

## **Effects of physical therapy programs on the treatment and control of diabetes mellitus: A review**

**Wagner Tavares<sup>1</sup>, Rosângela Lima da Silva<sup>2</sup>, Francivaldo José da Conceição Mendes<sup>3</sup>, Jose Roberto Zaffalon Junior<sup>4</sup>, Smayk Barbosa Sousa<sup>5</sup>, Gileno Edu Lameira de Melo<sup>6</sup>, Alesandra Negrete Cabreira<sup>7</sup>.**

### **ABSTRACT**

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia, resulting from a deficiency in the production or action of the hormone insulin. This hormone is produced by pancreatic beta cells, and is responsible for regulating glucose metabolism, promoting its uptake by tissues. Its characteristics are: chronic hyperglycemia, which is usually accompanied by dyslipidemia; Hypertension; and endothelial dysfunction.

**Keywords:** Diabetes Mellitus, Impact on health, Hyperglycemia.

### **INTRODUCTION**

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia, resulting from a deficiency in the production or action of the hormone insulin. This hormone is produced by pancreatic beta cells, and is responsible for regulating glucose metabolism, promoting its uptake by tissues. Its characteristics are: chronic hyperglycemia, which is usually accompanied by dyslipidemia; Hypertension; and endothelial dysfunction (FRANCO JUNIOR; HELENO; LOPES, 2013).

DM represents an important and growing global health problem, with a great impact on health services. According to the International Diabetes *Federation* (IDF), it is estimated that in the world, between the age group of 20 and 79 years, there are 415 million people with Diabetes, with approximately 5 million deaths, for the same age group, in 2015 (SBD, 2017). Global estimates indicate that 382 million people live with DM (8.3%), and this number could reach 592 million in 2035. Despite this, around 50.0% of diabetics are unaware that they have the disease. By 2030, DM could jump from ninth to the seventh most important cause of death worldwide (FLOR; CAMPOS, 2017). The prospect is that the number of new carriers will reach 629 million by the year 2045, 50% of whom are not diagnosed

---

<sup>1</sup> University of the State of Pará – Pará

<sup>2</sup> University of the State of Pará – Pará

<sup>3</sup> University of the State of Pará – Pará

<sup>4</sup> University of the State of Pará – Pará

<sup>5</sup> University of the State of Pará – Pará

<sup>6</sup> University of the State of Pará – Pará

<sup>7</sup> University of the State of Pará – Pará



(IDF, 2017).

The state of chronic hyperglycemia resulting from defects in the secretion and/or action of insulin in patients with diabetes mellitus leads to possible tissue alterations that characterize the chronic complications of diabetes mellitus, accounting for 14.5% of worldwide mortality. These are categorized as microvascular disorders, such as retinopathy, nephropathy and diabetic neuropathy, and ulceration affects 15% of patients and represents between 6% and 20% of hospitalizations. Macrovascular disorders, which include the development of hyperlipidemia, arterial hypertension and coronary artery disease, such as atherosclerosis, culminating in acute myocardial infarction (AMI) and contributing to the development of cardiovascular diseases, which represent half of the cases of death among patients with diabetes, are considered the main cause of death among patients with type 2 diabetes (LEE, KRAUSE, 2004; SBD, 2017).

In addition, diabetes has been blamed for contributing to problems, directly or indirectly, in the musculoskeletal system, digestive system, cognitive function, and mental health, in addition to being associated with several types of cancer, especially pancreatic and endometrial cancers. The main risk factors involved in the development of diabetes are dyslipidemias, high blood pressure, obesity and overweight, which leads to the presence of comorbidities (SBD, 2017). Diabetes is associated with an increased risk of cardiovascular problems, such as heart disease and stroke. Physical therapy can include exercises that improve heart health, such as resistance training and cardiovascular exercises, helping to reduce this risk.

Regular exercise is known to lower blood sugar levels. A physical therapist can help patients develop a personalized exercise program, considering their physical condition, limitations, and specific needs. This can include aerobic exercise, such as walking, cycling, and swimming, which improve insulin sensitivity, helping the body better utilize blood sugar

Diabetes can cause circulatory problems, such as peripheral neuropathy and blood vessel problems. Poorly controlled diabetes favors the development of highly disabling complications, especially diabetic foot, blindness, and chronic renal failure, preventing people from continuing to carry out their daily and work activities, leading to high bed occupancy and absenteeism from work, due to prolonged and recurrent hospitalizations (BARROS et al, 2017). Physical therapy can include stretching and strengthening exercises that improve blood circulation, reducing the risk of circulation-related complications, as well as include pain relief techniques, such as manual therapy, to help reduce neuropathic pain. A well-structured physical therapy program not only helps with diabetes management but also improves patients' overall quality of life by providing more energy, disposition, and well-being.



## OBJECTIVE

This study aims to verify the main effects of a physical therapy program on the treatment and control of patients with diabetes mellitus in studies carried out in the period 2013-2023. As specific objectives, it seeks to characterize patients with diabetes mellitus; to point out the main physiotherapeutic resources used in the treatment of diabetes mellitus and to verify the main outcomes of physical therapy treatment in patients with diabetes mellitus.

## METHODOLOGY

The present work consists of a literature review, with a methodology adapted from Côrtes *et. al* (2013), based on studies that have been published in the journals PUBMED, Scielo and PEDro, which have as their main focus the occurrence of diabetes and its diagnosis. Thus, starting from the publication spaces, the descriptors to which the selected articles should correspond are delimited, through the search mechanisms of the selected database, which are: Diabetes; Diabetes Mellitus; Physiotherapy.

The period selected as a way of delimiting the studies was between the years 2013 and 2023. The language foreseen for the studies is Portuguese, but also accepting articles that represent research carried out in other countries and whose language is English or Spanish. Reflection and review articles may be included in the sample, as long as they meet the inclusion criteria.

All those that do not have a link with the theme of the study, along with research that has not been published in Portuguese, English or Spanish and that are not linked to indexed journals, will be excluded from the sample of articles. Thus, it is imagined that there may be published research on the subject that even presents contributions to its discussion, but rigor in the selection of studies is chosen as part of the chosen methodological proposal.

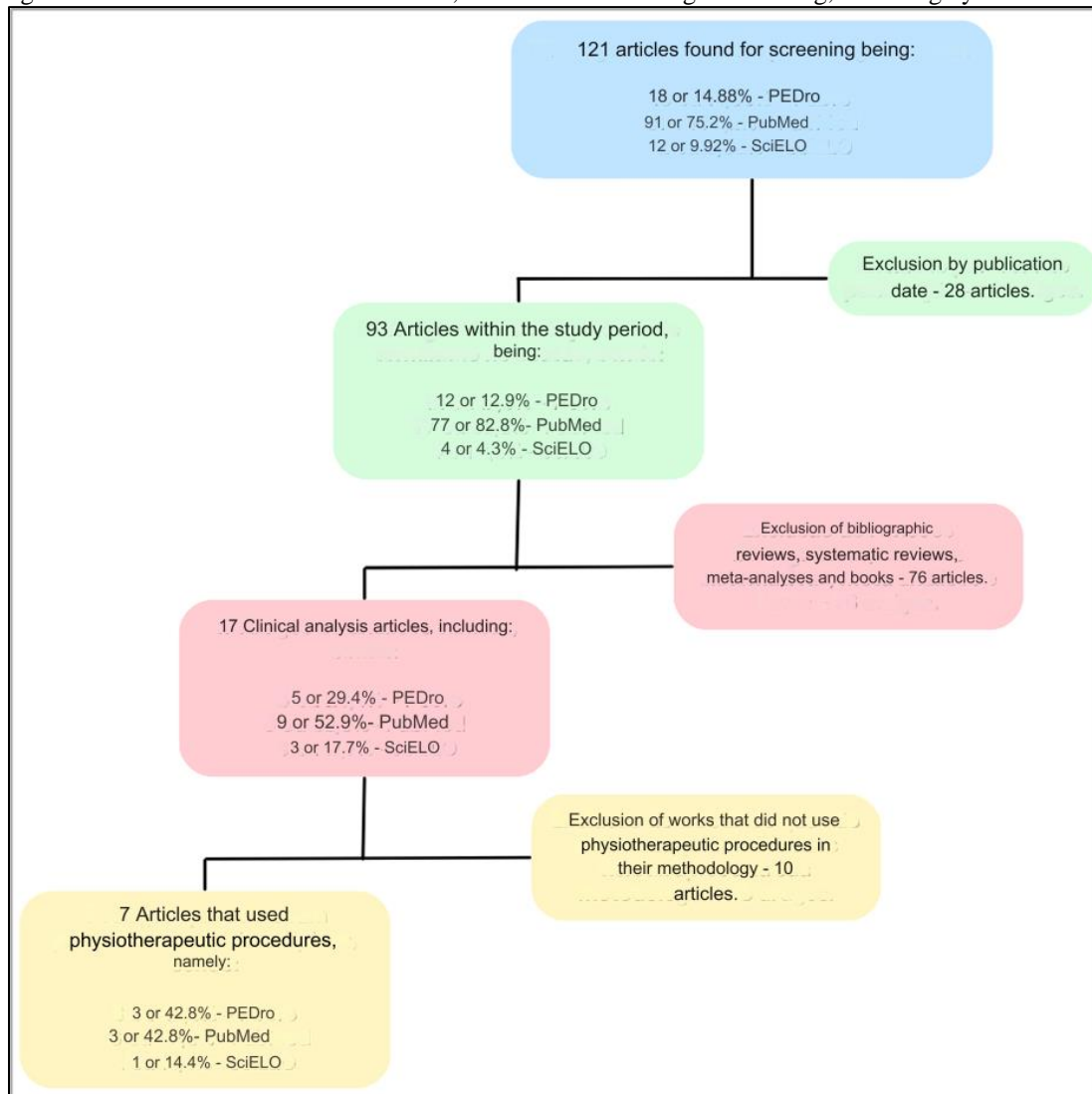
The data collection process took place as follows:

- 1° Collection of works on the sites with the keywords "Diabetes; Diabetes Mellitus; Physiotherapy", in Portuguese and English, this process resulted in a total of 121 articles, of which 18 or 14.88% - PEDro, 91 or 75.2% - PubMed and 12 or 9.92% - SciELO;
- 2° Delimitation of the studies within the determined period of the study, at this stage 28 articles were withdrawn, leaving 12 or 12.9% - PEDro, 77 or 82.8% - PubMed and 4 or 4.3% - SciELO;
- 3° Separation of publications that did not have the desired methodology for analysis, at this stage publications in the format of reviews and books were removed, thus obtaining 5 or 29.4% articles from PEDro, 9 or 52.9% articles from PubMed, 3 or 17.7% articles from SciELO and 76 articles were excluded;

4° Finally, there was a dissociation of studies that did not use physical procedures for the treatment of Diabetes Mellitus, removing 9 articles and resulting in the sampling of articles of 3 or 37.5% - PEDro, 4 or 50% - PubMed and 1 or 12.5% - SciELO.

Finally, the process and results can be viewed in the following flowchart.

Figure 01 – Total number of articles found, selected for screening and reading, including by data source.



Source: Prepared by the authors.

## DEVELOPMENT

### LITERATURE REVIEW

#### Diabetes

Diabetes *mellitus* is a disease that has been increasing in prevalence worldwide. It is a serious public health problem due to its high frequency in the current population, as well as due to its



complications, mortality, high financial and social costs involved in treatment, and significant deterioration of quality of life (SINGH et al, 2013).

### **Incidence rate**

In Brazil, there are approximately 12 million people with diabetes, which correspond to 6.9% of the population, according to the National Health Survey, carried out by the Ministry of Health in partnership with the IBGE, in 2015. In addition, the same survey informs that in 2013 Brazil had 11.9 million cases among adults (20 - 79 years) (FLOR; CAMPOS, 2017). A recent study carried out in six Brazilian state capitals by Schmidt et al. (2014), with public university employees aged 35 to 74 years, including oral glucose tolerance test, found a prevalence of 20%, around 102 people, in which approximately half of the cases had no previous diagnosis (MALMEGRIM, AZEVEDO, ARRUDA, et al, 2017).

### **Types**

Type 1 DM is characterized by the destruction of beta cells in the pancreas (usually caused by an autoimmune process), which leads to the stage of absolute insulin deficiency, and insulin administration becomes necessary to prevent ketoacidosis, coma, and even death. Type 2 DM is characterized by resistance to the action of insulin, as well as by insulin deficiency, which is manifested by the inability to compensate for this resistance. There are also other types of DM that are less frequent, and which can result from: genetic defects in beta cell function and insulin action, diseases of the exocrine pancreas, infections, side effects of medications, etc. Among the symptoms of DM are polyuria (excessive excretion of urine), polydipsia (excessive thirst), constant hunger, changes in vision and fatigue; These symptoms can occur suddenly. DM requires regular and systemic follow-up by a multidisciplinary health team that can offer the necessary resources for the patient to be able to manage the pathology, thus maintaining self-care to avoid worsening the disease. Thus, health education is very important for the management and control of DM (PETERMANN et al, 2015).

Type 2 diabetes mellitus is a chronic pathology marked by the presence of signs and symptoms such as: polydipsia, polyphagia, polyuria, weight loss, and hyperglycemia. Currently, it has a large increase in incidence on a global scale. Factors such as sedentary lifestyle, increased life expectancy, obesity are some of those responsible for this increase in incidence. The impairment in the quality of life of patients through their complications is of great importance, several organs and systems can be affected, such as kidneys, vision, central nervous system and cardiovascular. Its treatment requires intensive and multidisciplinary care, including drug therapy in addition to lifestyle changes (RIBEIRO, 2013).



Thus, the prevalence of type 2 DM has increased considerably, and is becoming a worldwide epidemic and a public health problem. The greatest risk is for sedentary people, overweight, central obesity, arterial hypertension, fasting plasma glucose  $\geq 100\text{mg/dl}$ , inadequate eating habits, older age, and also family history of DM, considered a non-modifiable risk factor. As a result, public health policies have been recommending the early identification of risk factors for DM2 in order to implement interventions to delay or prevent the manifestation of the disease, and also to reduce public health spending (LIMA et al, 2014).

Soon after, the resulting articles were read and cataloged in the following table:

Table 01 - Results of the studies found during the search in the databases.

<b>AUTHOR YEAR</b>	<b>PURPOSE OF THE STUDY</b>	<b>N° Patients</b>	<b>MAIN RESULTS</b>
<b>Monteiro et. al (2020)</b>	To examine the feasibility and preliminary efficacy of a 12-week foot-ankle exercise program on clinical, functional, and biomechanical outcomes in people with diabetic neuropathy (NPD)	45	The exercise program was feasible, based on a moderate recruitment rate and an adherent and satisfied population, and the intervention showed several positive preliminary effects over time compared to usual care.
<b>Rodriguez et. al (2017)</b>	To assess whether educational intervention in perimenopausal-age women with hypertension, diabetes mellitus, and/or dyslipidemia could achieve significant changes in reducing biochemical and hemodynamic risk parameters.	320	Women in the intervention group showed a decrease in low-density lipoprotein and an increase in high-density lipoprotein, as well as improvements in systolic blood pressure and frequency compared to women in the control group.
<b>Farinha et. al (2018)</b>	to investigate the influence of performing strength exercises before or after high-intensity interval exercise on blood glucose during and after exercise in patients with T1D	9	It was concluded that performing the HIIE before the EA decreases blood glucose at the end of the first exercise modality, while the reverse order postpones it to the end of the second exercise, although the HIIE + EA improves glycemic stability throughout recovery.
<b>Freire et. al (2015)</b>	Implement evaluation actions and guidance for patients with type 2 DM, regarding diabetic foot and the regular practice of physical exercises in the control and prevention of DM complications, who attend a Family Health Strategy (FHS).	17	Deformities were found in the patients' bodies, tactile sensitivity occurred in the heel region, there was a decrease in the movement function of the ankle joint. Of the participants, 76% were sedentary and 24% were aware of the benefits of regular physical activity; 25% had received a medical evaluation before practicing physical activity, 25% of which were by a qualified and supervised professional.
<b>Subramanian, Julius, Hariharasudan (2014)</b>	To analyze the efficacy of Physioball exercises on obesity in men with type II diabetes mellitus	50	Reductions in BMI by 6% and HbA1C by 7% among the experimental group were statistically proven
<b>Mehta, Patil (2020)</b>	Discovering the immediate effect of stretching on blood glucose level in individuals with diabetes mellitus	44	In the study, the postprandial BGL showed a statistically significant difference between the pre- and post-treatment values in groups A and B.

<b>Rajalaxmi et. al (2019)</b>	The aim of the study was to analyze the effectiveness of pelvic floor muscle training, yoga, and cognitive behavioral therapy for urinary incontinence in women with diabetes.	45	It was concluded that pelvic floor muscle training is more effective than yoga and cognitive behavioral therapy in treating patients with urinary incontinence in women with diabetes.
<b>Kulikova et. al (2022)</b>	The aim of this study was to perform a multifaceted evaluation of the pain syndrome in these patients before and after TENS, taking into account the levels of polyneuropathy, its severity, and the age of the patients.	75	TENS HF provided more significant analgesic effects than TENS LF, as it ensures the reduction of pain syndrome according to VAS
<b>Sairam, Peteti, Suresh (2020)</b>	To compare the efficacy of neurodynamic mobilization and the PNF program in improving sensorimotor function in diabetic neuropathy in the lower limbs.	Not located	Neurodynamic mobilization and proprioceptive neuromuscular facilitation have an effect on the sensorimotor function of diabetic neuropathy in the lower limbs.

Source: Prepared by the author.

## FINAL CONSIDERATIONS

Physical therapy programs play a significant role in the treatment and management of diabetes mellitus (DM). This review highlights that physiotherapy can be a valuable therapeutic approach for patients with DM, complementing conventional medical treatment. Physical therapy programs are intended to improve quality of life, prevent DM-related complications, and promote the overall well-being of patients. Regular exercise under the supervision of physical therapists contributes to glycemic control by increasing insulin sensitivity and facilitating glucose uptake by muscle cells. In addition, monitoring and adjusting glucose levels during physical therapy sessions helps prevent complications from hypoglycemia or hyperglycemia.

In addition, personalized exercise programs, including resistance, aerobic, and flexibility training, such as Pilates, help improve the physical capacity of DM patients. This results in improved cardiorespiratory fitness, muscle strength, balance, and flexibility, which contributes to quality of life and the prevention of complications.

Physical therapy plays an essential role in preventing complications of DM, such as neuropathy, retinopathy, nephropathy, and cardiovascular disease. This is achieved through blood pressure control, promoting vascular health, educating about self-care, and reducing the risk of musculoskeletal injuries. Thus, it is concluded that physical therapy plays a multifaceted role in the treatment and control of diabetes mellitus, addressing not only the physical aspects of the disease, but also the psychosocial aspects. It is essential that patients with DM consider including physical therapy programs as an integral part of their treatment plan, in collaboration with their medical teams. This can result in significant improvements in quality of life, prevention of complications, and proper control of the disease.



## REFERENCES

- Andrade, E. A., Fett, C. A., Vieira Junior, R. C., & Voltarelli, F. A. (2016). Exercício físico de moderada intensidade contribui para o controle de parâmetros glicêmicos e clearance de creatina em pessoas com Diabetes Mellitus tipo 2. *Revista Brasileira de Ciências e Movimento*, 24(1), 118–126.
- Almeida, A. D., Piana, B., Gallassi, T. F. B., Giacomoni Neta, A. H., Martinelli, B., & Arca, E. A. (2020). Efeitos de oito semanas de fisioterapia aquática na capacidade funcional em idosos com doenças crônicas não transmissíveis. *Salusvita*, 39(4), 1015–1029.
- Artioli, D. P., & Sa Filho, D. J. (2016). Efeitos da atividade física terapêutica sobre o perfil glicêmico, composição corpórea e capacidade física funcional em diabéticos tipo II. *ConScientiae Saúde*, 15(1), 78–88.
- Barros, M. F. A., Mendes, J. C., Nascimento, J. A., & Carvalho, A. G. C. (2012). Impacto de intervenção fisioterapêutica na prevenção do pé diabético. *Fisioterapia em Movimento*, 25(4), 747–757.
- Duncan, B. B., Chor, D., Aquino, E. M. L., Bensenor, I. M., Mill, J. G., Schmidt, M. I., Lotufo, P. A., Vigo, A., & Barreto, S. M. (2012). Doenças Crônicas Não Transmissíveis no Brasil: Prioridade para enfrentamento e investigação. *Revista de Saúde Pública*, 46(Suplemento), 126–134.
- Fontes, F. P., Correia, L. C., Lima Filho, B. F., & Gazzola, J. M. (2019). Intervenção fisioterapêutica na melhora do equilíbrio em idoso com diabetes mellitus tipo 2: Uma revisão sistemática. *Revista Brasileira de Ciências e Movimento*, 27(3), 200–209.
- Fortunatti, C., Delevatti, R. S., & Kruehl, L. M. (2015). O método pilates na prevenção e tratamento do Diabetes Mellitus tipo 2. *Arquivos de Ciências da Saúde UNIPAR*, 19(1), 45–52.
- Franco Junior, A. J., Heleno, M. G. V., & Lopes, A. P. (2013). Qualidade de vida e controle glicêmico do paciente portador de Diabetes Mellitus tipo 2. *Revista de Psicologia da Saúde*, 5(2), 105–113.
- Giacon, T. R., Vanderlei, F. M., Silva, A. K. F., Silva, N. T., Valenti, V. E., & Vanderlei, L. C. M. (2016). Influência da diabetes na função autonômica de crianças: Análise por meio dos índices geométricos. *Journal of Human Growth and Development*, 26(1), 28–34.
- Gomes, E. B., Campbell, C. S. G., Oliveira, D. B., Costa, L. C., & Carvalho, G. A. (2011). Avaliação da pressão plantar por plantígrafo F-Scan em diabéticos, com risco ou sem risco neuropático, e sua correlação com o controle glicêmico e a mobilidade articular. *Brasília Medical Journal*, 48(1), 19–26.
- International Diabetes Federation. (2015). *IDF Atlas (7th ed.)*. Brussels, Belgium: International Diabetes Federation.
- Lee, S., & Krause, D. S. (2004). Adult stem cell plasticity. In R. K. Burt & A. Marmont (Eds.), *Stem cell therapy for autoimmune disease* (pp. 59–76). Austin: Landes Biosciences.
- Lima, A. C. S., Araujo, M. F. M., Freitas, R. W. J. F., Zanetti, M. L., & Almeida, M. F. (2014). Fatores de risco para diabetes mellitus tipo 2 em universitários: Associação com variáveis sociodemográficas. *Revista Latino-Americana de Enfermagem*, 22(3), 484–490.





- Macedo, E. M. P., Neves, S. F., Palma, M. A., Motta-Santos, D., Rauber, S. B., Brandão, P. S., Freitas, M. L. M., & Campbell, C. S. G. (2017). Efeito de sessão aguda de Pilates no solo e na água sobre a glicemia de mulheres portadoras de diabetes tipo 2. *Fisioterapia Brasil*, 18(1), 47–55.
- Malmegrim, K. C., de Azevedo, J. T., Arruda, L. C., Abreu, J. R., Couri, C. E., & de Oliveira, G. L. (2017). Immunological balance is associated with clinical outcome after autologous hematopoietic stem cell transplantation in type 1 diabetes. *Frontiers in Immunology*, 8, 167.
- Petermann, X. B., Machado, I. S., Pimentel, B. N., Miolo, S. B., Martins, L. R., & Fedosse, E. (2015). Epidemiologia e cuidado à Diabetes Mellitus praticado na Atenção Primária à Saúde: Uma revisão narrativa. *Saúde (Santa Maria)*, 41(1), 49–56.
- Ribeiro, P. H. D. C. (2013). Relato de caso: Possível contribuição do exenatide no tratamento do diabetes mellitus tipo 2 (Specialization thesis). Universidade de São Paulo, São Paulo.
- Santos, A. F., Bernardo, D. N. A., Oliveira, L. C. N., Fabrizzi, F., Jokura, A., Mitidiero, J. M., & Rodrigues, W. (2016). Efeitos do treinamento de força em pessoas portadoras do diabetes mellitus tipo 2. *Revista Odontológica Araçatuba*, 37(1), 33–40.
- Silva, I., Mielke, G., Nunes, B., Böhm, A., Blanke, A., & Nachtigall, M. (2015). Espaços públicos de lazer: Distribuição, qualidade e adequação à prática de atividade física. *Revista Brasileira de Atividade Física & Saúde*, 20(1), 82–90.
- Singh, G. M., Danaei, G., Farzadfar, F., Stevens, G. A., Woodward, M., Wormser, D., Kaptoge, S., Whitlock, G., Qiao, Q., Lewington, S. (2013). The age-specific quantitative effects of metabolic risk factors on cardiovascular diseases and diabetes: A pooled analysis. *PLoS ONE*, 8(8), e65174.
- Sousa, N. C., Sousa e Souza, M., Queiroz, V. M. B., Silva, R. L. F., & Sá, M. A. F. (2020). Comparação entre as técnicas de estimulação sensorial em diferentes texturas e banho de contraste na melhora da sensibilidade plantar em indivíduos portadores de diabetes mellitus tipo 2. *Fisioterapia Brasil*, 21(2), 174–181.
- Veras, T. C., Rocha, L. R. M., Horianna, C. P. A., & Mendonça, C. S. (2015). Associação entre força muscular e sensibilidade plantar em pacientes diabéticos: Um estudo transversal. *Revista Saúde e Pesquisa*, 8(3), 525–532.