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Uncovering Diabetes: Tips For Defeating Your Sugary Opponent

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ABSTRACT

Diabetes is a significant public health concern, affecting the well-being of individuals from a wide variety of communities. With the rising cases of diabetes, an emphasis must be placed on the health impacts and risks of this chronic condition. The report will overview the biological process of diabetes covering the mechanisms of actions of insulin, outline the risk factors of the more commonly occurring type 2 diabetes, and provide information regarding health management and treatment. This research aims to explore the relationship between dietary habits and the risks of developing type 2 diabetes. By exploring the diets of countries that are significantly directed by surging rates of health concerns, valuable insights on health management can be made through lifestyle changes.

Introduction

Diabetes, a ravaging disease affecting more than 400 million people worldwide has ceased to see significant decline over the past few years. This disease is not spread by the touch of a hand or a sudden cough, but instead either has a genetic basis or in most cases is caused by the harmful/unhealthy choices of an individual. Diabetes is common all over the world and is a contributor to the top 10 causes of death in the United States as a whole[1]. But what exactly is diabetes? It is necessary to understand that diabetes has two main types: type 1 and type 2. Type 1 diabetes, commonly referred to as insulin-dependent diabetes is mainly caused by risk factors from a patient's genetics and immune system. Roughly 10 percent of diabetes cases are related to type 1 and have no way of prevention[2]. Meanwhile, type 2 diabetes is mostly related to the lifestyle habits of an individual. The majority of diabetes cases around the world are type 2 resulting in a much higher death rate. Countries such as China and Mexico for example, have high rates of diabetes type 2[3]. This is a result of the rising obesity rates as well as subpar eating habits that have begun to grow rapidly in these countries. To grasp a better understanding of the root causes the body experiences when encountering issues from diabetes, it is important to understand the roles the pancreas, glucose, and insulin play. Glucose is a simple sugar and is needed as the most common energy source for cells throughout the body. Glucose is obtained from the digestion of starchy and sweet foods and is eventually absorbed into the bloodstream[4]. Insulin is the necessary hormone that allows for the regulation of blood sugar alongside another hormone, glucagon, and insulin allows cells to import glucose from the bloodstream to be used as fuel. Both insulin and glucagon are produced and released from the pancreas, an organ in the upper section of the abdomen, which secretes insulin or glucagon in response to changes in blood glucose (blood sugar) levels.

Type 1 diabetes (T1D) is an autoimmune disease, meaning that the body's immune system will sabotage the body itself by attacking vital organs and tissues. In T1D the immune system, whose role is to protect the body's cells and fight infections, begins to attack the insulin-producing beta cells in the pancreas. These cells are destroyed by immune cells called T lymphocytes[5]. In the absence of insulin, glucose cannot be transported into the body's cells and instead begins to accumulate in the bloodstream. Scientists are unsure what prompts the immune system to attack insulin-producing cells but link the cause to a patient's genetics. People who have T1D are presented with the risk of high glucose levels in the blood causing harm internally. Long-term effects include damage to the blood vessels and

nerves prompting risks of heart attacks, kidney issues, and strokes[4]. As opposed to T1D, Type 2 diabetes (T2D) is more common worldwide and is primarily linked to the lifestyle habits of individuals. T2D usually begins with insulin resistance which occurs when cells cannot respond properly to insulin, causing an issue with sugar concentration in the blood[6]. The pancreas naturally begins to produce more insulin to counteract the high glucose levels in the blood-stream, which is a consequence of decreased glucose transport into the body cells. However, over time the pancreas can no longer keep up and slows down the insulin-producing rate resulting in a spike in glucose levels. People who tend to have unhealthy eating habits and do less physical exercise are more likely to get T2D due to the link between insulin resistance and higher fat concentration[7]. Similar to T1D, type 2 diabetes can cause problems revolving around the nerves, blood, and kidneys in the long term. It is important to note that type 2 diabetes is largely preventable through changes to diet and exercise.

Mechanism of Action of Insulin

Blood glucose level is controlled by insulin and is heavily influenced by the ingestion of food, mainly carbohydrates that enter the bloodstream. A group of transmembrane proteins called GLUT (short for glucose transporter) has the role of transporting glucose into cells from the bloodstream[8]. There are many types of GLUT proteins, but 4 of them are the main ones, called GLUT1 through 4, each one functioning in a specific cell type. GLUT1 is expressed mainly in fetal cells and red blood cells, GLUT2 is expressed in kidney, liver, and pancreatic cells, GLUT3 is expressed in nerve cells including brain cells, and GLUT4 is expressed in fat cells and muscle cells[9]. In diabetes, GLUT1 and GLUT4 are essential transporters in the body revolving around insulin and glucose. During exercise, there is more expression in both GLUT1 and GLUT4 allowing for an increase in the insulin-stimulated uptake in muscles [8]. GLUT proteins act as a gate, allowing glucose diffusion across the membrane. Under low blood sugar conditions, GLUT proteins are not embedded in the plasma membrane of the cells, but are stored in vesicles inside the cells, as part of their membrane. Following increased blood sugar, insulin is secreted from the beta cells. When it binds to its receptor on target cells, it starts a cell signaling pathway that allows the fusion of the vesicles mentioned with the plasma membrane, resulting in GLUT proteins being embedded in the membrane, allowing for glucose to be imported into the cell[9].

Risk Factors of Diabetes Type II

Although Type 2 diabetes is composed of unavoidable risk factors such as genetics, age, and family history, changes to one's lifestyle significantly may lower the chances of developing health issues. In the United States, obesity and lifestyle habits cause 90 to 95 percent of diabetes cases[10]. The U.S. is known for its vast fast food chains and easily accessible so-called junk food, which act as catalysts to rising dietary issues. Eating habits from consuming high-sugar and fatty foods cause spikes in blood sugar levels, and once becoming a daily routine raise the risk of developing T2D[11]. It is important to note that foods that are relatively easier to access and are cheaper in most cases come with the cost of having lower quality and being packed with sodium and sugar. Exercising strengthens the heart and allows muscles to efficiently respond to insulin and use glucose. A lack of exercise, however, can create issues revolving around the sensitivity of cells to insulin, promoting problems in the regulation of sugar levels. A common condition that results from high blood pressure is called prediabetes. Prediabetes occurs when the body's blood glucose is higher than expected, but isn't diagnosed as type 2 diabetes[12]. Although not T2D, prediabetes sets you up for future health risks if changes aren't made to directly address the problem. Roughly 96 million Americans have prediabetes and more than half are unaware they have it[12]. Despite the drastic health consequences that await if a patient is unaware of prediabetes, the condition is reversible and allows the possibility to avoid progression to T2D. Early changes such as implementing more exercise and cutting down sugar intake significantly lower the probability of prediabetes worsen-ing. When looking at the tiny country of Nauru, which holds the highest obesity rate among all countries, the effects

of lifestyle habits can easily be examined. About 40% of the population is affected by diabetes with an obesity rate of more than 50% in 2019[13]. Nauru lacks proper nutrition due to the consumption of foods such as instant noodles, and white rice, and the majority of the food is imported from Western countries resulting in what some call the "Western Diet"[13]. This Western Diet consists of processed foods that are more accessible and easier to obtain than actually growing foods. The absence of a variety of fruits and vegetables has heavily affected the food availability among the citizens as proper nutrition is severely lacking in the community's diet. The disastrous consequences of a malnourished diet are evident in this island country where people are suffering from climbing health conditions. In the northern hemisphere of the world lies the country of Mexico which has seen a rise in diabetes cases over the past few years. About 14% of the population out of 128 million was affected by diabetes in 2017 and rates are still increasing[14]. Throughout the country, the number of diabetes cases and obesity rates are closely tied together. Mexico is known for its vendors and wide range of hot street food with foods such as tacos, tamales, quesadillas, and fajitas stapled in people's diets. Citizens who work long hours are more likely to consume cheap and easily accessible meals that are sold by vendors to get the energy they need[15]. However, many of the popular foods that are sold on the streets are packed with high amounts of salt and fats, which are the gateway to health issues regarding obesity and nutrition intake. It is important to note that Mexico is one of the top consumers of Coca-Cola in the world. Coke is practically everywhere and in some cases easier to find than bottles of water, causing the price to be roughly similar. In 2012, the average soda intake was about 176 liters per person, equivalent to around 500 cans[14]. Coke is seen as a default drink among people in Mexico and the popularity of such a high-sugar drink stains the average diet as diabetes rates continue to soar. Millions of people with diabetes are burdened with financial troubles as patients are forced to pay for medications and those who are on the older side of the spectrum are left with the probability of early retirement[14]. Government and healthcare officials in Mexico are working towards spreading more awareness to the population on the dangers of the rising health conditions and advocating for healthier eating habits and exercise patterns. Based on the troubling data on the health of countries with rising cases of diabetes such as Nauru and Mexico, it is apparent that factors from dietary habits are linked to obesity and diabetes.

Health Advice to Prevent/Manage Diabetes Type II

Despite the risk of health consequences from prediabetes and type 2 diabetes, prevention is achievable through tweaks and adjustments to one's behavior and lifestyle. Keeping track of the amount of physical activity you do is crucial to lowering the risks of developing diabetes. Many root causes of health issues, not only diabetes, stem from obesity and being overweight. The CDC (The Centers for Disease Control and Prevention) recommends that people should exercise for at least 150 minutes every week and incorporate some work-intensity activities[16]. Exercise can range anywhere, from taking simple walks, participating in the gym, or even playing more extreme sports which are all beneficial to managing weight and improving overall mental and physical health. According to the American Diabetes Association (ADA), the more exercise you do the more the body is trained to process glucose and increase insulin sensitivity[17]. As we know, insulin resistance is a leading cause of prediabetes and type 2 diabetes. A form of exercise called anaerobic exercise, which involves strength training and resistance training is shown to be distinctly helpful in preventing diabetes. In anaerobic exercises, muscles become active in bursts and burn more glucose using less oxygen, compared to aerobic exercises which revolve around high oxygen consumption[18]. Muscles are made up of many fibers and it is these fibers once torn and then repaired that strengthen the body. Christel Oerum, a cofounder of Diabetes Strong, states that training that directly involves the muscles allows the fibers to tear, requiring the burning of more glucose which is important to lower the risk of developing diabetes[19]. Strength training can range from a variety of exercises from weight training, and circuit training, to intense weightlifting like bench presses and deadlifts. This type of training is recommended to be done 3 times a week and good rest is important for muscle recovery between the sessions[20]. Many adults tend to avoid working out either because of cost issues, negative views of themselves, or even difficulty managing time wisely. Free methods of exercising include taking everyday hikes/walks or even playing a sport with friends. It is important to understand that exercise is not strictly fenced off by just going to the gym and

buying a membership; there are plenty of other ways to work on personal health without paying a fee. People can also hesitate to commit time to working out due to self-conflicting views on themselves[21]. Visual changes from physical activity do not happen overnight; consistency is important to achieve the changes many seek. However, changes you can see right away are blood sugar drops as well as an increase in heart rate showing that a steady inception of exercise will show clear results as time goes by. Adjusting one's daily routine to incorporate a designated time for exercise is key to creating a healthier lifestyle. In terms of dietary habits, it is important to build a daily routine that inclines towards foods that will lead the path to diabetes prevention. Foods should be selected based on a balance of nutrients as well as to maintain blood sugar levels in the body[22]. Introducing more fruits, vegetables, and lean protein to your everyday plate is a great way to incorporate the needed nutritional value. For example, vegetables such as broccoli and spinach are packed with fiber and vitamins and do not cause dramatic increases in blood sugar levels[23]. Lean proteins such as salmon and eggs are low in saturated fat and are healthy ways to consume protein which helps stabilize blood sugar. Swapping your breakfast cereal which may contain lots of sugar for whole grain options such as oatmeal is another example of a healthier alternative. Popular staple foods in many countries such as white rice are high on the glycemic index (a measure of how foods increase blood sugar) and should be opted out for brown rice which is better for managing glucose levels[24]. Foods that contain added sugars and have high concentrations of simple carbohydrates, such as white rice and many bakery foods, are high on the glycemic index meaning that they will cause spikes in your blood sugar which is necessary to avoid to keep your health on the road to diabetes prevention. Daily consumption of processed and fast foods should be turned down due to the absurd amounts of saturated fats and calories. Drinking more water or even sparkling alternatives instead of sugary sodas are small steps that can build into a habit in terms of your diet. Popular foods such as white bread and white rice are thought of as staples in many diets around the world, but understanding that these refined grains are bad for your blood sugar is key to moving them aside. Snacks containing high-fructose corn syrup such as soda and many candies are primarily seen in all markets, grocery stores, and movie theaters which further the temptation of customers to buy. Creating a strong sense of care for your overall health will aid in resisting the urge to comply with health-threatening foods that are sold and marketed everywhere. Many popular diets that aim to avoid conditions that can lead to diabetes have the goal of lowering blood sugar while bringing in nutrients and limiting calorie intake. The Keto Diet is a typically temporary dietary plan that targets fat to be burned instead of carbohydrates[23]. Those who go with this plan tend to consume foods that are high in fat but low in overall carbs. This type of diet should be assisted with the help of your doctor or healthcare professional in the case of harmful effects since it is unnatural for the body. Another well-known diet called the DASH diet is known to benefit those who have issues with high blood pressure levels. The diet consists of eating more fruits, vegetables, lean protein, and foods that have low sodium and sugar[23]. This artisanal-based diet is known to help with insulin sensitivity and blood sugar and pressure, which are all risk factors for diabetes and other conditions such as hypertension. A more radical or extreme approach is experimenting with a plant-based diet. Being vegan or vegetarian is another alternative to switching up unhealthy lifestyles. Although a more difficult diet since animal products like meat are completely off the plate, vegans and vegetarians are commonly known to have an improvement in blood sugar levels and blood glucose concentration[23]. It is important to note that diets that involve the absence of animal products can lead to deficiencies in vitamins and minerals such as vitamin B12, calcium, iron, and zinc. However, taking the right supplements and asking health professionals about dietary changes are ways to address this issue.

Exercises for Diabetics

Physical exercise is also key to maintaining the body to effectively manage diabetes. Increased physical activity allows for muscle cells to respond to insulin and use glucose more efficiently allowing for a lowering in the risks of developing diabetes. Aerobic exercises (involving oxygen) such as walking and running are methods to increase physical activity without the need for equipment. A clinical trial proved that walking on low intensity paired with a low-fat diet reduced the risk of diabetes by 58 percent[25]. Other aerobic exercises that can be done to get the heart to beat faster are swimming, hiking, and dancing. It is recommended by the ADA that at least 30 minutes of anaerobic exercises should

be done on most days of the week[26]. Slowly incorporating more ways to get your heart pumping by climbing the stairs or choosing to walk instead of driving are small steps into a daily habit. Aerobic exercise allows for a lowering of blood glucose and increases insulin sensitivity[27]. But what if your hunger pushes your body to the limit? A form of exercise that also works towards the prevention of diabetes while being high-intensity is anaerobic exercise. Anaerobic exercise, unlike aerobic exercises, is high-intensity and breaks down glucose in the body without the need for oxygen. Aerobic exercises use glycogen from the muscles as a means of fuel causing a build-up of lactic acid. Examples of anaerobic exercise include calisthenics, weightlifting, resistance training, and sprinting. A popular form of anaerobic exercise that can easily be put into one's routine is weightlifting. Resistance training exercises such as weightlifting improves blood glucose control and allows insulin to be used efficiently[26]. When doing strength and resistance training, it is important to avoid injuries and overburdening your body. Beginners should train 3-4 times per week for benefits and to consult a trainer or someone experienced for proper form and technique.

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