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Instrument for assessing tissue integrity of the feet of patients with diabetes *mellitus*

Instrumento para avaliação da integridade tissular dos pés de portadores de diabetes *melittus*

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Keywords
Nursing assessment; Nursing research; Nursing process; Diabetes *mellitus*; Lower extremity

Descritores
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Abstract

Objective: To construct and validate a scale for assessment of the feet of patients with diabetes *mellitus* according to NOC indicators to the outcome "Tissue Integrity: skin and mucous membranes".

Methods: This study was developed using evidence-based nursing. Based on the question: "Which indicators should be employed for assessing the feet of patients with diabetes *mellitus*?", a search was performed in databases and textbooks and subsequently the construction of a scale and assessment by expert nurses.

Results: The final version of the instrument consists of 20 indicators for assessment of the conditions of skin and hair, blood circulation, sensitivity, temperature and foot plantar pressure.

Conclusion: The instrument proposed for assessment of tissue integrity of the feet of patients with diabetes *mellitus* was constructed and validated by expert nurses with a high level of acceptance.

Resumo

Objetivo: Construir e validar uma escala de avaliação dos pés de portadores de diabetes *mellitus*, a partir dos indicadores da NOC para o resultado "Integridade Tissular: pele e mucosas".

Métodos: Utilizou-se da enfermagem baseada em evidências para realização deste estudo. A partir da questão: "Quais indicadores devem ser utilizados para a avaliação dos pés de pacientes com diabetes *mellitus*?" foi realizada uma busca em bases de dados e livros-textos e, posterioremente, a construção da escala e a avaliação por enfermeiros peritos.

Resultados: A versão final do instrumento consiste em 20 indicadores para avaliação das condições da pele e pêlos, circulação sanguínea, sensibilidade, temperatura e pressão plantar dos pés.

Conclusão: O instrumento de avaliação proposto integridade tissular dos pés de portadores de diabetes *melittus* foi construído e validado por enfermeiros peritos com nível excelente de aceitação.

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Introduction

Diabetes *mellitus* causes several complications and, among them, those affecting the lower limbs stand out. Due to the degenerative process resulting from neuropathy and peripheral arteriopathy, the feet become vulnerable to traumas which can damage skin integrity.[1]

The manifestation of injuries in the lower limbs may result, among other disorders, in the loss of independence as it directly affects the individual's quality of life. Therefore, healthcare professionals are supposed to thoroughly and frequently analyze the feet of patients with diabetes *mellitus*.

In addition to performing a key role in providing guidance and education for patients, nurses also monitor the progress of people with diabetes, as well as control the complications related to this pathology. Among these, nurse must assess tissue integrity of lower limbs and be attentive to characteristics which may offer risks for skin breakdown.[1]

The constant professional update and follow-up of technological innovations increase the problem-solving potential and allow providing nursing care accordingly to high quality standards. Thus, the reflective nursing practice must be based on scientific knowledge.

The acknowledgment of the importance of integrating research and care has been implemented in the last 30 years and, as of this period, instruments have been developed to improve the way healthcare is provided and support the processes related to nursing in the current days.[2]

In this sense, the adoption of a process or a method to provide healthcare is appropriate. It may call upon taxonomies or classifications for nursing practices, such as, the Nursing Diagnosis from NANDA-I, the *Nursing Interventions Classification* (NIC) or the *Nursing Outcomes Classification* (NOC).

NOC was developed in 1991 by a team of researchers from the University of Iowa upon the need to identify the expected outcomes and patients' reactions in response to the care provided.[3] The expected outcomes reported in the NOC have been tested, which contributes to strengthen their validity and reliability.

In light of the need for methods to assess the condition of the feet of patients with diabetes *mellitus*, as well as to measure the effectiveness of intervention to be implemented by the nursing staff, there was an effort to identify indicators which represent such situation. This purpose is also justified considering that the outcome "Tissue Integrity: skin and mucous membranes" (1101), from the NOC, does not describe the specific aspects related to the target public of this study.

The aim of this study was to construct and validate a scale to assess the feet of patients with diabetes *mellitus* based on NOC indicators to the outcome "Tissue Integrity: skin and mucous membranes" (1101) and those identified in the literature.

Methods

The precepts of evidence-based nursing have been used as methods. This methodology involves, firstly, the structure of a problem to be solved, the access to information available in the literature and analysis of its validity, as well as its effectiveness and applicability.[2]

The methodological process of this study consisted of five phases: formulation of the problem based on practices; search for evidence available in the literature; analysis of findings with regard to transfer generalization and validity; use of the best evidence in the care of patients, and assessment of the healthcare professional in relation to the care provided.[3]

Formulation of the problem based on practices

Considering evidence-based practices, the first phase of the study consisted of the selection of an adequate nursing expected outcome to estimate the condition of lower limbs of patients with diabetes mellitus, as well as capable of assessing possible interventions to be implemented for this purpose. Thus, the outcome "Tissue Integrity: skin and mucous membranes" (1101) from the NOC, defined

as the "structural integrity and normal skin physiological function", was found applicable as a goal to be achieved by the nursing staff by means of planning effective actions. Based on this expected outcome, the following guiding question was: "Which indicators should be employed to assess the feet of patients with type II diabetes *mellitus*?"

Search for evidence available in the literature

Once the problem to be solved was structured, the second phase of the study was started: search for evidence in scientific literature which could compound the indicators for assessment of the feet of patients with diabetes. During the entire month of March 2012, a search was conducted in the databases PUBMED, CINAHL, SCIENCE DIRECT and LILACS. The search period was not restricted, comprehending all studies published to date. The following research strategies were employed: "nursing care" [words] and "diabetic foot" [words] and "integrity cutaneous" [words]. At the end of the bibliographical survey, 31 quotations were gathered. Afterwards, a critical analysis of the articles was performed with a full reading aiming at verifying whether the studies covered the main subject studied. In this phase, 12 articles were excluded because these did not point out the indicators, remaining 19 articles to compose the revision.

A manual search was performed in textbooks in order to complement the scientific-based study. Materials approaching skin injuries and physical examination of lower limbs were assessed.

Analysis of findings with regard to transfer generalization and validity.

In the third phase, all indicators suggested by literature were strictly analyzed, aiming at meeting the objective proposed. The degree of generalization of the studies was observed, that is, the capacity of being replicated in different contexts, and the transfer validity, which consists of the capacity of modifying parameters in accordance with the updating of outcomes found in further studies.

Use of the best evidence in the care of patients

The scale proposed has considered several indicators of concern in the expected outcome "Tissue Integrity: skin and mucous membranes" (1101), which was referred to in the NOC, in addition to others identified in the literature revision. All of these indicators composed the best scientific evidence for assessment of the feet of patients with diabetes mellitus and measurement of the effectiveness of interventions implemented by the nursing staff. Aiming at quantifying the situation of each indicator analyzed, the five aspects suggested by the NOC instrument were maintained, and score varied between one (severely compromised) and five (not compromised).

Assessment of healthcare professionals in relation to the care provided

The "snowball" method was employed in order to select professionals to act as judges. In this regard, a researcher has indicated an evaluator and this, in turn, was requested to indicate another evaluator and so forth.

Data were collected by means of a form to assess the appearance, relevance and understanding of indicators; such instrument presented alternatives to dichotomous responses (yes/no), with the possibility of adding suggestions at the end of each item. Each evaluator received a form along with a letter inviting them to join the assessment process. The period of one mouth was established for evaluators to return the instrument and they were contacted one week before this deadline via e-mail.

Statistical analysis

Data were organized on a Microsoft Office Excel® spreadsheet and later converted to the Statistical Package for the Social Sciences (SPSS) program, version 17.0.

Data analysis was conducted in order to assess the agreement level among judges. Therefore, the inter-evaluator agreement analysis was accomplished through the Kappa test. The interpretation of agreement values measured by Kappa followed the guidance provided in the specialized literature, that is: kappa below 0: poor; from 0 to 0.20: mild; from 0.21 to 0.40: satisfactory; from 0.41 to 0.60: moderate; from 0.61 to 0.80: significant and from 0.81 to 1.00: perfect agreement.

Results

Assessment indicators

The scale proposed by the NOC to "Tissue Integrity: skin and mucous membranes" (1101) refers to 13 indicators: temperature (110101), sensation (110102), elasticity (110103), hydration (110104), pigmentation (110105), perspiration (110106), color (110107), texture (110108), thickness (110109), tissue free of injury (110110), tissue perfusion (110111), hair growth on skin (110112) and skin integrity (110113). It is possible to add other items to this scale whether the evaluator deems they are required to be analyzed, in accordance with the specificity presented by each patient.

The indicators found in the literature, both in scientific articles and textbooks, encompass manifestations in the lower limbs which may vary accordingly to the degree of compromising. The indicators proposed in the analyzed studies for assessing the lower limbs of people with diabetes *mellitus* consist of: the color of feet 10 seconds after raising the lower limbs 30 cm high, pedal pulse, tibial pulse, edema, varicose veins, sensitivity (neuropathic symptoms) and plantar pressure.

After the indicator analysis in accordance with the assessment capacity in many different contexts and specificities, a scale was developed containing the 13 indicators suggested by the NOC and other seven indicators derived from suggestions found in the literature.

When considering cultural characteristics, understanding capacity and the services employed in the literature, the authors decided to replace the term "sensation", which was formerly suggested by the NOC, with "sensitivity", provided that this word has a broader meaning comprising the reaction property of bodies to external and internal stimuli, not restricted to the impression caused by only one external factor.[4] In this regard, it was necessary to add to the group of indicators a parameter which would ensure the assessment of sensitive alterations, with the identification of neuropathic symptoms, provided that such characteristic was pointed out as essential in several studies.[1]

In addition, in order to simplify understanding during the feet assessment process, it was decided to refer to synonyms or words similar to some terms used in the scale; this is the case of the word "hirsutism", which in the instrument appears attached to the term "hair growth". The words "elasticity" and "skin integrity" are also presented in the literature as "turgor" or "peeling skin syndrome" (which is understood as any skin breakdown), respectively. Thus, analogous terms appear together in the scale, implying similarity.

The indicators proposed both by the NOC and the consulted literature composed five groups in accordance with the characteristics to be assessed. The group related to skin and its annexes covers the following issues: tissue injury (a wound on cutaneous tissue), hair growth on skin/hirsutism, elasticity/turgor, hydration, perspiration, texture, thickness, and color, color 10 seconds after raising 30 cm high, pigmentation and skin integrity. Blood circulation comprises: tissue perfusion, pedal pulse, tibial pulse, edema and varicose veins. In order to assess the sensitivity, it is necessary to apply the neuropathic symptoms score and proceed with the Semmes Weinstein Monofilament Testing. The temperature indicator can be measured through medical thermography or surface thermometer.

In the case of plantar pressure, it may be analyzed by means of an instrument named Baropodometer. This instrument consists of a pressure-sensitive platform connected to a computer with an appropriate software to visualize color images and statistical data. Baropodometry is a method to analyze foot pressure with high diagnostic value, and the procedure is performed with the individual in the orthostatic position, walking and standing.[1]

The final version of the assessment instrument consists of twenty indicators, among which eleven characterize the conditions of skin and feet annexes, five refer to blood circulation, two characterize sensitivity, one refers to temperature and one characterizes plantar pressure. All indicators are classified in accordance with feet conditions, in a 5-point Likert scale, as proposed by the NOC, as follows: (1) extremely compromised; (2) significantly com-

promised; (3) moderately compromised; (4) mildly compromised, and; (5) not compromised.[5]

Once the modifications required were applied and literature basis was set, the order of presentation of the indicators was adjusted aiming at organizing and systematizing the procedure for assessment of the feet.

Assessment by expert nurses

A group of seven judges took part in this phase, namely six nursing professors expert in complications related to diabetes mellitus, physical examination methods and researches involving nursing care systematization; and one stoma therapist nurse expert in prevention and treatment of diabetic foot.

By proceeding with scale refinement, the high level of agreement among the evaluators became evident. There was no controversy with regard to appearance and relevance, with 100% acceptance. Among 20 items, only one presented disagreement concerning the understanding level, only reaching 94.12% acceptance.

Only two evaluators deemed necessary to reassess the method proposed in the item "varicose veins" provided that, according to them, the terms "limb" and "legs" may raise doubts regarding the anatomical differentiation. In this case, it was decided to use the term "legs" when referring only to the part of lower limbs between knees and ankles, and the term "limb" when referring to all the lengths of thigh, leg and foot.

In general, there was 98.32% agreement as compared to the total of assessment performed. By applying the Kappa test, K values varied from 0.98 to 1.00, which confers an excellent level of acceptance.

Discussion

As of the 1990's, the development of instruments to assess outcomes related to the care provided by nursing team began; and since then, researches have targeted to test the reliability and validity of such measurements.

Within this context, nursing expected outcomes have emerged encompassing patients' behaviors and reactions toward the care provided.[5] This assessment model constituted the scale proposed for assessment of the feet of patients with diabetes mellitus aiming at identifying parameters which would gauge the feet condition.

The suggestions provided by expert professionals during the validation process should be analyzed and considered by a researcher in order to contribute to strengthen and improve the study. The nurses acting as judges, by assessing a certain item and proposing modifications in the instrument, assist this methodology consolidation within the nursing field, as well as contribute to identify gaps; which promote proposals of new researches in the scientific literature.

Regarding the presence of tissue injury, it is possible to identify the extensive destruction of the tissue through the presence of wounds; tissue with total skin involvement, or epidermis (breakdown); epidermis without tissue loss (presence of blisters) or intact tissue, with no alterations.[6]

Hirsutism may be assessed through inspection with particular regard to the presence of areas with scarcity or total loss of hair. In order to analyze the elasticity, it is necessary to pinch a skinfold and observe its return. The degree of hydration may be measured in accordance with the presence of dryness, whether with burning or itching, cracks or peeling. Perspiration is analyzed accordingly to the degree of humidity perceptible in the limbs. As to the skin texture, it may be wrinkled, rough, thin and rough, thin and smooth or soft to the touch.[3,7] The analysis of tissue thickness includes: apparent hypertrophy, hypertrophy only when pinching the skin, apparent atrophy, atrophy when pinching the skin or eutrophy.

It is recommended to assess the color of the feet in two stages: first proceeding with an inspection paying attention to the presence of paleness and cyanosis; later, raising the feet 30 cm high for 10 seconds and reassessing their color to check the presence of alterations.[1,8] When the skin of the feet presents macules, whether light-brown, brownish blue, ground color or even purple pigmentation, it is considered the presence of tissue integrity involvement.[3] In order to assess skin

integrity, the presence of peeling, cracks, chips or scales is also observed.

Tissue perfusion is an effective indicator for assessing blood circulation, and this is performed by compressing the tissue and observing the time required for vascular filling.[5] Pedal and tibial pulses should be palpated aiming at verifying the perception, as well as the reduction of both.[3,5,8-10] Godet sign (pitting), characterizing the presence of edema, should be assessed concerning its depth.[4,11-13] The presence of varicose veins, whether in only one of the limbs or both, represents an aggravating factor to condition of the feet of patients with diabetes *mellitus*.[6,7,11]

The score of neuropathic symptoms allows to assess the pain arising from peripheral neuropathy. Along with examinations which assess the tactile sensation of the lower limbs, such as 10-g Semmes Weinstein monofilament, the scale becomes an effective instrument for detecting sensitivity compromising.[14-17]

To be considered normal, the temperature of the feet should be between 36ºC and 38ºC in adults, and 35ºC and 37ºC in elderly people.[3] By assessing the temperature of specific points of the feet, it is recommended to use a surface thermometer or even medical thermography, which allows verifying, both through numbers and photographs, areas with decreased or increased heat.[14]

Plantar pressure, whether dynamic or static, is measured through Baropodometry, which allows detecting altered pressure points.[18,19] Areas with maximum pressure equals to or higher than 89.22 Kg/cm² are considered susceptible to developing ulcers.[17]

At the end of the assessment, it is possible to consider each indicator of the scale in accordance with its degree of compromising. Aiming at verifying the feet compromising score, it was deemed necessary to add to the scale the mark achieved by the sum of indicators score. In case the final score is between 20 and 35, tissue integrity of the feet is extremely compromised; from 36 to 51, significantly compromised; from 52 to 66, moderately compromised; from 67 to 84, mildly compromised, and when the mark achieved is equals to or higher than 85, it is not compromised. By summing up scores or assessing each indicator individually, it is possible to monitor the effect of the care provided by the nursing team, whether in prevention, treatment or recovery of the feet of patients with diabetes *mellitus*.

Conclusion

The instrument proposed to assess tissue integrity of the feet of patients with diabetes *mellitus* was constructed and validated by expert nurses with a high level of acceptance.

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Collaborations

Silva NCM, Chaves ECL, Iunes DH and Carvalho EC have contributed to the research concept, development and interpretation of data. They collaborated in writing the article, with the relevant critical review of its intellectual content, and the approval of the final version to be published.

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