Ineffective peripheral tissue perfusion in patients with diabetic foot: a mid-range theory

Perfusão tissular periférica ineficaz em pacientes com pé diabético: uma teoria de médio alcance

Perfusión de tejido periférico ineficaz en pacientes con pie diabético: una teoría de rango medio

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ABSTRACT
Objective: to develop a mid-range theory for nursing diagnosis ineffective peripheral tissue perfusion in patients with diabetic foot. **Method:** the theory construction was carried out in six stages: approach definition; theoretical-conceptual model definition; definition of the main concepts; pictogram development; construction of propositions and establishment of causal relationships evidence for practice. **Results**: twelve etiological factors and 22 clinical indicators were included in the theory, some of which were not listed in NANDA International (Inc.) and others were adapted to better characterize patients with diabetic foot. A pictogram was constructed and eight propositions were established to verify causal relationships and evidence for practice. **Conclusion:** medium-range theory made it possible to broaden the concepts and demonstrate the causal relationships between the elements of ineffective peripheral tissue perfusion, providing subsidies to minimize gaps in knowledge and assist clinical nursing practice.
Descriptors: Nursing Diagnoses; Nursing Theory; Hyperglycemia; Diabetic Feet; Diabetic Vascular Complication.

RESUMO
Objetivo: desenvolver uma teoria de médio alcance para o diagnóstico de enfermagem perfusão tissular periférica ineficaz em pacientes com pé diabético. Método: a construção da teoria foi realizada em seis etapas: definição da abordagem; definição do modelo teórico-conceitual; definição dos conceitos principais; desenvolvimento de pictograma; construção das proposições e estabelecimento das relações de causalidade evidências para a prática. **Resultados**: foram incluídos na teoria 12 fatores etiológicos e 22 indicadores clínicos, alguns destes não estavam listados na NANDA Internacional (Inc.) e outros foram adaptados para melhor caracterização dos pacientes com pé diabético. Construiu-se um pictograma e foram estabelecidas oito proposições para verificar as relações causais e evidências para a prática. **Conclusão:** a teoria de médio alcance possibilitou ampliar os conceitos e demonstrar as relações causais entre os elementos do diagnóstico perfusão tissular periférica ineficaz, fornecendo subsídios para minimizar as lacunas no conhecimento e auxiliar a prática clínica da enfermagem.
Descritores: Diagnóstico de Enfermagem; Teorias de Enfermagem; Diabetes Mellitus; Pé Diabético; Angiopatias Diabéticas.

RESUMEN
Objetivo: desarrollar una teoría de rango medio para el diagnóstico de enfermería de la perfusión tisular periférica ineficaz en pacientes con pie diabético. **Método:** la construcción de la teoría se realizó en seis etapas: definición del enfoque; definición del modelo teórico-conceptual; definición de los principales conceptos; desarrollo de pictogramas; construcción de proposiciones y establecimiento de relaciones causales basadas en evidencia para la práctica. **Resultados:** se incluyeron en la teoría 12 factores etiológicos y 22 indicadores clínicos, algunos de los cuales no estaban incluidos en NANDA International (Inc.) y otros se adaptaron para caracterizar mejor a los pacientes con pie diabético. Se construyó un pictograma y se establecieron ocho proposiciones para verificar las relaciones causales y la evidencia de la práctica. **Conclusión:** la teoría de rango medio permitió ampliar los conceptos y demostrar las relaciones causales entre los elementos del diagnóstico de perfusión tisular periférica ineficaz, brindando subsidios para minimizar las brechas en el conocimiento y ayudar a la práctica clínica de la enfermería.
Descriptors: Diagnóstico de Enfermería; Teoría de Enfermería; Diabetes Mellitus; Pie Diabético; Angiopatías Diabéticas.

INTRODUCTION

Diabetes Mellitus (DM) is a chronic condition characterized by a set of metabolic disorders associated with hyperglycemia[1]. DM has stood out as an important public health problem due to the damage it causes to people affected, something that has generated economic impact due to high costs of health care and high rates of morbidity and mortality[2].

In the long term, people with DM can develop chronic complications, resulting from poor glycemic control, time of disease progression and genetic factors. The main complications of the disease are classified as microvascular (diabetic nephropathy, diabetic retinopathy and diabetic neuropathy) and macrovascular (acute myocardial infarction, stroke and peripheral arterial disease)[3].

Considered one of the most prevalent forms, peripheral neuropathy is a risk factor for the development of ulcers and possible amputations, being the main mechanism for triggering the diabetic foot. Diabetic foot has a complex etiology, being characterized by the presence of ulcers, infection and destruction of tissues in the lower limbs, caused by neurological and / or vascular dysfunctions that include infection, peripheral neuropathy and peripheral arterial disease (PAD), which may be associated or not[4].

Among the nursing diagnoses that may be present in patients with diabetic foot, literature highlights the diagnosis ineffective peripheral tissue perfusion (IPTP)[5]. IPTP is defined as "decrease in blood circulation to the periphery that may compromise health"[6]. The present diagnosis is applicable to these individuals, because the complications of diabetes cause great impacts on the whole organism and mainly affect the nervous and vascular system, constituting an important cause of disability.

Given the above, it is believed that early identification of this diagnosis, based on a careful evaluation of patients with diabetic foot, can provide an appropriate treatment, increasing the probability of resolving injury and reducing the chances of major complications. Therefore, it is necessary that IPTP be revised to verify the reliability of its indicators and if there are new concepts in literature that apply to patients with diabetic foot, since an accurate diagnostic inference covers the relationship between clinical indicators and etiological factors according to the needs presented by patients[6].

To obtain this information in a reliable way, some scholars have used medium-range theories (MRT) to aggregate knowledge and demonstrate the relevant causal relationships to solidify nursing care[7]. This theory corresponds to a set of ideas aimed at a limited dimension of the reality of nursing, which seeks to relate a small number of clearly defined concepts and propositions to reduce the gaps related to knowledge generated through research[8-9].

Unlike the great theories, a medium-range ones allow an approximation between the theoretical and empirical knowledge that underlie the construction of propositions with a view to explaining the facts in a specific, concrete and theoretically based way, to be applicable to nurses' professional practice[10]. This interconnection between research and practice reduces the level of abstraction built by great theories and leads to the production of new knowledge within the scope of nursing, being an alternative to minimize the challenges of implementing targeted care, making their practice based on evidence[11].

The use of MRT has been applied in several areas of nursing[11], one of which is in the diagnostic validation process, which includes concept analysis, expert validation and clinical validation, in which scholars have proposed the replacement of analysis of concept for building an MRT[12]. The development of this type of theory in studies with nursing diagnosis is necessary, as it provides a better basis for the diagnosis for specific populations, making them more robust and reliable when analyzing their structural components and verifying the causal factors and their relationships to meet users' demands[7].

Thus, due to the relevance of this type of study for nursing, it is pertinent to build a MRT for IPTP in patients with diabetic foot. It is believed that, based on the knowledge constructed through theory, it is possible to identify the real needs and particularities of this population, which result from peripheral nervous and vascular system impairment, which can cause great impacts and damage to individuals, such as amputations, constituting a disabling factor that affects patients' quality of life[13].

In this context, the construction of MRT is fundamental to explain and clarify the occurrence of IPTP in the studied population, as it allows: to identify the etiological factors and clinical manifestations of peripheral vascular involvement and their relationships between the elements contained in NANDA International, Inc. Taxonomy (NANDA-I); unveil new concepts in the context of diagnosis, present in individuals with diabetic foot, to accurately characterize this human response and base the care plans, based on an appropriate assessment to perform assistance. This evidence will provide individuals with targeted care with a focus on disease prevention, in addition to favoring the evolution of nursing practice through the development of clinical and critical reasoning based on scientific evidence.

OBJECTIVE

To develop a mid-range theory for nursing diagnosis ineffective peripheral tissue perfusion in patients with diabetic foot.

METHOD

This is an integrative literature review for the construction of a MRT, developed from the model proposed by Lopes, Silva and Herdman[7], adapted from Roy[14], divided in six steps: *Definition of medium-range theory construction approach*; *Definition of theoretical-conceptual models*; *Definition of the main concepts of a medium-range theory*; *Development of a pictorial scheme*; *Construction of medium-range theory propositions*; *Establishment of causal and evidence relationships for practice*. Each step is described in the following items.

Definition of medium-range theory construction approach

In this study, a MRT for IPTP was developed in patients affected by the diabetic foot. This stage was developed from an integrative literature review, with the purpose of searching for concepts relevant to nursing diagnosis for the construction of a MRT, i.e.,

etiological factors and clinical indicators and supporting the conceptual and operational definitions of each identified element.

Integrative review

Integrative literature review allows a synthesis and analysis of scientific knowledge of a given subject already studied, enabling the production of relevant new knowledge that will provide a basis for clinical practice, in addition to contributing to the theoretical development[15]. This integrative review went through the following steps: identification of the theme and elaboration of the guiding question, establishment of inclusion and exclusion criteria for the search, categorization of studies, evaluation, interpretation of results and review presentation[16].

To elaborate the guiding question, PEO strategy[17] was used, which was adapted to carry out this study, in which P refers to the study population (patients with diabetic foot), E is exposure of interest, being an independent variable (etiological factors and clinical manifestations), O is the result identified as a dependent variable (peripheral vascular impairment). Thus, the following guiding question was defined: what etiological factors contribute to peripheral vascular impairment in patients with diabetic foot and what are its clinical manifestations?

In order to verify the main descriptors about the theme of the question elaborated, an initial search was carried out in the Medical Literature Analysis and Retrieval System Online database (MEDLINE), in order to obtain a greater number of studies. Thus, the controlled descriptors were selected in the following Health Sciences Descriptors (DeCS) and Medical Subject Heading (MeSH): diabetic angiopathies, diabetes mellitus, diabetic foot, diabetic neuropathy and peripheral arterial disease. For the crossing of terms, the Boolean operators AND and OR were used, resulting in the following combinations: diabetic angiopathies AND diabetes mellitus AND diabetic foot (crossing 1); diabetic foot AND (peripheral arterial disease OR diabetic neuropathy) AND diabetic angiopathies (crossing 2).

The search took place in June and July 2019. It was carried out only by the main researcher on the National Library of Medicine (PUBMED) portal in the Cumulative Index to Nursing and Allied Health Literature (CINAHL) and in the Virtual Health Library (VHL), selecting, separately, the Latin American and Caribbean Health Sciences (LILACS), Medical Literature Analysis and Retrieval System on-line (MEDLINE) and Nursing Database (BDENF) databases.

Articles that addressed peripheral vascular impairment in patients with diabetic foot and texts available in full, in English, Spanish or Portuguese were included in the study. Theses, dissertations, reviews (systematic, narrative and integrative), opinion articles, editorials and repeated articles were excluded from the study.

In the initial sample, 835 and 452 studies were identified for crossings 1 and 2. After applying the eligibility criteria, 36 articles (crossing 1) and 27 pre-selected articles (crossing 2) were read in full, in which a final sample of 28 articles was obtained. The search and selection processes are described in the flowchart according to the PRISMA group[18] (Figure 1).

For data extraction and analysis, an instrument was developed with the following items: title of publication, author (s), year of publication, journal, study objective, language, type of study, level of evidence according to Melnyk and Fineout- overholt[19], etiological factors and clinical manifestations related to diagnosis ineffective peripheral tissue perfusion in patients with diabetic foot, conceptual and operational definitions and causal relationships between concepts. From reading, the included articles were categorized using this instrument and synthesized into etiological factors and clinical indicators for descriptive analysis.

Definition of theoretical-conceptual models
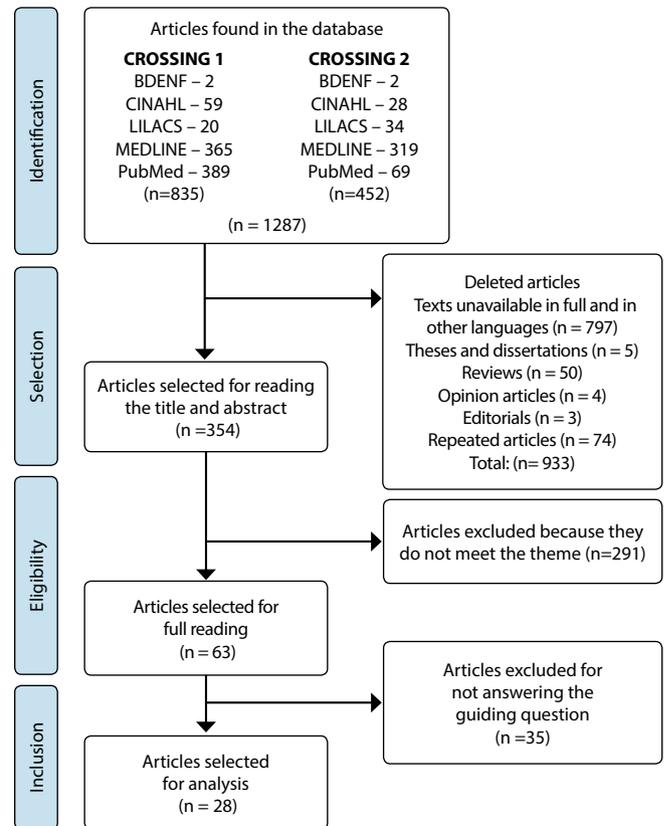
Source: adapted from the PRISMA by Moher et al.[18].
Figure 1 – Flowchart of selection of articles according to the databases, Imperatriz, Maranhão, Brazil, 2021

To support the development of MRT, the Wanda de Aguiar Horta Model[20] was adopted on the Theory of Basic Human Needs, in which its construction was directed starting from the laws of balance (homeostasis and hemodynamics), adaptation (interaction with the environment) and holism (individuals are seen as a whole and should not be compared in parts).

Basic human needs are classified into psychobiological, psychosocial and psycho-spiritual, from which they allow nurses to plan their care based on the relationships between the diverse needs of patients[20]. This theoretical model was chosen because it encompasses several fundamental aspects for the homeostasis of patients with diabetic foot.

Thus, considering that the focus of this research is the diagnosis IPTP, to support MRT, the components included in the psychobiological needs were used, mainly vascular regulation, in which

a large part of the elements found results from this altered need, which addresses the transport mechanism of essential nutrients for tissues and the removal of unnecessary substances, in order to maintain homeostasis and the organism survival[20]. In addition to the psychobiological needs, three components referring to the psychosocial needs were used with regard to learning, self-esteem and self-image.

Definition of the main concepts of a mid-range theory

To develop an MRT, three primary concepts were used: tissue perfusion, which corresponds to the conceptual core of the diagnosis; etiological factors, which favor the development of this human response; clinical indicators, which are the clinical manifestations of the diagnosis presented by patients with diabetic foot. The elements of diagnoses (related factors, defining characteristics and associated conditions) mentioned in the NANDA-I Taxonomy[6], the components of Horta Theory and new elements obtained through ILR were considered to be included in MRT.

These concepts were determined by the main researcher, by analyzing the studies found in the review, in which the etiological factors and clinical indicators of IPTP were obtained.

Development of a pictorial scheme

From the elements identified in literature, a pictorial scheme was developed, characterized by an illustration that involved the concepts for understanding the causal relationships of the presence of the diagnosis. This may contain textual or graphic elements, in order to synthesize the etiological factors and clinical indicators included in MRT[12].

Construction of mid-range theory propositions

In this stage, propositions were constructed to explain the pertinent relationships to the elements found by the theory that supported the nursing diagnosis. These propositions include statements that relate etiological factors to clinical indicators, as consequent to the present diagnosis, to establish the differentiation of indicators in common among other diagnoses[12].

Establishment of causal relationships and evidence for practice

In the last step, which is described in discussion, the causal relationships of the elements that integrate IPTP in patients with diabetic foot were established. This stage includes the description of the entire theoretical-causal model aimed at nursing diagnosis, highlighting the clinical interactions that lead to clinical reasoning and judgment, which must be clear and precise, in order to reduce the existing gaps in the research[12].

RESULTS

The preparation of MRT was based on a sample of 28 studies, whose years of publication comprised the period from 1991 to 2018, with English predominating (67.9%), followed by Spanish (17.9%) and Portuguese (14.2%). Levels of evidence IV and VI prevailed, corresponding to cohort studies (28.6%) and cross-sectional ones (42.9%), respectively.

As for the frequency of etiological factors and clinical indicators for IPTP, found in the review studies, 12 etiological factors were identified, the most frequent of which were peripheral neuropathy (32.1%), diabetes diagnosis time (28.5%), PAD (25%), advanced age (17.8%), smoking (14.2%) and inadequate blood glucose monitoring (14.2%). Furthermore, 20 clinical indicators were identified, the most frequent of which were ankle-brachial index <0.9 (17.8%), absence and decrease in peripheral pulses (14.2%), intermittent claudication (14.2%) and delay in wound healing (14.2%).

Chart 1 presents the elements found in the review for MRT and the components of Theory of Basic Human Needs. The elements were organized according to these components. From a bibliographic survey, it was found that the main changes identified in patients with diabetic foot corresponded to an imbalance of psychobiological and psychosocial needs. Thus, each element was classified according to these needs, with some contemplating changes in the two types of basic needs mentioned above.

From this review, new elements were found for IPTP aimed at patients with diabetic foot. Currently, the present diagnosis has five related factors, four associated conditions and 17 defining characteristics; however, with literature search, it was possible to identify eight etiological factors and 10 clinical indicators that are not found in NANDA-I[6].

These factors, based on the theoretical model of Horta, together with those of NANDA-I[6], supported the MRT construction. Charts 2 and 3 represent the diagnostic elements present in NANDA-I[6], those obtained by the integrative review and the elements that were included in MRT. It was necessary to exclude some elements listed in NANDA-I[6] that were not suitable for the study population and others were adapted based on the integrative review for a better characterization of patients with diabetic foot.

The etiological factors insufficient knowledge of disease process and the modifiable factors were compiled in the factor insufficient knowledge of disease, considering that during the review it was noticed that the deficient knowledge among patients occurs in general, encompassing the entire pathology, being possible to check these two criteria in just one factor. The same was done with the excessive sodium intake factor and the associated condition hypertension, both were grouped into the hypertension factor, as they present similar pathophysiology.

About the associated condition DM, from this, three new elements originated: inadequate blood glucose monitoring, peripheral neuropathy and diabetes diagnosis time. As for conditions associated with endovascular procedure and trauma, both were not identified in the review and were not included in MRT, as they are not related to the clinical picture and etiology of diabetic foot.

Regarding clinical indicators, alteration in skin characteristic had its nomenclature changed and was subdivided into five elements (cold foot, cyanosis, pallor, absence of hair and dystrophic nails). Skin color pales with limb elevation has been modified to alteration in skin color with limb elevation. Such changes made clinical indicators more specific to assess changes related to poor peripheral perfusion in patients with diabetic foot.

Alteration in motor functioning, distance in the 6-minute walk test below normal range, decrease in pain-free distances achieved in the 6-minute walk test and femoral bruit were excluded because they did not present additional evidence in literature that pointed to their relationship with patients with diabetic foot to support their permanence in MRT, since most patients have previous amputations and gait changes, which would make it impossible to identify the factor. However, the decrease in blood pressure in extremities and color does not return to lowered limb after 1 minute leg elevation were included in MRT, even though they were not identified in the review, as they are elements that have a direct relationship with the pathophysiology of the diabetic foot when affected peripheral vascular.

From these identified elements, a pictogram (Figure 2) with the IPTP was built, relating it to the etiological factors and clinical indicators to demonstrate the existing causal relationships. The etiological factors were classified into: predisposing, which refers to individual susceptibility; disabling, which impairs recovery and health promotion; precipitating, factor that initiates the causal chain; reinforcing, which intensifies existing clinical conditions[7].

Chart 1 - Components of Theory of Basic Human Needs and concepts found for ineffective peripheral tissue perfusion, Imperatriz, Maranhão, Brazil, 2021

Components of Theory of Basic Human Needs Psychobiological needs	Mid-range theory elements
Oxygenation	Cyanosis, decrease in oxygen supply
Hydration	Absence or reduction in sweating
Exercise and physical activity	Sedentary lifestyle
Body care	Smoking
Physical and cutaneous-mucosal integrity	History of pressure ulcer and previous amputation, cold foot, pallor, dystrophic nails, edema, absence of hair
Thermoregulation	Cold foot
Hormonal regulation	Diabetes diagnosis time, advanced age, dyslipidemia, increased liver enzyme
Immune regulation	Infection
Cell growth	Delay in peripheral wound healing
Vascular regulation	PAD, heart failure, rest pain, color does not return to lowered limb after 1 minute leg elevation, absence of peripheral pulses, intermittent claudication, alteration in skin color with limb elevation, ankle-brachial index<0.90, decrease in peripheral pulses, capillary refill time>3seconds, hallux-brachial index<0.7
Hydrosaline and electrolyte balance	Hypertension, decrease in blood pressure in extremities, edema
Neurological regulation, tactile and painful perception	Peripheral neuropathy, paresthesia
Motility and locomotion	Intermittent claudication
Therapy	Inadequate blood glucose monitoring
Psychosocial needs	**Mid-range theory elements**
Learning	Insufficient knowledge of disease
Self-esteem and self-image	Delay in peripheral wound healing, dystrophic nails, history of pressure ulcer, and previous amputation

Source: adapted from Horta[20].

Chart 2 - Etiological factors of ineffective peripheral tissue perfusion in patients with diabetic foot, Imperatriz, Maranhão, Brazil, 2021

NANDA-I[6]	Integrative review	Mid-range theory*
Insufficient knowledge of disease process	Insufficient knowledge of disease	Insufficient knowledge of disease**
Insufficient knowledge of modifiable risk factors		
Sedentary lifestyle	Sedentary lifestyle	Sedentary lifestyle
Smoking	Smoking	Smoking
Excessive sodium intake	Hypertension	Hypertension
Hypertension		
Diabetes Mellitus	Inadequate blood glucose monitoring	Inadequate blood glucose monitoring
	Peripheral neuropathy	Peripheral neuropathy
	Diabetes diagnosis time	Diabetes diagnosis time
Endovascular procedure	Not identified	Excluded
Trauma	Not identified	Excluded
Not identified	Advanced age	Advanced age
Not identified	Dyslipidemia	Dyslipidemia
Not identified	Elevated liver enzymes	Elevated liver enzymes
Not identified	Peripheral arterial disease	Peripheral arterial disease
Not identified	Heart failure	Heart failure

*Note: *Concepts of mid-range theory; **Concepts adapted from NANDA-I.*

Chart 3 – Clinical indicators of ineffective peripheral tissue perfusion in patients with diabetic foot, Imperatriz, Maranhão, Brazil, 2020

NANDA-I[6]	Integrative review	Mid-range theory*
Color does not return to lowered limb after 1 minute leg elevation	Not identified	Color does not return to lowered limb after 1 minute leg elevation
Alteration in skin characteristic	Cold foot	Cold foot
	Cyanosis	Cyanosis
	Pallor	Pallor
	Absence of hair	Absence of hair
	Dystrophic nails	Dystrophic nails
Alteration in motor functioning	Not identified	Excluded
Absence of peripheral pulses	Absence of peripheral pulses	Absence of peripheral pulses
Intermittent claudication	Intermittent claudication	Intermittent claudication
Skin color pales with limb elevation	Alteration in skin color with limb elevation	Alteration in skin color with limb elevation**
Decrease in blood pressure in extremities	Not identified	Decrease in blood pressure in extremities
Distance in the 6-minute walk test below normal range	Not identified	Excluded
Decrease in pain-free distances achieved in the 6-minute walk test	Not identified	Excluded
Extremity pain	Rest pain	Rest pain**
Edema	Edema	Edema
Ankle-brachial index<0.900	Ankle-brachial index<0.90	Ankle-brachial index<0.90
Paresthesia	Paresthesia	Paresthesia
Decrease in peripheral pulses	Decrease in peripheral pulses	Decrease in peripheral pulses
Delay in peripheral wound healing	Delay in wound healing	Delay in peripheral wound healing
Femoral bruit	Not identified	Excluded
Capillary refill time>3seconds	Decrease in peripheral perfusion	Capillary refill time>3seconds
Not identified	Hallux-brachial index<0.75	Hallux-brachial index<0.75
Not identified	Absence or reduction in sweating	Absence or reduction in sweating
Not identified	Infection	Infection
Not identified	Decrease in oxygen supply	Decrease in oxygen supply
Not identified	History of pressure ulcer and previous amputation	History of pressure ulcer and previous amputation

*Note: *Concepts of mid-range theory; **Concepts adapted from NANDA-I.*
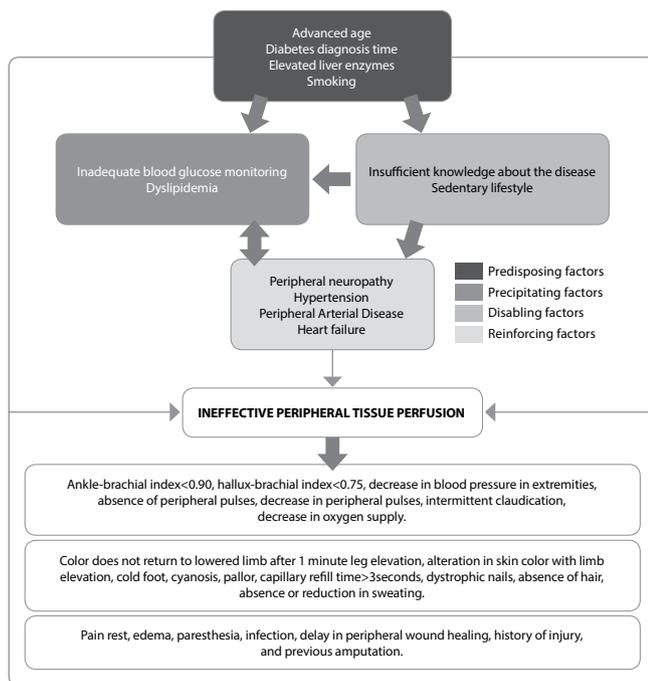
Figure 2 - Pictogram of etiological factors and clinical indicators of ineffective peripheral tissue perfusion in patients with diabetic foot, Imperatriz, Maranhão, Brazil, 2020

Construction of mid-range theory propositions

The propositions include statements that relate etiological factors to clinical indicators, factors consequent to the diagnosis, interrelating etiological factors in order to establish a causal hierarchy for the occurrence of IPTP[21]. Such propositions are described below, in line with the altered psychobiological and psychosocial needs, which correspond to the elements included in MRT:

1. Advanced age, diabetes diagnosis time, elevated liver enzymes and smoking are predisposing factors that make individuals more susceptible to peripheral vascular impairment.
2. Inadequate blood glucose monitoring and dyslipidemia are factors that trigger IPTP, as they alter the entire metabolic control of glucose and lipids, favoring the development of DBP and, consequently, the diabetic foot. These factors are considered precipitating and are influenced by predisposing factors.
3. Insufficient knowledge of disease and sedentary lifestyle are disabling factors, as they interfere with patients' self-care and recovery. They are also influenced by predisposing factors and contribute to the occurrence of precipitating factors.
4. Peripheral neuropathy, PAD, hypertension and heart failure are diseases that can be classified as reinforcing factors, as they aggravate the clinical condition of vascular impairment

in diabetic patients, being related to the disabling factors and directly associated with the precipitating factors for the occurrence of IPTP.

5. Ankle-brachial index <0.90, hallux-brachial index <0.75, decrease in blood pressure in extremities, absence of peripheral pulses, decrease in peripheral pulses, intermittent claudication, decrease in oxygen supply are the consequence of a PAD chart caused by hyperglycemia and changes in lipid profile and liver enzymes.

6. Color does not return to lowered limb after 1 minute leg elevation, alteration in skin color with limb elevation, cold foot, cyanosis, pallor, capillary refill time> 3seconds, dystrophic nails, absence of hair, absence or reduction in sweating are conditions that occur in the face of impaired tissue perfusion and impairment of peripheral nerves.

7. Rest pain, edema, paresthesia, infection, delay in wound peripheral healing, history of pressure ulcer and previous amputations are clinical indicators that undermine and interfere in the patient's quality of life and are related to the presence of precipitating and disabling factors, as these enhance the degree of peripheral vascular impairment.

8. All clinical indicators identified occur as a result of the influence of predisposing, precipitating, disabling and reinforcing factors in peripheral vascular impairment, being used to characterize the presence of IPTP in patients with diabetic foot.

DISCUSSION

The etiological factors and clinical indicators included in MRT are elements that represent IPTP in patients with diabetic foot. This study demonstrated the main causal relationships that lead to the referred diagnosis and how it manifests itself in the studied population. Such a phenomenon is presented in this discussion, corresponding to the sixth stage of MRT, which refers to the "establishment of causal and evidence relationships for practice", in which, scientifically based, highlighted the interactions visualized in the pictogram for the occurrence of peripheral vascular impairment.

Diabetic foot patients may have a large part of their basic human needs in imbalance due to the pathophysiological mechanism of the disease that affects the hormonal, neurological and vascular system, and also due to several other factors, as seen in the pictogram. Therefore, individuals who do not have adequate therapeutic follow-up may be susceptible to changes in oxygenation, skin hydration, difficulty in performing exercises and physical activity, in addition to a deficit in self-care that can cause loss of skin integrity due to low tissue perfusion, loss of tactile and painful perception, and consequently, evolve to uncontrolled infection and amputation of the limb, resulting in impaired locomotion, low self-esteem, lack of acceptance, loss of self-image, among other altered needs.

Therefore, the development of this MRT had the purpose of explaining the relationships between the elements found in the review, which were substantiated by Theory of Basic Human Needs, covering from the beginning of the causal chain to the occurrence of diabetic foot and its clinical manifestations for determination of IPTP.

This whole process starts with patients with DM who are susceptible to various complications that mainly involve the macro and microvascular system and are associated with advanced age (>60 years), diabetes diagnosis time (≥10 years), smoking and change in liver enzymes. Tuxedo is considered a risk factor due to the release of substances such as nicotine and carbon monoxide by burning cigarette, which damages the vascular endothelium, causing an inflammatory reaction. These factors predispose individuals to developing diabetic complications and are called predisposing factors[21-22].

Among the complications of DM, the diabetic foot is one of the most common, occurring due to dysfunction of peripheral vessels and nerves, which compromises peripheral circulation and individual sensitivity. There are some factors that trigger these impairments in peripheral perfusion and contribute to the manifestation of IPTP. Inadequate blood glucose monitoring, for example, is responsible for the beginning of the causal chain, as a persistent hyperglycemia condition can lead to the development of PAD and peripheral neuropathy. It is known that a good glycemic control is able to prevent the complications that originate diabetic foot[22]. Another relevant point that should be emphasized is that lipid changes, common in diabetic patients, are precipitating factors, as they favor the accumulation of atheromatous plaques in the vessels that, associated with deficient glycemic metabolism, contribute to the process of atherosclerosis[21].

In this perspective, PAD can also occur in the face of a change in liver enzymes that contribute to insulin resistance and release of atherogenic factors; thus, trigger a chart of atherosclerosis, which hinders blood flow to peripheral vessels due to narrowing and blocking of vessels[23]. Faced with this vascular impairment, patients may experience intermittent claudication due to insufficient oxygen supple to the tissues, ankle-brachial index <0.9 and hallux-brachial index> 0.75 due to decrease in blood pressure in extremities, absence of peripheral pulses, decrease in peripheral pulses, cold foot, cyanosis, pallor, color does not return to lowered limb after 1 minute leg elevation and alteration in skin color with limb elevation. Additionally, the rapid progression of PAD is influenced by hypertension, increased diabetes diagnosis time and smoking[24-25].

Peripheral neuropathy is related to predisposing and precipitating factors, but it is considered a reinforcing factor for worsening vascular impairment, as it contributes to the reduction of vessel contractility, making them unable to increase blood flow to peripheral vessels. This endothelial dysfunction can lead to the appearance of ulcers in diabetic patients and this can be explained by the reduction of nitric oxide synthesis, the main vasodilator released by the endothelium, which is reduced in patients with peripheral neuropathy[26].

DM diagnosis time and inadequate blood glucose monitoring are factors that contribute to the development of peripheral neuropathy. This disease affects both sensory and motor nerves as well as autonomic nerves, causing the conduction of nerve stimuli to be interrupted due to the hyperglycemia picture[27]. Thus, patients may present both paresthesia and altered tactile and painful sensitivity, this can trigger the appearance of ulcers that can progress to amputations and, in patients with this history, may compromise the contralateral limb[22].

The reinforcing factors directly contribute to the manifestation of IPTP. PAD is characterized by a chart of arterial insufficiency due to vessel obstruction, which causes a decrease in oxygen supply and nutrients to tissues and favors a low tissue perfusion, which can trigger the absence or reduction in sweating and the

presence of dystrophic nails[28]. Regarding rest pain and capillary refill time> 3seconds, they may be related to an ischemia chart that results from the presence of the reinforcing factors PAD and heart failure, as they are diseases that interfere in blood flow to peripheral tissues and aggravate the clinical condition of patients with diabetic foot when interfering with their quality of life[23].

Regarding delay in peripheral wound healing, an important factor in the peripheral vascular impairment, studies report that it is associated with ulcer depth and location, the presence of infection that, in the presence of poor tissue perfusion, makes the lesion environment conducive to colony. bacteria, presence of PAD, longer duration of diabetes[29-30], presence of heart failure[31], edema and liver disease[23].

Disabling factors are related to all other factors, as they are elements that impair health recovery and rehabilitation. Sedentary lifestyle and insufficient knowledge of disease lead to failures in the implementation of measures to prevent diabetic foot and its complications, which favors unfavorable repercussions on the patient's well-being[22,32].

Study limitations

As a limitation, initially, the search restriction regarding English, Portuguese and Spanish stands out, as articles in another language that answered the research question could have been published. Moreover, the fact that we excluded gray literature (theses, dissertations, unpublished articles, among others) was also considered a limitation, which may have compromised the identification of other references that could contribute to the construction of MRT. A point that hindered the elaboration of the study was the deficient scientific production that addresses the nursing diagnosis IPTP in patients with DM, since no specific studies were found that involved the referred diagnosis and the theme of diabetic foot complication. There was also a scarcity of studies related to the development of MRT for the review of nursing diagnosis and for the elaboration of new diagnoses, which reflects the need to carry out this type of study in order to make the diagnostic inference more accurate and complete.

Contributions to nursing and health

Diabetic foot is one of the complications that have great repercussions on individuals' quality of life, such as the presence of ulcers, infections, amputations, sensory and motor changes. Thus, nurses, professional that is closest to the community, is the most suitable to carry out assessment of the feet of people with diabetes, as recommended by the Ministry of Health[28]. Therefore, in order to evaluate these patients in a complete way, they need the help of instruments that contemplate all patients' particularities, in order to reduce the problems of this complication.

In this perspective, the MRT built in this study helped to identify and explain the causal relationships between the etiological factors and clinical indicators of IPTP, adapt the care plan to the clinical context of the patient with diabetic foot, in order to identify early the manifestation of these factors in patients with diabetic foot, with the purpose of list specific therapeutic measures and prevention strategies for disabling diseases, in an attempt to offer effective care, better health and well-being.

CONCLUSION

In general, the course of this study enabled the knowledge of new elements, in addition to those contained in NANDA-I, which highlights the importance of this type of research to study nursing diagnoses in diverse clinical contexts. From the identified elements, eight propositions were built, demonstrating the causal relationships between the factors, with 12 etiological factors identified; of these, only four (insufficient knowledge of disease, smoking and sedentary lifestyle, hypertension) were at NANDA-I. Thus, there is a need to improve the nursing diagnoses contained therein, in view of specific situations experienced by individuals.

Thus, 22 clinical indicators were identified, five new elements, four indicators with readjusted nomenclature and one indicator (alteration in skin characteristic) subdivided into five new indicators. Six clinical indicators listed in NANDA-I were found in the review, four of which were not included in MRT, because no studies were identified that had a corroborative relationship that better characterized the studied population. However, it was decided to keep decrease in blood pressure in extremities and color does not return to lowered limb after 1 minute leg elevation in MRT, which were not identified in the review and are present in NANDA-I, as they have a direct relationship with the pathophysiological chart of the population, so that, later, in a content validation, next step to carry out the diagnostic validation process, the judges could evaluate the relevance of these indicators for IPTP.

In view of this, MRT made it possible to broaden the concepts and demonstrate the causal relationships between the elements of IPTP, providing subsidies to minimize gaps in knowledge and assist clinical nursing practice, by identifying the etiological factors and clinical manifestations that can guide the implementation of effective interventions to provide safe and resolutive care to patients.

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