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The Prevalence of Diabetes in Juveniles

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by

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Abstract

Diabetes mellitus, simply known as diabetes, is a metabolic disorder that impacts how the body makes use of glucose or blood sugar. Glucose is the primary supply of energy for the body's cells, which is controlled by insulin, a pancreatic hormone. Diabetes results in high blood glucose levels (hyperglycemia), which are caused by either insufficient insulin production by the pancreas or ineffective insulin utilization by the body (Dean & McEntyre, 2004). Although there are several types of diabetes, the two main types are type 1 and type 2. Type 1, also known as juvenile diabetes, is an inflammatory condition in which the body's immune system targets and kills pancreatic insulin-producing cells (Dean & McEntyre, 2004). This type of diabetes typically affects children and adolescents. Type 2 diabetes is the most common type of diabetes that usually happens when the body becomes resistant to insulin or does not produce enough insulin. Oftentimes this kind of diabetes is more likely to develop in middle-aged and older people and normally related to lifestyle factors such as lack of exercise, obesity, and poor nutrition. This analysis is organized by the history and epidemiology of this condition, including the two main types of diabetes, the prevalence, impacts, risk factors, and preventative care and treatment for diabetes in juveniles.

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List of Keywords

Glucose, prevalence, adolescents, children, juveniles, diabetes, diabetes mellitus, type 1 diabetes, type 2 diabetes

The Prevalence of Diabetes in Juveniles

Introduction

The term "diabetes mellitus" derives from the Greek word "diabetes", which means siphon and it is to pass through; the term "mellitus" is from Latin, meaning sweet. The presence of glucosuria (glucose) in the urine is one of the many effects of diabetes. When blood glucose levels in the body are continuously high, the kidneys are unable to reabsorb the extra glucose, causing portions of it to be released in the urine (Dean & McEntyre, 2004). According to a previous study, in 400 B.C. an ancient Indian physician by the name of Sushruta was able to describe the taste of diabetic urine as sweet which became essential to diagnosing what is known today as diabetes (Dean & McEntyre, 2004).

Not all people with diabetes will have glucose present in their urine and it also doesn't mean that someone who does not have glucose in their urine does not have diabetes (Dean & McEntyre, 2004). Another common way to detect high blood glucose levels is by taking a blood test. Although numerous blood tests have advanced over many decades, they are likely to be a more dependable and careful way to diagnose diabetes. The fasting plasma glucose (FPG) serves as the most common blood test used to diagnose diabetes. This test is performed to measure blood glucose levels after completing a short term fast and is one of the primary diagnostic tests for diabetes today (Standl et al., 2019). Generally, it is recommended that adults and adolescents should get check-ups on an annual basis, but that is dependent upon their overall health status to determine how frequently they visit their doctor.

Diabetes has been an epidemic that is progressively increasing in rate, affecting juveniles worldwide and varying widely depending on the country and region. This chronic condition significantly impacts the health and quality of life. Since the late 1900s, the global trend of increasing rates of diabetes, particularly in juveniles, has become the leading cause to health complications, resulting in the rise of mortality rates (Dean & McEntyre, 2004). There are a variety of contributing factors that play a role in the increase in diabetes in juveniles. Obesity is one of the main risk factors for increasing the likelihood of type 2 diabetes, but not type 1. This is due to the fact that the fundamental causes of the two forms of diabetes differ. In type 1 diabetes, the body's autoimmune system mistakenly targets and eliminates cells that generate insulin in the pancreas (Dean & McEntyre, 2004). There is a third form of diabetes called gestational diabetes and it pertains to children who are born to mothers that have had history of gestational diabetes during their pregnancy. Although this type of diabetes will not be discussed in this review, it is important to know that children who are born to mothers with a past history of gestational diabetes are at a greater risk of contracting this disease later in life.

The purpose of this paper is to provide an analysis of the prevalence of diabetes in juveniles, highlighting the risk factors, consequences, and potential prevention and treatment to acknowledge the increase in this major public health issue. While the prevalence of diabetes in juveniles is a significant concern, it is just one piece of a larger puzzle. Understanding the prevalence of diabetes on an international level is essential to developing effective prevention and treatment strategies. Any gaps or limitations in the studies for future research will be discussed as well.

Prevalence

Diabetes mellitus is a widespread chronic condition with severe public health implications in juveniles that affects their overall health and life expectancy. Due to the infrequent examination of global-scale incidence trends regarding type 1 and type 2 diabetes, it is critical to determine the geologic patterns of diabetes on a global scale. (Liu et al., 2020). In doing so, this will help researchers and physicians gain a more accurate understanding of the global patterns and trends of diabetes in juveniles and determine risk factors to develop early and effective preventative care and strategies.

The epidemiology of type 1 diabetes is not fully understood because of speculation that the cause is a combination of environmental and genetic factors. Like other forms of diabetes, type 1 does not have a cure and can lead extensive health complications. Even though type 1 diabetes can occur and affect patients of all ages, it is typically diagnosed in childhood or early adulthood (Diaz-Valencia et al., 2015). However, because type 1 diabetes is typically diagnosed in juveniles, the cause is unrelated to lifestyle variables like exercise and food. The annual increase of both new (incident) and existing (prevalent) cases of type 1 diabetes are on the rise due to the escalating incidence observed in numerous countries. Type 1 diabetes prevalence varies by region, with some regions having substantially greater rates than others. In a previous study, the authors reported that data for type 1 diabetes shows significant differences globally, with incidence in the highest country (Finland) over fifty times higher than various countries in South Asia, Africa, South and Central America and the Western Pacific (Ogle et al., 2021).

On the other hand, given the high incidence rate of diabetes in the general population, it is important to investigate potential links between diabetes and Covid-19, as emerging evidence suggests that Covid-19 influenced the significant increase in the prevalene of type 2 diabetes. For example, Rathman et al. (2022) conducted a retrospective cohort examination to include individuals with acute upper respiratory tract infections (AURI) as a non-exposed control group. Using undisclosed data from the panel, they were able to review the prevalence of diabetes following infection with Covid-19. Compared to those with AURI, researchers concluded that individuals with Covid-19 in the database from March 2020 to January 2021 exhibited a higher risk in the prevalence of type 2 diabetes (Rathman et al., 2022).

Similar to the previous study mentioned, researchers conducted a brief analysis to evaluate the potential influence of Covid-19's two-year duration on the prevalence of type 1 diabetes. This information was gathered in Piedmont, Italy by using their local patient data The study population consisted of patients treated by the NHS regional network of 4 pediatric units in northwest Italy and 19 diabetic care facilities. With this strategy, they were able to calculate the incidence rates, incidence rate ratios, and 95% confidence intervals (see Table 1). These data show a drastic increase in prevalence of type 1 diabetes in 2021 and were differentiated by age groups 0 – 14 and 15 – 29, as well as gender, to investigate the potential variations caused by these characteristics. Based on Table 1, sections B and C, juveniles aged 0-14 years, including boys under 18 within the 15-29 age group, displays a significant increase in 2021 which puts them at a greater risk for type 1

diabetes. In essence, these findings emphasized the substantial growth of type 1 diabetes, particularly in 2021 during the pandemic (Giorda et al., 2022).

There were two retrospective studies were conducted, both of which specifically examined the post-pandemic prevalence of diabetes in juvenile. However, the first investigation evaluated the rate and severity of new Covid-19 cases based on chart reviews consisting of patients under the age of 21 that were diagnosed with youth-onset type 2 diabetes. The new cases that were discovered during the first year, post pandemic in the U.S., were compared to the mean of the results from the previous two years of the Covid-19 pandemic. According to the researchers' findings, a total of 3,459 patients that were newly diagnosed with onset type 2 diabetes, were recognized from across 24 centers in the United States. Of those patients, almost 350 patients were excluded from this study due to various reasons regarding insufficient data for those patients. Upon review of the data collected, it was concluded that there was a 77.3% increase during the first year of the pandemic as opposed to during the first two years of the epidemic. Although the prevalence of diabetes was already on the rise in the U.S. and non-U.S. countries, the findings of this study confirmed that the incidence of type 2 diabetes, including the presence of diabetic ketoacidosis (DA) spiked during the Covid-19 pandemic.

In a similar investigation, researchers focused on northern Italy as it was the first European country to become infected with Covid-19. This included a population of patients under the care of NHS regional network of 19 diabetes care units and 4 pediatric units (Giorda et al., 2022). Researchers conducted a quick analysis of regional data from an entire Italian region to measure and interpret the potential impact on the increased
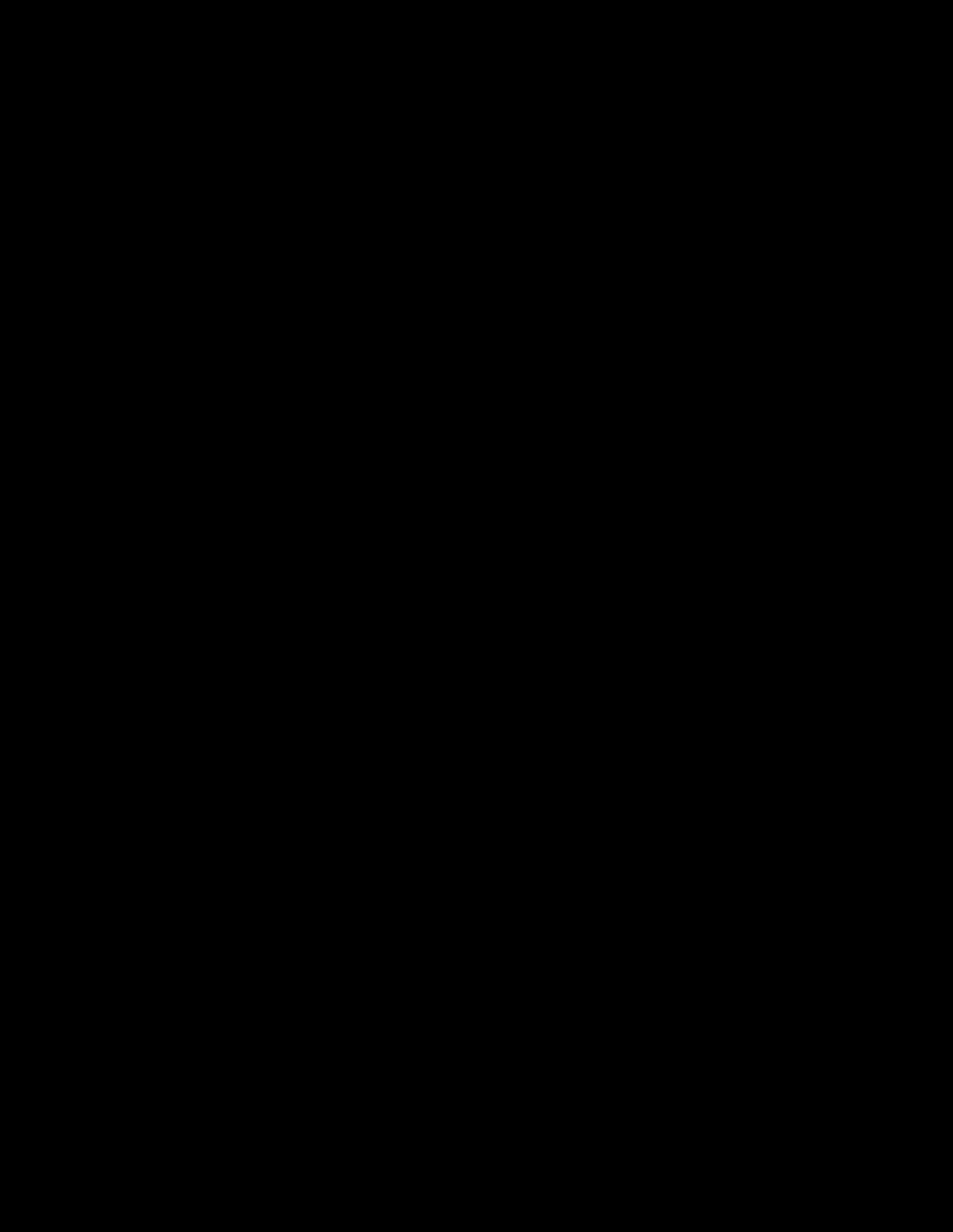
prevalence of type 1 diabetes during two years of experiencing the outbreak and aftermath of the pandemic. Using the electronic medical record of the regional registry of diabetes (RRD), they collected the data of all patients aged 0-29 diagnosed with type 1 diabetes from 2017 to 2021. The data was then transferred to what is called the "Epidemiology Unit" for evaluation in which incidence rates (IRs), 95% confidence intervals, and incidence rate ratios (RRs) were all calculated (Giorda et al., 2022). With this information, they were able to determine that there was a significant increase in 2021 after confirming a stable trend in the prevalence of type 1 diabetes from 2017 to 2020.

To gain a more in-depth understanding of the prevalence of type 1 diabetes in non-U.S. countries, researchers have carried out studies in different regions. A recent study implemented by Passanisi et al. (2022), focused on the prevalence of type 1 diabetes in the pediatric population of Calabria, which is the southern region of Italy, during the years of 2019-2021. Like the previous study that examined northern Italy, the data in this study was organized according to age groups 0-4 years, 5-9 years, and 10-14 years, including gender. Incidence ratios (IRs) were calculated for each province in the region. The study compared the total incidence rates of three non-Covid years (2017-2019) to those of two Covid-19 years (2020-2021), which confirmed a significant rise in the entire population.

In addition, to study potential changes impacted by these parameters, we did a subgroup analysis based on age groups (0-14 and 15-29) and gender. During the year 2021, there was a significant increase in patients aged 0-14 years and boys aged 0-29. Over the course of the study period, there was a gradual rise of 43% in the yearly incidence within

the region. This evidence highlights the prevalence of type 1 diabetes which was higher in

the province of Reggio Calabria (26.5/100,000 person-years) and displays noticeably lower

incidence ratios in the provinces of Crotone, Catanzaro, and Vibo Valentia (see Figure 1).

(Passanisi et al., 2022).

Table 1

Note: Giorda, C., Roberto, G., Barbara, T., Roberta, M., Alessandro, M., Lucia, F., Silvia, F., & Rabbone

Ivana. (2022). Increased incidence of type 1 diabetes in 2 years of COVID-19 pandemic. Acta Diabetologica,

60(4), 587–589. https://doi.org/10.1007/s00592-022-01986-w

Figure 1
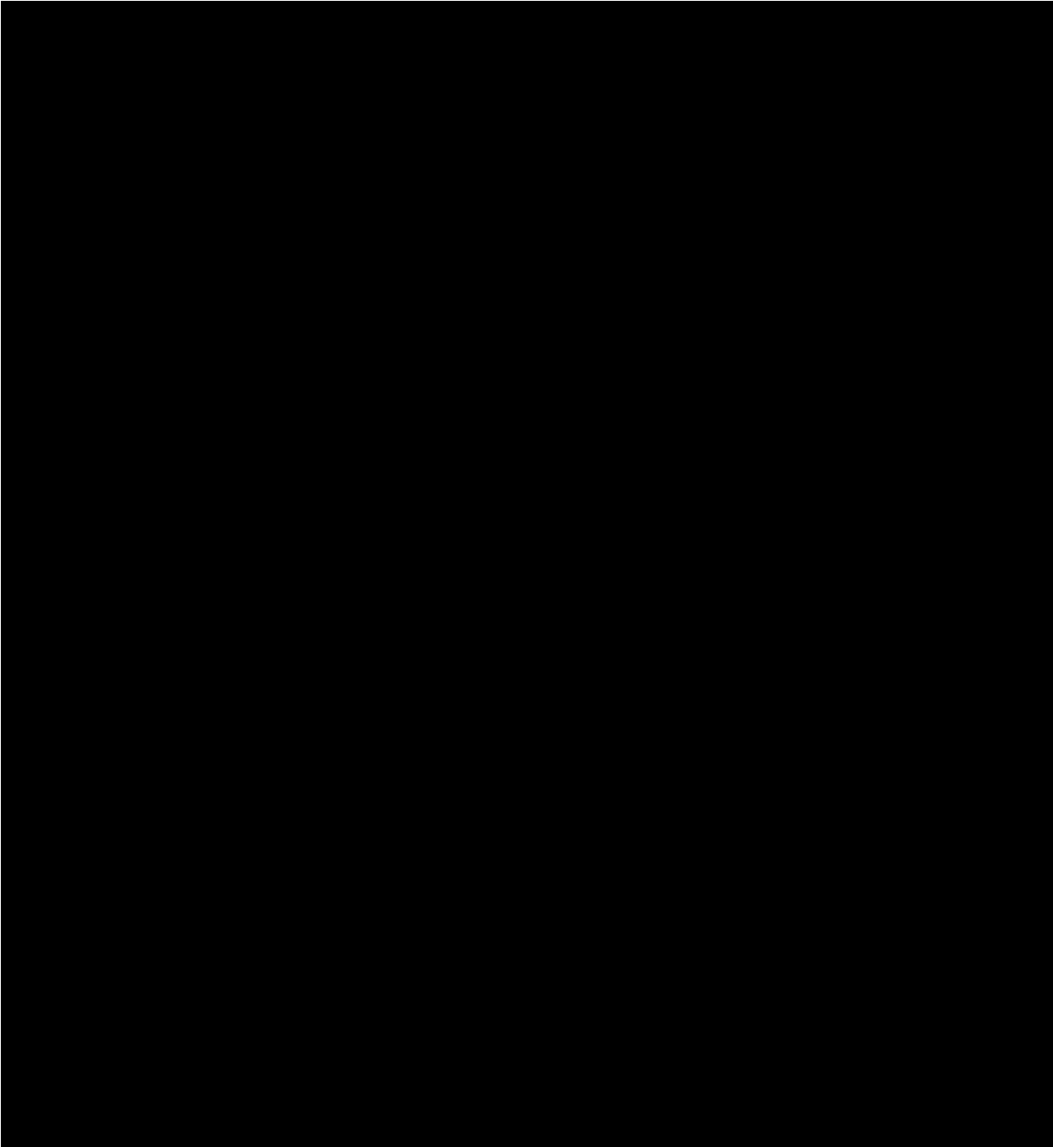
Note: *Google Maps*. Google Maps. Retrieved April 28th, 2023, from https://www.google.com/maps/@39.0123355

While type 2 diabetes is typically diagnosed in adults, the prevalence of type 2 diabetes in juveniles has increased in recent years and much about the underlying causes and contributing factors remains still unknown. However, the rise of type 2 diabetes can be attributed to various lifestyle factors. As related to the first study mentioned in this review, scientists organized a recent study to assess the prevalence and impact of type 2 diabetes in juveniles in the United States within the first year of Covid-19. This study was composed of a retrospective chart review of children and adolescents under the age of 21 years that were recently diagnosed with type 2 diabetes between 2018 and 2020 The results were then compared with the previous two years from 2018 – 2020 and showed a significant increase in the development of type 2 diabetes among recently diagnosed juveniles. There was a significant rise in the incidence of type 2 diabetes throughout the pandemic period, with new cases indicating a 77.2% increase when compared to the average of the previous two years, specifically 2019 and 2018 (Magge et al., 2022).

Lynch et al. (2020) conducted an analysis of country-specific incidence data on type 2 diabetes in juveniles, discovering both similarities and differences between the periods of 2008 and 2019. In order to narrow down the focus of this analysis, the study was defined as individuals aged 20 years or younger. Research that focused on individuals aged 20 and over was excluded and out of the several articles reviewed, only a few were included in this analysis. As seen in figure 2, the study identified the highest reported prevalence rate to be in the United States and China. The lowest reported prevalence was Ireland and Denmark (Lynch et al., 2020). In general, it is critical to address the increased prevalence of type 2 diabetes in adolescents by implementing public health programs that promote public health interventions that promote healthy lifestyles, facilitate early diagnosis, and facilitate effective management of the condition.

These strategies have the potential to alleviate long-term complications and enhancing overall

health outcomes for adolescents affected by type 2 diabetes.

Figure 2:
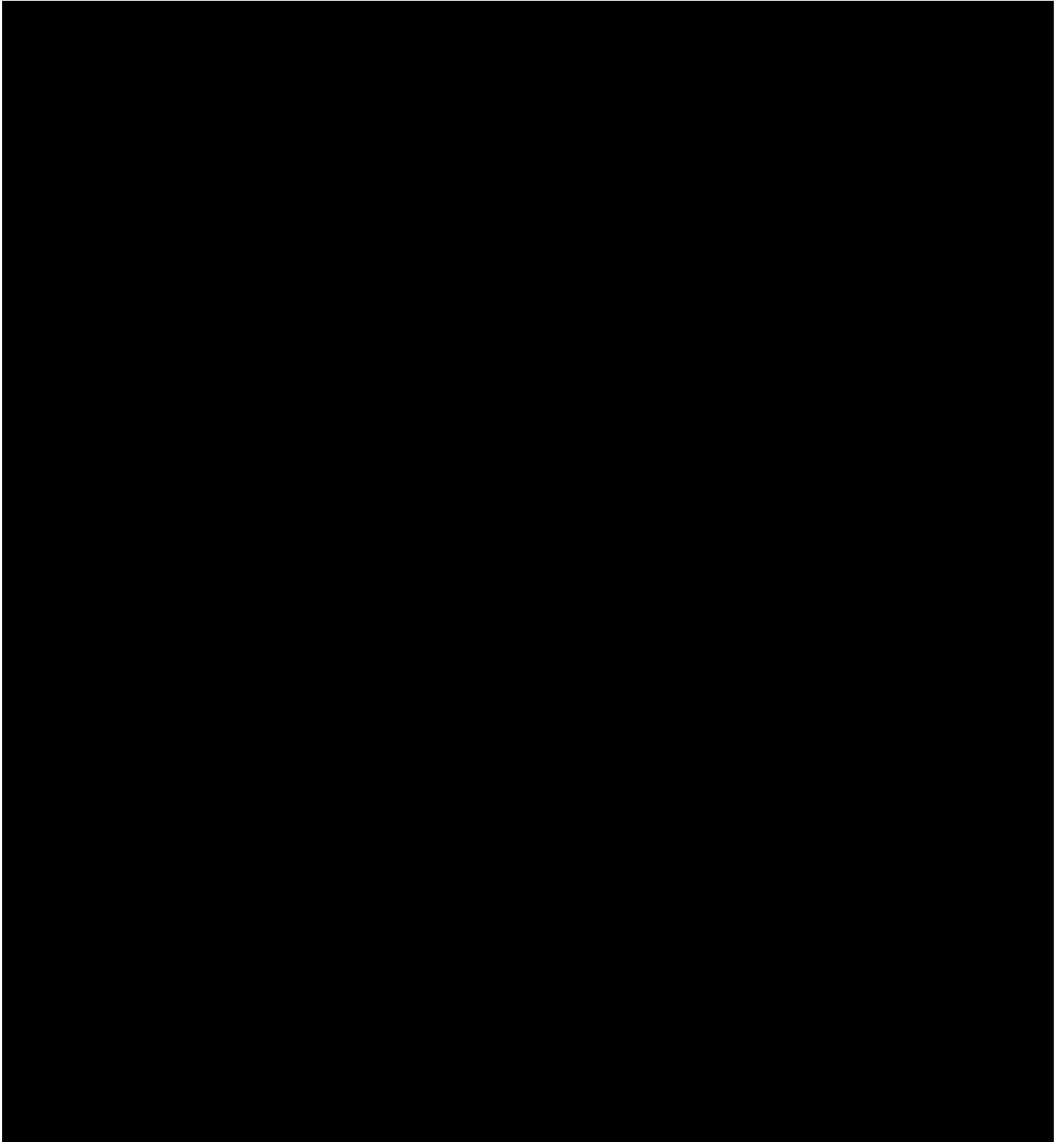
Note: Adapted from Wikipedia; Data from Lynch, J. L., Barrientos-Pérez, M., Hafez, M., Jalaludin, M. Y., Kovarenko, M., Rao, P. V., & Weghuber, D. (2020). Country-Specific Prevalence and Incidence of Youth-Onset Type 2 Diabetes: A Narrative Literature Review. Annals of Nutrition and Metabolism, 76(5), 289–296. https://doi.org/10.1159/000510499

Risk Factors

Diabetes is caused by a number of risk factors, including medical diseases, lifestyle, dietary and physical habits, and genetic factors. Certain ethnic communities, such as African Americans, Hispanic/Latinos, and Native Americans, are predisposed to type 2 diabetes. In one of the latest research studies, data collected in 2019 from the Global burden of Diseases, Injuries, and Risk Factors study (GBD) was used to determine the fatality rate of individuals infected with diabetes on an international level younger than 25 years old. In accordance with the results, scientists discovered an estimate of 16,300 global deaths due to type 1 and type 2 diabetes combined (Ogle et al., 2021).

Genetics is a major risk factor for diabetes in juveniles. Based on a recent study, children and adolescents who have a family history of diabetes are more likely to get the disease themselves. In fact, having a parent or sibling with type 1 diabetes raises a child's chance of acquiring the disease by up to tenfold when compared to those who do not have a family history. Furthermore, certain genetic markers that may increase a child's risk of developing type 2 diabetes, which is more commonly associated with lifestyle factors, have been identified (Rewers et al., 2018).

As previously stated, obesity, along with genetic susceptibility and/or family history, is the primary risk factor for type 2 diabetes in juveniles and is not associated with the cause in the development of type 1 diabetes (Temneanu et al., 2016). A multifaceted combination of genetic,

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environmental, and behavioral variables leads to childhood obesity. A high-calorie and sugar-rich diet, a sedentary lifestyle with little physical activity, and hereditary variables that impact metabolism and weight gain are all contributing elements (Karnik et al., 2012).

Lastly, another major risk factor that has become increasingly significant today is polycystic ovary syndrome (PCOS). Women who experience PCOS have high levels of insulin and testosterone that affects the hormonal balance. This means that the body produces more insulin than needed to try and compensate, but instead this could lead to increased risk of diabetes and higher blood sugar levels (Rojas et al., 2014).

Symptoms and Signs

Along with risk factors of developing diabetes are signs and symptoms that are common for causing health complications. The standards used to diagnose diabetes involve testing the levels of glucose in the blood through laboratory analysis and determining if any symptoms are present (Craig et al., 2014). The symptoms of diabetes can vary from person to person based on numerous variables like weight, age, etc. Diabetes in children can manifest as a variety of symptoms that are easily neglected or misread. Frequent urination is one of the most prevalent symptoms of diabetes. Children with diabetes may need to urinate more frequently than normal, and they may even experience bedwetting despite being potty-trained (Wolfsdorf et al., 2009). A growing thirst is another sign of diabetes in children. They may be thirsty all the time and desire sweet drinks or water. Excessive appetite is another typical diabetes symptom, as the body tries to turn sugar into energy. When glucose levels are inadequate, the body attempts to burn fat and muscle for energy, resulting in unexplained weight loss in children with diabetes. As a result, they may feel weariness, irritability, and impaired eyesight in certain circumstances. Diabetes

can cause nerve damage, kidney damage, visual issues, and cardiovascular disease in children over time (Reed et al., 2021).

Prevention and Treatment

Prevention, treatment, and management are essential in controlling the effects of diabetes in children. Obesity and physical inactivity are two modifiable risk factors that can be reduced via lifestyle changes. Regular physical exercise, good eating habits, and weight control are examples of lifestyle interventions. Diabetes management and care is the focus for anyone diagnosed with this disease. The primary goal of treatment is to keep blood sugar levels within the target range to prevent complications. Treatment options include insulin injections, oral medications, and lifestyle modifications. The main course of treatment for type 1 diabetes is insulin therapy, which is also occasionally utilized for type 2 diabetes. Children with diabetes should receive regular check-ups to monitor their blood sugar levels, kidney function, and overall health. Proper diabetes management involves regular self-monitoring of blood glucose levels, adhering to the treatment plan, and making necessary lifestyle changes (Karnik et al., 2012).

Scientists have discovered that preventing diabetes before it occurs is nearly equally important as controlling and treating the disease. This can be related to the fact that maternal lifestyle decisions such as gestational diabetes and obesity may have an impact on generations to come. To lower the rate of diabetes, it is imperative to address these underlying risk factors in addition to providing preventative treatment and treatment recommendations. By doing so, this identifies the crucial periods in life when treatments may have a notable impact on the prevalence of non-transmissible illnesses. Implementing interventions of this nature will contribute to the assurance and facilitation of positive lifestyle choices. This is also a way to

improve the physiological state of the fetus as well as decrease the prevalence of gestational diabetes in pregnant women. If productive methods for preventing gestational diabetes are not implemented soon, the long-term health complications will continue to progress steadily, posing a significant threat to public health (Hanson et al., 2012). Diabetes prevention is critical for lowering the chance of getting the illness and its ramifications. Early screening and detections are vital, as well as risk factors, to avoid progression in the future.

Consequences

Children with diabetes are subjected to serious life-threatening health complications if the condition is left untreated. One of the most serious consequences is diabetic ketoacidosis (DKA) and it is one of the most serious consequences, which happens when the body uses fat for energy instead of glucose, resulting in a buildup of poisonous ketones in the blood. Symptoms include deep, rapid breathing, nausea, vomiting, loss of consciousness in extreme cases, etc. (Wolfsdorf et al., 2009).

If left uncontrolled, diabetes can cause severe consequences that could possibly affect the livelihood of someone who is suffering from this disease. High blood sugar levels can cause major harm to different organs and systems in the body, including the cardiovascular system, nervous system, the eyes, and much more. Diabetes in the eyes can lead to diabetic retinopathy which could then result to blindness if remained untreated. This condition caused by diabetes happens when the high blood glucose levels injure the retina, also known as the light – sensitive tissue in the back of the eye, by harming the blood vessels. When blood vessels are broken, they might leak fluid and blood, causing swelling and deformation of the retina. As time progress, new blood vessels will form, but they could cause even more damage and vision loss due to them being weak and leaking (Dabelea et al., 2017).

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In addition to the different consequences that comes with being diagnosed with diabetes, there have been recent studies regarding recent advances in behavioral research that also plays a critical role in living with diabetes. Based on the examination, researchers were able to conform that the prevalence of type 1 diabetes in children aged 1-7 is steadily on the rise. Changes in diabetes treatment and supervision have had an impact on young children since 2014, highlighting the need for enhanced attention and interventions to promote diabetes management, particularly among caregivers who are primarily accountable for their young child's diabetes management (Monaghan et al., 2022).

Discussion

Diabetes in children is an increasing issue for medical practitioners and researchers alike. It is becoming more common in this demographic, according to studies. This can be related to a variety of variables, including dietary and lifestyle changes, as well as heredity. Obesity is a key factor contributing to the rise in diabetes prevalence. Because of the growth in sedentary habits and the availability of high-calorie, low-nutrient meals, an increasing number of adolescents are becoming overweight or obese. The most prevalent form of diabetes in this age range, type 2 diabetes, is more likely to develop as a result, putting individuals, specifically juveniles, at an increased risk. A family history of diabetes, ethnic origin, and certain medical problems such as PCOS are all risk factors for diabetes in adolescents.

The consequences of diabetes in juveniles can be severe and long-lasting. Furthermore, juveniles with diabetes may experience psychological effects such as anxiety, depression, and social isolation (Neo et al., 2022). To address the rising prevalence of diabetes in children, healthcare providers and parents must prioritize preventative initiatives. This involves promoting healthy lives by means of nutrition and exercise, as well as regular illness testing. Early

identification and treatment of juvenile diabetes can considerably improve outcomes, lowering the risk of complications and enhancing overall quality of life.

In this review, the studies that were discussed focused primarily on the prevalence of diabetes as a whole in juveniles. The two main forms of diabetes that were reviewed is type 1 and type 2 diabetes. Gestational diabetes was reviewed in terms of its potential consequences on those who are affected by this disease. Most of the methods that were used to analyze the data and perform these studies were peer-reviewed journal articles that detailed the cause and incidence of the prevalence of diabetes in juveniles. There were a few studies that were in comparison to one another, emphasizing the resources used to obtain data.

After noticing an increase in the prevalence of diabetes in juveniles, it is possible to infer that this issue has been a major public health concern for decades and will continue to remain one for as long as changes are ineffective and not enforced. Diabetes management and treatment can lower the likelihood of consequences and improve health outcomes. Diabetes control requires insulin medication, dietary and lifestyle adjustments, and frequent medical care.

Limitations include lack of long-term data on the prevalence and rate of diabetes in children and adolescents, as well as difficulties in properly diagnosing diabetes within this study group. The sample size and criteria to participate in the study are also limitations that could possibly hinder the accuracy of the prevalence of diabetes in children adolescents. It is concluded that decreasing the mortality rate of juveniles affected with diabetes and younger than the age of 25 will remain a global wide objective. The reason is due to the lack of knowledge for proper diagnosis, emphasizing the immediate need for better access to treatment and healthcare services (Ogle et al., 2021).

Conclusion

In summary, diabetes is a major public health issue that impacts millions of individuals globally. Not being able to accurately identify the underlying mechanism of diabetes at the rate that it is consistently increasing should warrant further research of the prevalence of diabetes in juveniles (youth and adolescents). This may be due to various constraints to studying data such as the lack of diversity and what I mean by this is that many studies are performed in developed countries with primarily white populations and there could be differences in prevalence rates among different ethnic and racial groups.

It is critical to promote knowledge about the risk factors for diabetes, such as lack of exercise, poor eating habits, and a sedentary lifestyle. This may be accomplished through focused educational initiatives that advocate healthy lifestyle practices and encourage physical exercise on a regular basis in hopes of being able to save those at a greater risk. Diabetes can be considerably decreased by employing effective preventative techniques such as lifestyle changes and early identification.

To prevent and treat diabetes, public health activities should focus on raising knowledge about diabetes prevention, supporting healthy habits, and encouraging frequent health check-ups. Over the years, the healthcare system has declined in service and affordability. This is one of the main reasons why people may not know they have diabetes, especially if they are without health insurance or restricted access to proper healthcare (Standl et al., 2019). Some people may also be unaware of their risk factors like family history of the disease, having high cholesterol or blood pressure, and being overweight. Also, not many people are aware of the signs and symptoms for diabetes due to the fact that the symptoms of diabetes can either be mild or nonexistent in the early stages of the disease. As a result of this, a lot of people may delay seeking medical

attention until the disease has progressed to a more advanced stage or becomes uncontrollable.

That is why it is imperative to practice making healthier lifestyle decisions stay active in any

way, shape, or form.

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