 1 Diabetes* in children is caused when the insulin-making cells of the pancreas are attacked by the immune system leading to the production of little to no insulin. Report on *Type 2 diabetes* occurs when body cells lose their sensitivity to insulin also known as *insulin resistance* and the production of enough insulin at the pancreas is unable to sustain normal blood glucose levels. *Type 2 diabetes* is the target of this report due to the fact that lifestyle management and constant monitoring could enable many individuals to manage the condition (Ramachandran *et al.*, 2024).

Type 2 diabetes can be exposed to a variety of factors, some of which can be inherited in the family, or can occur in an individual due to their age, inactivity and excessive body weight, especially abdominal fat. Risk may be affected by additional factors like ethnicity and a history of gestational diabetes. Nonetheless, individuals with varying bodies and backgrounds might experience diabetes, and therefore, there is no similar risk profile. Knowledge of the condition leads to an informed decision by the patients in regards to diet, exercise, smoking and blood glucose checks. As practice nurses, they can assist patients by educating them and creating individualised care plans to help them to decrease complications and enhance their quality of life.

2. Regulation of blood glucose

The process by which the body ensures there is an appropriate amount of glucose in the blood is referred to as blood glucose regulation (Hantzidiamantis, Awosika and Lappin, 2024). The pancreas, liver and body cells work together to ensure glucose is maintained in its availability as a source of energy but without glucose in the blood being too high or too low. During digestion, simple sugars such as glucose, are formed after the breakdown of carbohydrates following a meal. The glucose is passively taken into the blood stream leading to the increase of glucose in the blood. This rise is detected by the pancreas and insulin is produced by specialised beta cells. *Insulin* is a chemical messenger and the glucose is taken to muscle and fat cells to be used in energy production. It also interacts to promote the storing of excess glucose by the liver and muscles in the form of glycogen. It is referred to as glycogenesis. When glucose is stored in this manner, the level of glucose in the blood slowly restores to normal levels.

Blood glucose levels can decrease between meals or when there is fasting or a rise in energy demand (such as a result of more active exercise). This is followed by the release of glucagon by alpha cells in the pancreas. It is a hormone that makes the liver decompose the stored glycogen to glucose, a process called glycogenolysis. The liver sets free glucose into the blood, which helps to sustain the supply that the body requires in its organs such as the brain. When needed, glucose can be made by the liver using non-carbohydrate substances by a process known as *gluconeogenesis* (Barroso *et al.*, 2024). Thus, insulin and glucagon act contrary yet complementary to each other. There is a reduction of blood glucose through insulin and an increase of glucose through glucagon (when it is necessary). The activities they engage in facilitating their glucose homeostasis.

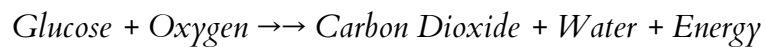
This control mechanism is less effective in Type 2 diabetes. This makes body cells resistant to insulin i.e. less responsive to insulin. First, the pancreas can additionally produce more insulin to make up. This can change over time, though, as the production of insulin can be too little to supply the body. As such, glucose does not go into the cells effectively but stays in the bloodstream causing hyperglycaemia to persist. With long-term elevated blood glucose, blood vessels and nerves may become damaged, which makes the body susceptible to cardiovascular disease, renal issues, loss of vision and foot issues. The comprehension of such processes assists the patients in comprehending the importance of medication, good nutrition, exercise and frequent clinical visits. Insulin sensitivity is also enhanced by lifestyle changes and certain cases have the use of medications to obtain safe glucose levels. The design of the treatment therefore should be based

on the personal health requirements and clinical guidance (Alsararate, Ahmed and Elachola, 2026).

3. Glucose, Oxygen and Cellular Metabolism

The cellular metabolism involves chemical reactions to ensure that the cells get the energy, construct building blocks and components that are necessary and sustain normal functions of the cell. *Cellular respiration* is one of the processes through which the divisions of the body dissolve glucose to create adenosine triphosphate (ATP). The primary source of instantaneous consumable energy available to the cells, such as muscle contraction, active transportation, tissue repair and the preservation of normal cell functions is ATP (Hu, J2022).

In aerobic respiration, a series of steps occur which involves glucose interacting with oxygen. The entire procedure can be recapped as follows:



The initial is the *glycolysis*, which takes place in the cytoplasm. This degrades one of the glucose molecules into two molecules of pyruvate, with a small part of ATP and electrons carriers generated. Glycolysis is non-oxygen-dependent and, thus, when the oxygen is in short supply, it proceeds. In case of ample oxygen, pyruvate gets into the mitochondria and is transformed into acetyl coenzyme A, which passes through the Krebs cycle also known as citric acid circle (Chaudhry and Varacallo, 2023). Carbon dioxide is evolved during this cycle and energy carrying electron carriers are generated. There is also a low level of ATP produced. Such electron carriers pass their energy to the next process of respiration.

The next step is the *electron transport chain* and is present in the inner membrane of the mitochondria. The electrons travel through the sequence of protein complexes emitting energy that can be used to create a proton gradient. This gradient is what is used by ATP synthase to generate large quantities of ATP. Oxygen is the last electron acceptor which combines with the electrons and hydrogen ions to create water. Most of the ATP produced during aerobic respiration comes about through this process, called *oxidative phosphorylation* (Clark, Douglas and Choi, 2018). A reduced supply of oxygen means that the electron transport chain will not work as normal, lowering efficient production of ATP. Cells have a greater dependence on glycolysis, which produces a lot less ATP. This can be an enhanced pyruvate to lactate transformation in the human tissues.

4. Blood glucose monitoring

Monitoring of blood glucose assists both patients with Type 2 diabetes and their medical team to comprehend the effectiveness of combating the condition. The documentation of results to time can reveal patterns, assist in making treatment decisions and aid in decreasing the chance of complications. Two essential methods relevant include direct blood glucose tests and glycated haemoglobin (HbA1c) tests (Santoso *et al.*, 2023).

Finger-prick blood glucose test is an examination that evaluates the quantity of glucose in a tiny segment of the blood at a specific point of time. Recent meals, physical exercise, illness and stress as well as medication may influence the outcome. In cases where self-monitoring is a recommendation, writing down the readings at meal times, during exercise and medication may give patients an idea of the patterns. An illustration is that when post-meal, consistently the readings are high so it may be necessary to discuss food options or medications with a medical provider. Low readings that fall below expectations might be because hypoglycaemia (specifically in individuals who take insulin or some glucose-lowering medications) could have occurred (Bappy and Solanki, 2023).

Nevertheless, *finger-prick testing* is only a record of blood glucose. At a range of readings that are considered normal, it does not necessarily indicate that there has been no fluctuation of glucose over the day. Additionally, over testing without an obvious reason may bring about discomfort, cost and stress. *HbA1C* is a more comprehensive test. The glucose binds with haemoglobin which is a protein in the red blood cells. The HbA1c outcome is the percentage of haemoglobin transporting glucose and an indication of the average blood sugar in an average period of about two or three months. It is not confined to specific time as is the case with a finger-prick reading. The NICE (2015), suggests that HbA1c should be checked in a time interval of three-six months till the values stabilize and at the most opportune time, they should be checked after every six months. The discussion should be individual with the healthcare team and patient.

Measures of results are used to evaluate the effectiveness of lifestyle modifications and medication in clinicians. In case HbA1c is not at the agreed level, the care plan might need to be changed. In case glucose levels indicate that a person has low levels regularly, treatment can be as well reviewed.

5. Evidence-based lifestyle recommendations

A significant aspect of Type 2 diabetes management is lifestyle changes, as it can make people more sensitive to insulin, help them to balance blood sugar levels and minimize cardiovascular diseases.

Calorie intake and balance of eating

The patients need to seek a balanced diet of vegetables, fruit, wholegrains, pulses, right sources of proteins and unsaturated fats. Fibrous foods, such as oats, wholemeal bread, beans and lentils, could aid in the health of the digestion and assist in enhancing the overall quality of the diet. Consuming more primitive sources of carbohydrates and balancing the size of portions could help in curb soaring blood sugar post meal (Bizimana Rukundo, 2024).

Regular physical activity

Working out assists one's muscles to utilize glucose as a source of energy, as well as assisting in enhancing insulin sensitivity. Brisk walking, cycling, swimming, gardening and dancing are activities that may help to improve glucose control. Where suitable, the NHS suggests a goal of at least 150 minutes of moderate-intensity exercise every week.

Weight Management

In patients with overweight conditions, gradual weight reduction, which is sustainable, is possible to enhance the sensitivity of insulin and to decrease the doses of medication in certain situations. Weight loss is not however suitable for all (Bizimana Rukundo, 2024).

Education and Personal Support for Diabetes

Diabetes education should be provided to the patients in a structured form to learn the management of glucose, taking medication, monitoring and complications prevention. NICE (2026) promotes healthy lifestyles and proper medical care along with personalised HbA1c level.

6. Conclusion

Type 2 diabetes intersects with the normal functioning of the body in terms of how it adjusts the blood glucose levels due to insulin resistance and with time, the body is unable to produce enough insulin. Knowledge of the functions of insulin, glucagon, glucose and oxygen would assist patients to realise how the body generates energy and the need to control glucose. The frequent HbA1c analysis and proper monitoring of blood sugar levels can be used to establish patterns and make decisions regarding the treatment. Opposite dieting, physical exercise, proper weight control, quitting smoking and education on diabetes may enhance health outcomes. Nonetheless, management of diabetes cannot be done in a similar fashion to all individuals. Individualised guidance by practice nurses and other medical professionals should be offered, progress needs to be tracked and patients to be assisted to adhere to safe and effective care plans.

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