



Diabetic Mellitus Peripheral Neuropathic Complications and Its Effect on the Wellbeing of African Americans

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Abstract

Elevated blood glucose levels are an indicator of diabetes, a chronic metabolic condition that can severely damage the body's organs. The number of people with diabetes has shot up during the last few decades, with over 422 million people worldwide affected. Peripheral neuropathy is nerve damage that can result from various conditions, including diabetes and it is a common complication that can cause weakness, paresthesia, and discomfort in the hands and feet, among other symptoms. Early diagnosis and management of diabetes and its complications are crucial to enhance patient outcomes and lessen the burden of the disease (diabetes) on individuals and healthcare systems. The review examines diabetic peripheral neuropathy (DPN) complication and how it affects the wellbeing of African Americans. This review shows that DPN can cause numbness, pain, and weakness, especially in the hands and feet. It can lead to serious health problems like ulcers, infections, and even amputations. Poor blood sugar control, smoking, and obesity are all risk factors for DPN. It also reveals that African Americans experience DPN differently than Caucasians by reporting lower pain intensity and frequency compared to Caucasians with DPN. Additionally, compared to other ethnicities, African Americans are not likely to receive a diagnosis of DPN or discuss their pain symptoms with healthcare providers. These disparities can have serious consequences. Under-diagnosis of DPN in African Americans can lead to inadequate pain management. In conclusion, unmanaged DPN can worsen over time and contribute to physical

disability. Cultural variations in pain expression among African Americans may play a role.

Subject Areas

Cardiology

Keywords

Diabetes Mellitus, Peripheral Neuropathy, African Americans, Caucasians, Hispanics, Blood Glucose, Hba1c, Insulin, Diabetes Prevalence, Polyneuropathies

1. Concept of Diabetes Mellitus

Diabetes mellitus, commonly known as just diabetes, is a chronic, metabolic disease characterized by elevated levels of blood glucose (or blood sugar), which leads over time to serious damage to the heart, blood vessels, eyes, kidneys and nerves [1]. Glucose is the main source of energy for the body's cells. The levels of glucose in the blood are controlled by a hormone called insulin. The pancreas is responsible for producing insulin. The cells that produce insulin are beta cells. These cells are distributed in a cluster of cells in the pancreas called the Islets of Langerhans. There are two main types of diabetes: type 1 diabetes and type 2 diabetes [2]. The most common is type 2 diabetes, usually in adults, which occurs when the body becomes resistant to insulin or doesn't make enough insulin. In the past 3 decades, the prevalence of type 2 diabetes has risen dramatically in countries of all income levels [1]. Type 1 is characterized by the destruction of beta cells in the pancreas, typically secondary to an autoimmune process. The result is the absolute destruction of beta cells, and consequently, insulin is absent or extremely low [3]. Type 1 diabetes is also known as juvenile diabetes or insulin-dependent diabetes [1]. Type 2 involves a more insidious onset where an imbalance between insulin levels and insulin sensitivity causes a functional deficit of insulin. Insulin resistance is multifactorial but commonly develops from obesity and aging [3]. People with type 1 diabetes must use insulin injections to control their blood glucose. Type 1 is the most common form of diabetes in people who are under age 30, but it can occur at any age. Ten percent of people with diabetes are diagnosed with type 1 [2]. Type 2 diabetes is thought to affect middle-aged and older adults who have prolonged hyperglycemia due to poor lifestyle and dietary choices. The pathogenesis for type 1 diabetes and type 2 diabetes is drastically different, and therefore each type has various etiologies, presentations, and treatments [3].

About 422 million people worldwide have diabetes, the majority living in low- and middle-income countries, and 1.5 million deaths are directly attributed to diabetes each year. Both the number of cases and the prevalence of diabetes have been steadily increasing over the past few decades [1]. Diabetes symptoms are caused by rising blood sugar. The general symptoms of diabetes include increased hunger,

increased thirst, weight loss, frequent urination, blurry vision, extreme fatigue, sores that don't heal. In addition to the general symptoms of diabetes, men with diabetes may have a decreased sex drive, erectile dysfunction (ED), and poor muscle strength. Women with diabetes can also have symptoms such as urinary tract infections, yeast infections, and dry, itchy skin [2]. Long-term complications of diabetes include retinopathy with potential loss of vision; nephropathy leading to renal failure; peripheral neuropathy with risk of foot ulcers, amputations, and Charcot joints; and autonomic neuropathy causing gastrointestinal, genitourinary, and cardiovascular symptoms and sexual dysfunction. Patients with diabetes have an increased incidence of atherosclerotic cardiovascular, peripheral arterial and cerebrovascular disease. Hypertension and abnormalities of lipoprotein metabolism are often found in people with diabetes [4].

Diagnosis of diabetes is very important as a significant percentage of cases of diabetes are undiagnosed [5]. Four diagnostic tests for diabetes are currently recommended, including measurement of fasting plasma glucose, 2-hour (2-h) post-load plasma glucose after a 75 g oral glucose tolerance test (OGTT), HbA1c, and a random blood glucose in the presence of signs and symptoms of diabetes. People with fasting plasma glucose values of ≥ 7.0 mmol/L (126 mg/dl), 2-h post-load plasma glucose ≥ 11.1 mmol/L (200 mg/dl), HbA1c $\geq 6.5\%$ (48 mmol/mol), or a random blood glucose ≥ 11.1 mmol/L (200 mg/dl) in the presence of signs and symptoms are considered to have diabetes [6]. If elevated values are detected in asymptomatic people, repeat testing, preferably with the same test, is recommended as soon as practicable on a subsequent day to confirm the diagnosis [6].

Currently, there is no cure for type 1 diabetes, but effective approaches are available to prevent type 2 diabetes and prevent the complications and premature death that can result from all types of diabetes [1]. The starting point for management of diabetes is an early diagnosis—the longer a person lives with undiagnosed and untreated diabetes, the worse their health outcomes are likely to be. Easy access to basic diagnostics, such as blood glucose testing, should therefore be available in primary health care settings. Patients will need periodic specialist assessment or treatment for complications. Also, engaging in practices that contribute to good health for everyone, regardless of whether they have diabetes, such as exercising regularly, eating healthily, avoiding smoking and controlling blood pressure and lipids, helps to prevent type 2 diabetes and manage diabetes [1]. A series of cost-effective interventions can improve patient outcomes, regardless of what type of diabetes they may have. These interventions include blood glucose control through a combination of diet, physical activity and, if necessary, medication; control of blood pressure and lipids to reduce cardiovascular risk and other complications; and regular screening for damage to the eyes, kidneys and feet to facilitate early treatment [1].

2. Peripheral Neuropathy

Neuropathy, or nerve damage, can result from a wide range of conditions, such as

diabetes and even treatments like chemotherapy [7]. Peripheral neuropathy happens when the nerves that are located outside of the brain and spinal cord (peripheral nerves) are damaged. This condition often causes weakness, numbness and pain, usually in the hands and feet. It also can affect other areas and body functions including digestion and urination [8]. Peripheral neuropathy was also said to be the many conditions that involve damage to the peripheral nervous system, which is a vast communications network that sends signals between the central nervous system (the brain and spinal cord) and all other parts of the body [9]. Neuropathy can be divided into mononeuropathies, multifocal neuropathies, and polyneuropathies [10]. Mononeuropathy refers to the condition in which only one single peripheral nerve is involved. Typically, patients complain of numbness, prickling or tingling sensations, and pain in an area specific to a single peripheral nerve [10]. Occasionally, pain may radiate into other regions (especially in carpal tunnel syndrome (CTS)). Aside from these sensory complaints, mononeuropathy can also lead to muscle weakness, for example, weakness of intrinsic hand muscles in case of an ulnar neuropathy, wrist drop in case of radial neuropathy, or foot drop in case of a peroneal neuropathy. Mononeuropathy can be caused by internal (e.g. by soft-tissue masses such as ganglia and lipomas) or external compression, entrapment, or trauma of a peripheral nerve. Other causes include metabolic and endocrine disorders (diabetes mellitus, hypothyroidism), inflammation (neuralgic amyotrophy, vasculitis), infection (Lyme disease, leprosy, human immunodeficiency virus (HIV), Epstein-Barr virus), and drugs and toxins.

Polyneuropathy is when multiple peripheral nerves become damaged. Symptoms include problems with sensation, coordination, or other body functions. Polyneuropathy is also known as peripheral neuropathy. Peripheral neuropathy is more common in patients with diabetes mellitus, human immunodeficiency virus infection, and dysproteinemia disorders and in those receiving chemotherapy [11]. A study carried out showed that in more than 1400 people with type 2 diabetes, every fifth person had diabetic neuropathy. Most peripheral neuropathies develop over months or years, but some are rapidly progressive [10]. Other risk factors include Alcohol abuse, Autoimmune conditions such as Sjogren's syndrome, celiac disease, Guillain-Barré syndrome, rheumatoid arthritis, and lupus, Bone marrow disorders like some forms of bone cancer, and lymphoma, Exposure to toxins such as arsenic, lead, mercury, and thallium, Hereditary disorders such as Charcot-Marie-Tooth disease, Hypothyroidism, Kidney disease, Liver disease, Certain medications such as chemotherapy, Deficiencies of vitamins B-1, B-6, B-12, and E may lead to polyneuropathy, repeated physical trauma or injury. The treatment is multifaceted. It can be treated using medications for associated conditions such as insulin for diabetes and thyroid hormones for hypothyroidism; over-the-counter pain relief can be beneficial for those with mild to moderate pain and some antidepressants, such as a group of medications called TCAs (including amitriptyline or nortriptyline), can be used, and another group called SNRIs, such as duloxetine, may also help. Corticosteroid injections could possibly be used for

mononeuropathies, and some seizure medications such as gabapentin or pregabalin may help. Other treatments include medical therapy, acupuncture, chiropractic care, massage, meditation.

2.1. Peripheral Neuropathy in Patients with Diabetes

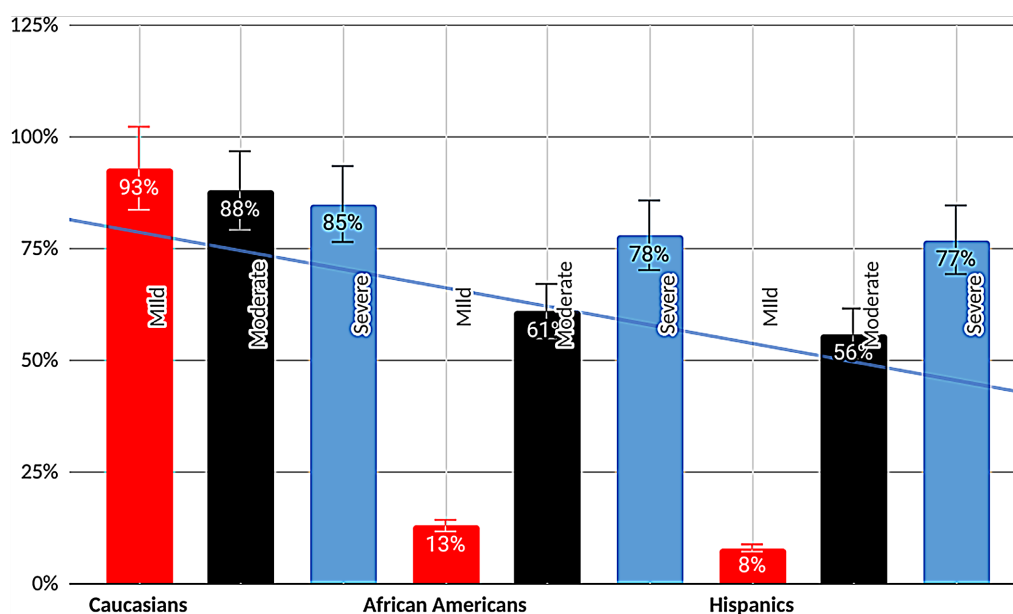
Diabetic peripheral neuropathy (DPN) is a common complication of type 1 and type 2 diabetes that is characterized by nerve damage. When Diabetic peripheral neuropathy presents with painful symptoms the condition is known as painful diabetic peripheral neuropathy (pDPN) [12]. Diabetic peripheral neuropathy encompasses sensory, motor, and autonomic neuropathy. Implicated causes of peripheral nerve damage include oxidative stress damage, accumulation of sorbitol, advanced glycosylation end products, and a disturbance of hexosamine, protein kinase C, and polymerase pathways. Neurovascular impairment with poor repair processes and endothelial dysfunction also has been implicated [13]. Symptoms of diabetic peripheral neuropathy includes, abdominal discomfort, dysphagia, nausea, fecal incontinence, constipation, diarrhea, hypotension, sinus tachycardia, variable heart rate, weak urinary stream, incomplete emptying of bladder, heat intolerance, gustatory sweating, extreme diaphoresis, carpal tunnel syndrome, radiculopathy, lumbosacral, and cervical neuropathy. In addition, cranial nerves 3, 4, 6, and 7 may be affected [14]. Poorly treated diabetics have higher morbidity and complication rates associated with PN than well-controlled diabetics. Peripheral neuropathy often leads to skin breakdown, infection, ulceration, and eventually to amputation. Further, the treatment of Peripheral Neuropathy is not satisfactory, and adverse cardiac events are common. Less than a third of patients achieve good pain control. For most patients with Peripheral Neuropathy, the quality of life is poor and there are complications such as amputations of the toes, foot, or leg, infections of the foot, dizziness falls, diarrhea, failure to thrive, dehydration, pain, cardiovascular neuropathy can cause death [14]. Diabetic neuropathy affects many organ systems and is best managed by an interprofessional team. Because there is no cure for the disorder, the key is prevention. All people with diabetes should have a dietary consultation and receive education on what foods they should eat and what to avoid [14]. Also, one can prevent or delay diabetic neuropathy and its complications by closely managing your blood sugar and taking good care of the feet. **Table 1** and **Figure 1** show the ethnic prevalence of symptom severity.

2.2. Risk Factors Contributing to Peripheral Neuropathy in Patients with Diabetes

Diabetic peripheral neuropathy (DPN), the most common chronic complication of diabetes, has become an important public health crisis worldwide [15]. Diabetic neuropathy is a very problematic complication of diabetes mellitus [16]. Given that DPN is extremely difficult to treat, determining its risk factors and controlling it at an early stage is critical to preventing its serious consequences and the

Table 1. Ethnic prevalence of symptoms severity.

Ethnicity	Symptoms Severity	Prevalence (%)
Caucasians	Mild	93
African Americans	Mild	13
Hispanics	Mild	8
Caucasians	Moderate	88
African Americans	Moderate	61
Hispanics	Moderate	56
Caucasians	Severe	85
African Americans	Severe	78
Hispanics	Severe	77

**Figure 1.** Bar chart showing the ethnic prevalence of symptoms severity.

burden of social disease [15]. Anyone who has diabetes can develop neuropathy, but certain risk factors make nerve damage more likely. Risk factors include the duration of diabetes, age, glycosylated hemoglobin A1C (HbA1c), diabetic retinopathy, smoking, and body mass index, amongst others. In a study, it was found that diabetic patients with an HbA1c > 6.5% were 16.9 times more likely to develop neuropathy [16]. Oguejiofor *et al.* found a lower prevalence of polyneuropathy in those with duration of DM < 5 years and highest in those with a duration of DM > 15 years and should be recognized as a special group at high risk for foot disease from diabetes mellitus [17]. Having a body mass index (BMI) of 25 or more may increase the risk of diabetic neuropathy. Also, smoking narrows and hardens the arteries, reducing blood flow to the legs and feet. This makes it more difficult for wounds to heal and damages the peripheral nerves [18].

2.3. Effect of Diabetic Peripheral Neuropathy

Diabetic peripheral neuropathy pain (DPNP) is one of the common diabetic peripheral neuropathy, it can have a profound effect on one's quality of life in terms of social and psychological wellbeing, as well as physical ill-health, and is one of the most psychologically debilitating symptoms of the disease [19]. Among patients with DPN, 11% could have pain called diabetic peripheral neuropathic pain (DPNP). Clinically, DPNP could present with pain of burning, shooting or aching. It may also be accompanied by allodynia, hyperalgesia and numbness, which often get worse at night that could result in disturbed sleep, anxiety and depression. Sleep deprivation leads to lack of energy, strongly influencing a patient's ability to function from decreased mobility and dependence on others in everyday functioning [19] [20]. Health-related quality of life of diabetic patients is negatively influenced by diabetic peripheral neuropathic pain, the common complication of diabetes. The Role Physical and Mental Health domains of health-related quality of life were the most impacted. Older diabetic patients, who suffered for longer duration of illness and those with diabetes-related complications, were found to have poorer health-related quality of life [21].

2.4. Diabetic Mellitus Peripheral Neuropathic Complications and African Americans

Diabetic peripheral neuropathy (DPN) is a common complication of type 1 and type 2 diabetes that is characterized by nerve damage. When DPN presents with painful symptoms, the condition is known as painful diabetic peripheral neuropathy (pDPN). While the epidemiology of pDPN has not been well-characterized, an overall prevalence of 15% has been estimated in the diabetic population. According to a study carried out by Eichholz *et al.* [12], African Americans may experience diabetic peripheral neuropathy (DPN) symptoms with lower frequency and report experiencing DPN pain with less intensity compared to Caucasians. This could be due to several factors, including cultural variations in pain expression or biological differences in pain processing. Also, the study found that African Americans are less likely to receive a diagnosis of DPN from a healthcare provider. They are less likely to discuss pain symptoms with a healthcare provider, they may feel less comfortable communicating about pain. All of these could lead to underdiagnosis and inadequate pain management among African Americans with the disease. **Table 2** and **Figure 2** indicate the prevalence of diabetic mellitus peripheral neuropathic complications in ethnic groups.

Table 2. Prevalence of diabetic mellitus peripheral neuropathic complications in ethnic groups.

Ethnic	Prevalence (%)
Caucasians	87
African Americans	51
Hispanics	36

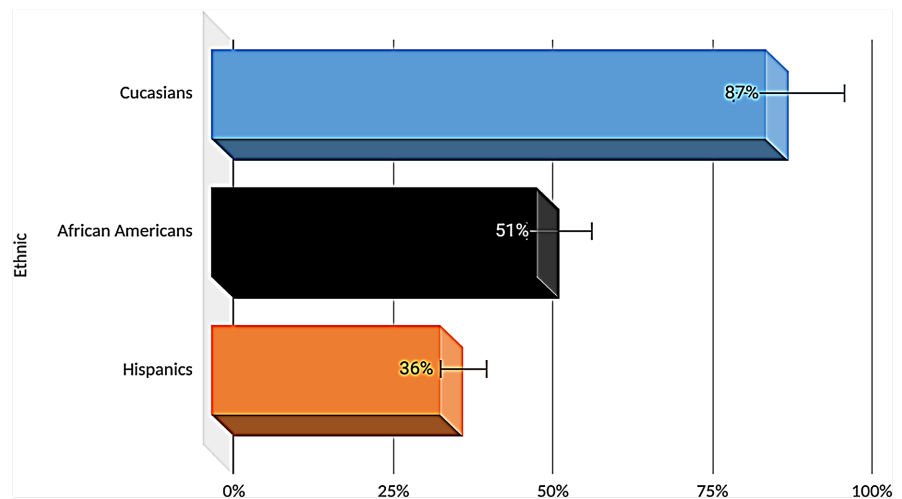


Figure 2. Bar chart showing the prevalence of diabetic mellitus peripheral neuropathic complications in ethnic groups.

2.5. Diabetic Mellitus Peripheral Neuropathic Complications and Its Effect on the Wellbeing of African Americans

A study carried out by [12] fielded a survey to better understand pDPN and its impact on African American, Caucasian, and Hispanic populations. In this study, a survey was fielded by phone or internet, among adults with pDPN symptoms in the United States between August and October 2015. The survey, which was developed without patient input but in collaboration with experts in the field, including clinicians, was administered by Internet among Caucasians, and by either Internet or phone among African Americans and Hispanics, with Internet respondents recruited from a national research panel and phone respondents recruited from purchased phone lists. Respondents included 823 Caucasians, 525 African Americans, and 537 Hispanics. The impact of ethnicity was explored based on the combined main sample and oversample and controlled for effects of age, education, and household income using layered cross-tabulations (Chi-square tests) and stepwise linear regression.

The study found that almost half of the African Americans (49%) and more than half of the Hispanics (59%) were under 40 years of age, compared with only 12% of Caucasians. African American and Hispanic patients were less likely than Caucasians to experience a range of sensory symptoms that are characteristic of neuropathic pain including some symptoms that appear to drive pain severity such as sensitivity to touch and shooting pain. The research indicates African Americans were less likely to receive a diagnosis of pDPN from a healthcare provider. They were also less likely to discuss their pain symptoms with a healthcare provider. The study suggests African Americans may feel less comfortable communicating about pain with healthcare providers. The layered cross-tabulations of the six symptoms that were significant by ethnicity (electric shock-like pain; pain and discomfort at night; stabbing pain; burning pain sensation; shooting pain; sensitivity to touch) show that these differences by ethnicity generally hold for stabbing pain, with a significant

effect of ethnicity for 12 of the 16 strata ($p < 0.05$); shooting pain, which was significant for 11 strata ($p < 0.05$); and electric shock pain ($p < 0.05$: for 9 strata). However, significant differences ($p < 0.05$) by ethnicity were limited for pain and discomfort at night (only 4 strata showed a significant effect of ethnicity) and burning pain. African Americans and Hispanics were less likely to rate their pain as moderate or severe, 65% and 49%, respectively, relative to Caucasians (87%; both $p < 0.05$). This finding was confirmed through a stepwise linear regression where ethnicity (operationalized as 3 dummy variables, one each for Caucasian, African American, and Hispanic) as well as age, education, and household income were used as independent variables to predict reported pain levels. According to the study, pDPN also impairs work activity of African Americans, 53% of affected individuals reported activity impairment during this study. All of these go to show that pDPN impacts the health of African Americans negatively, and it affects the overall wellbeing of individuals affected.

Another study carried out by [22] titled “The Relationship of Reduced Peripheral Nerve Function and Diabetes with Physical Performance in Older White and Black Adults” provides valuable insights into the relationship between peripheral neuropathy, diabetes, and physical performance in older adults, particularly focusing on Blacks. The study included a significant number of Black participants, it included 2364 participants (761 white men, 381 black men, 701 white women, and 521 black women). The results indicated that poor peripheral nerve function explains a portion of the association of diabetes with physical disability. In this population of community-dwelling older adults, both poor sensory and motor peripheral nerve function were independently associated with worse physical performance. The study suggests that the detrimental effects of peripheral neuropathy and diabetes on physical performance appear to be consistent for both White and Black participants. This multiethnic study of older men and women showed consistent associations of poor sensory and motor peripheral nerve function and worse objective physical performance. Considering the high prevalence of poor peripheral nerve function in older adults, in the study and in the U.S., and the current diabetes epidemic, the study noted that peripheral nerve impairments are an unappreciated problem in the elderly population. The study also concluded that peripheral nerve function should be evaluated when one is studying physical performance in older adults.

3. Conclusion

Diabetes peripheral neuropathy (DPN) affects all ethnicities, but this review shows that African Americans experience the condition differently. Though they may report lower pain intensity and frequency compared to Caucasians, African Americans have a lower likelihood of being diagnosed with pDPN by a healthcare professional or discussing their pain with a healthcare provider. These factors can lead to under-diagnosis and inadequate pain management. These disparities highlight the need for further research into the biological and cultural factors influencing pain

perception and communication among African Americans with DPN. The review emphasizes the need for further research in two key areas. First, there is a need to understand the biological factors that influence pain perception in African Americans with DPN. Second, there is a call for developing culturally sensitive communication strategies between healthcare providers and African Americans with DPN. This review highlights the importance of recognizing racial disparities in DPN. By improving communication and increasing awareness, healthcare providers can work towards better pain management and overall wellbeing for African Americans with DPN. Additionally, healthcare providers should be aware of these disparities and strive to create culturally sensitive communication to ensure diagnosis and improve pain management for African Americans with DPN.

Conflicts of Interest

The authors declare no conflicts of interest.

References

- [1] World Health Organization (2023) Diabetes. https://www.who.int/health-topics/diabetes#tab=tab_1
- [2] Dwivedi, M. and Pandey, A.R. (2020) Diabetes Mellitus and Its Treatment: An Overview. *Advances in Pharmacology*, **1**, 48-58.
- [3] Sapra, A. and Bhandari, P. (2023) Diabetes Mellitus. StatPearls Publishing. [https://www.ncbi.nlm.nih.gov/books/NBK551501/#:~:text=Diabetes%20mellitus%20\(DM\)%20is%20a%20metabolic%20disease%2C%20involving%20inapropriately](https://www.ncbi.nlm.nih.gov/books/NBK551501/#:~:text=Diabetes%20mellitus%20(DM)%20is%20a%20metabolic%20disease%2C%20involving%20inapropriately)
- [4] American Diabetes Association (2014) Diagnosis and Classification of Diabetes Mellitus. *Diabetes Care*, **37**, S81-S90. <https://doi.org/10.2337/dc14-s081>
- [5] World Health Organization (2019) Classification of Diabetes Mellitus.
- [6] World Health Organization (2011) Report of a World Health Organization Consultation. Use of Glycated Haemoglobin (HbA1c) in the Diagnosis of Diabetes Mellitus. *Diabetes Research and Clinical Practice*, **93**, 1-25.
- [7] Salomon, S.H. and Yochelson, M.R. (2023) What Is Neuropathy? Symptoms, Causes, Diagnosis, Treatment, and Prevention. <https://www.everydayhealth.com/neuropathy/guide/>
- [8] Mayo Clinic (2019) Peripheral Neuropathy. <https://www.mayoclinic.org/diseases-conditions/peripheral-neuropathy/symptoms-causes/syc-20352061>
- [9] National Institute of Neurological Disorders and Stroke (2020) Polyneuropathy Fact Sheet.
- [10] Hanewinkel, R., Ikram, M.A. and Van Doorn, P.A. (2016) Peripheral Neuropathies. In: *Handbook of Clinical Neurology*, Elsevier, 263-282. <https://doi.org/10.1016/b978-0-12-802973-2.00015-x>
- [11] Watson, J.C. and Dyck, P.J.B. (2015) Peripheral Neuropathy: A Practical Approach to Diagnosis and Symptom Management. *Mayo Clinic Proceedings*, **90**, 940-951. <https://doi.org/10.1016/j.mayocp.2015.05.004>
- [12] Eichholz, M., Alexander, A.H., Cappelleri, J.C., Hlavacek, P., Parsons, B., Sadosky, A., *et al.* (2017) Perspectives on the Impact of Painful Diabetic Peripheral Neuropathy in

- a Multicultural Population. *Clinical Diabetes and Endocrinology*, **3**, Article No. 12. <https://doi.org/10.1186/s40842-017-0051-2>
- [13] Ghotaslou, R., Memar, M.Y. and Alizadeh, N. (2018) Classification, Microbiology and Treatment of Diabetic Foot Infections. *Journal of Wound Care*, **27**, 434-441. <https://doi.org/10.12968/jowc.2018.27.7.434>
- [14] Bodman, M.A. and Varacallo, M. (2023) Peripheral Diabetic Neuropathy. StatPearls Publishing.
- [15] Liu, X., Xu, Y., An, M. and Zeng, Q. (2019) The Risk Factors for Diabetic Peripheral Neuropathy: A Meta-Analysis. *PLOS ONE*, **14**, e0212574. <https://doi.org/10.1371/journal.pone.0212574>
- [16] Nisar, M.U., Asad, A., Waqas, A., Ali, N., Nisar, A., Qayyum, M.A., *et al.* (2015) Association of Diabetic Neuropathy with Duration of Type 2 Diabetes and Glycemic Control. *Cureus*, **7**, e302. <https://doi.org/10.7759/cureus.302>
- [17] Oguejiofor, O.C., Odenigbo, C.U. and Oguejiofor, C.B. (2010) Evaluation of the Effect of Duration of Diabetes Mellitus on Peripheral Neuropathy Using the United Kingdom Screening Test Scoring System, Bio-Thesiometry and Aesthesiometry. *Nigerian Journal of Clinical Practice*, **13**, 240-247.
- [18] Mayo Clinic (2022) Peripheral Neuropathy. <https://www.mayoclinic.org/diseases-conditions/diabetic-neuropathy/symptoms-causes/syc-20371580>
- [19] Tesfaye, S., Vileikyte, L., Rayman, G., Sindrup, S.H., Perkins, B.A., Baconja, M., *et al.* (2011) Painful Diabetic Peripheral Neuropathy: Consensus Recommendations on Diagnosis, Assessment and Management. *Diabetes Metabolism Research and Reviews*, **27**, 629-638. <https://doi.org/10.1002/dmrr.1225>
- [20] Kasim, K., Amar, M., Sadek, A.A.E. and Gawad, S.A. (2010) Peripheral Neuropathy in Type-II Diabetic Patients Attending Diabetic Clinics in Al-Azhar University Hospitals, Egypt. *International Journal of Diabetes Mellitus*, **2**, 20-23. <https://doi.org/10.1016/j.ijdm.2009.10.002>
- [21] Degu, H., Wondimagegnehu, A., Yifru, Y.M. and Belachew, A. (2019) Is Health Related Quality of Life Influenced by Diabetic Neuropathic Pain among Type II Diabetes Mellitus Patients in Ethiopia? *PLOS ONE*, **14**, e0211449. <https://doi.org/10.1371/journal.pone.0211449>
- [22] Strotmeyer, E.S., de Rekeneire, N., Schwartz, A.V., Faulkner, K.A., Resnick, H.E., Goodpaster, B.H., *et al.* (2008) The Relationship of Reduced Peripheral Nerve Function and Diabetes with Physical Performance in Older White and Black Adults. *Diabetes Care*, **31**, 1767-1772. <https://doi.org/10.2337/dc08-0433>