DOI 10.18471/rbe.v33.28790

BODY COMPOSITION AND PRESSURE ULCER OCCURRENCE: AN INTEGRATIVE REVIEW

COMPOSIÇÃO CORPORAL E OCORRÊNCIA DE LESÃO POR PRESSÃO: REVISÃO INTEGRATIVA

COMPOSICIÓN CORPORAL Y OCURRENCIA DE LESIÓN POR PRESIÓN: REVISIÓN INTEGRADORA

Jéssica Gomes da Silva[1]
Karoline Faria de Oliveira[2]
Maria Beatriz Guimarães Ferreira[3]
Flávia Ana Pacheco[4]
Isadora Braga Calegari[4]
Maria Helena Barbosa[5]

How to cite this article: Silva JG, Oliveira KF, Ferreira MBG, Pacheco FA, Calegari IB, Barbosa MH. Body composition and pressure injury occurrence: an integrative review. Rev baiana enferm. 2019;33:e28790.

Objective: to analyze the relationship between body composition and interface pressure distribution under bony prominences and the occurrence of pressure injury. Method: this is an integrative literature review conducted in the PubMed, CINAHL, Lilacs, Embase®, Scopus, and Web of Science databases, published between 1990 and July 2018. Results: nine studies were selected and classified into two thematic categories. The first category addressed the relationship of pressure injury with nutritional classification and the second the relationship of body composition with interface pressure. The risk of pressure injury was related to the decrease in lean body mass, body water content and extreme body mass index; besides higher incidence in institutionalized elderly with fat mass reduction. Conclusion: there was a relationship between body composition and the occurrence of pressure injury, showing differences between adults and the elderly.

Descriptors: Body Composition. Electrical Impedance. Pressure Ulcer. Patient Positioning. Patient Safety.

Objetivo: analisar a relação entre a composição corporal com a distribuição de pressão de interface sob proeminências ósseas e a ocorrência de lesão por pressão. Método: revisão integrativa da literatura realizada nas bases de dados PubMed, CINAHL, Lilacs, Embase®, Scopus e Web of Science, publicados entre 1990 e julho de 2018. Resultados: foram selecionados nove estudos e classificados em duas categorias temáticas. A primeira categoria abordou a relação da lesão por pressão com classificação nutricional e a segunda a relação da composição corporal com a pressão de interface. O risco de lesão por pressão esteve relacionado à diminuição da massa magra, da quantidade de água corporal e ao índice de massa corporal extremo; além de maior incidência em idosos institucionalizados com redução de massa gorda. Conclusão: houve relação da composição corporal com a ocorrência de lesão por pressão, apresentando divergências entre adultos e idosos.

Descritores: Composição Corporal. Impedância Elétrica. Lesão por Pressão. Posicionamento do Paciente. Segurança do Paciente.

[1] Nurse. Independent Researcher. Uberaba, Minas Gerais, Brazil.
[2] Nurse. PhD in Health Care. Nurse, Institute of Health Sciences, Federal University of Triângulo Mineiro. Uberaba, Minas Gerais, Brazil.
[3] Nurse. PhD in Sciences. Adjunct Professor at the Federal University of Uberlândia. Uberaba, Minas Gerais, Brazil.
[4] Nurse. Federal University of Triângulo Mineiro. Uberaba, Minas Gerais, Brazil.
[5] Nurse. PhD in Adult Health Nursing. Associate Professor. Federal University of Triângulo Mineiro. Uberaba, Minas Gerais, Brazil. mhelena331@hotmail.com

Objetivo: analizar la relación entre la composición corporal con la distribución de presión de interface debajo de prominencias óseas y la ocurrencia de lesión por presión. Método: revisión integradora de la literatura realizada en las bases de datos PubMed, CINAHL, Lilacs, Embase®, Scopus e Web of Science, publicados entre 1990 y julio de 2018. Resultados: se seleccionaron nueve estudios y se clasificaron en dos categorías temáticas. La primera categoría abordó la relación de la lesión por presión con clasificación nutricional y la segunda, la relación de la composición corporal con la presión de interface. El riesgo de lesión por presión estuvo relacionado a la disminución de la masa magra, de la cantidad de agua corporal y al índice de masa corporal extremo; además de mayor incidencia en ancianos institucionalizados con reducción de masa grasa. Conclusión: hubo relación de la composición corporal con la ocurrencia de lesión por presión, presentando divergencias entre adultos y ancianos.

Descriptores: Composición Corporal. Impedancia Eléctrica. Lesión por Presión. Posicionamiento del Paciente. Seguridad del Paciente.

Introduction

Despite the wide availability of technological resources for the prevention of pressure ulcers (PU), such as the use of support surfaces[1], the occurrence of this type of injury is still considered a high incidence problem related to health care[2]. This incidence is directly associated with the quality of care, patient safety, length of stay, and hospital costs[3-4].

Among the risk factors for the development of PU, nutritional aspects are described as indirect causal factors[5]. Extreme nutritional classifications, such as thinness or obesity, are considered risk factors for the occurrence of PU. The first one, by increasing the exposure of the patient's bony prominences, by reducing the contact areas exposed to interface pressure. The second one, because it potentiates complications arising from the positioning[6-7].

Body mass index (BMI) is the indicator, it used to perform the nutritional classification of thinness and obesity. However, other indicators of body composition, such as the ratio of lean mass, fat mass, and body water, could be used to determine the influence on the occurrence of lesions, as they may modify the exposure of bone prominence according to the type of tissue to which this extremity is exposed.

Given the above, the aim of the present study was to analyze the relationship between body composition and the distribution of interface pressure under bony prominences and the occurrence of pressure ulcer, thus verifying whether this relationship will provide support so nurses can identify patients at higher risk of PU and elaborate a care plan based on the incorporation of research results into clinical practice.

Method

This is an integrative literature review, performed through the following steps: the establishment of the research question, the sampling or literature search of primary studies, the data extraction, the study evaluation and the inclusion in the review, analysis, and interpretation of results, and the synthesis of knowledge[8]. The guiding questions of the integrative review were: What evidence is available regarding the association of the occurrence of pressure ulcer with body composition? Is there a relationship between body composition and the redistribution of interface pressure exerted on bony prominences?

To survey the studies, the following databases were used: US National Library of Medicine (Pubmed), Cumulative Index to Nursing and Allied Health Literature (Cinahl), *Literatura Latino Americana e do Caribe em Ciências da Saúde* (Lilacs), *Excerpta Medica dataBASE* (Embase®), Scopus Elsevier and Web of Science. For the definition of the databases, it was considered the quantitative indexation of health articles, bases that include primary and thematic studies related to nursing.

The selection of the descriptors occurred according to the search tools of the respective

primary databases, using terms from the Medical Subject Headings (Mesh), for search on the bases PubMed, Embase®, Web of Science and Scopus; terms from Health Sciences Descriptors (*Descritores em Ciências da Saúde* – DeCS), for the Lilacs database; and terms from Cinahl Headings, for the Cinahl database. The descriptors used – body composition, pressure ulcer, patient positioning, decubitus – were analyzed separately and with the aid of the Boolean operator "AND". It is noteworthy that not all were used in all bases due to divergence of nomenclature between them. The descriptors were grouped into two or three terms so that the search strategy was sensitized and did not underestimate the expected results. The search strategy that allowed the identification of primary studies included in the review is presented in Chart 1.

Chart 1 – Search strategy achieved that allowed the identification of primary studies in the integrative review

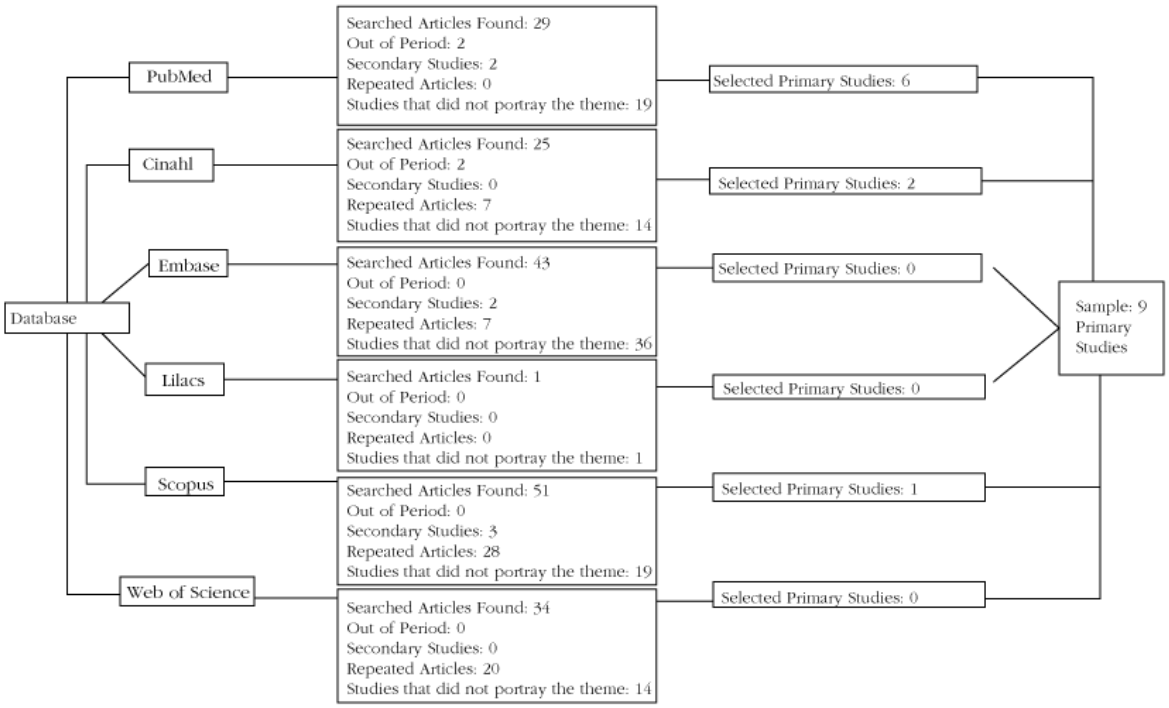
Database	Search Strategy		
	Pressure Ulcer / Decubitus AND Body Composition	**Pressure Ulcer / Decubitus AND Patient Positioning**	**Pressure Ulcer / Decubitus AND Body Composition AND Patient Positioning**
PubMed	6	0	0
Cinahl	2	0	0
Lilacs	0	0	0
Scopus	1	0	0
Web of Science	0	0	0
EmBase	0	0	0

Source: Created by the authors.

To include the articles, the following criteria were considered: studies that portrayed the theme, answering the guiding questions; published between 1990 and July 2018; and presented in full in Portuguese, English or Spanish. The papers found were classified in relation to the evidence hierarchy according to the Intervention Evidence / Treatment Questions Hierarchy Classification System[9]. Articles that did not address the relationship of body composition or interface pressure with the occurrence of PU were excluded, as well as editorial, response letter, literature review studies / traditional review, review methods and those that presented inconsistencies in the proposed methodology.

A total of 183 documents were identified in the six databases investigated. The selection of articles was guided by the Key Items for Reporting Systematic Reviews and Meta-Analysis (PRISMA) guidelines, as presented in Figure 1. The first selection of articles was performed by reading the title and abstract. According to the selection criteria of the integrative review, nine studies were selected. The order of the databases analyzed was PubMed, Lilacs, Embase®, Cinahl, Scopus and Web of Science. The order of exclusions had the following criteria: repeated article, outside the established years, outside the established languages, outside the theme, and literature review articles.

Figure 1 – Flow of selection of review articles according to PRISMA guidelines



Source: Created by the authors.

Data extraction from the selected primary studies was performed using an adapted and validated data collection instrument[10]. Such instrument includes the identification of the article, year and place of study, methodological characteristics, evaluation of methodological rigor, evidence level, main results, and discussions related to the investigated question.

Three researchers independently synthesized the results in this study. When there was no consistency of the synthesized results, a discussion was held between the investigators until a consensus was reached. The extracted information was tabulated for data synthesis.

The evaluation of the selected types of studies was based on the concepts of scientific methodology scholars[11], which classify them into two methodological approaches: quantitative and qualitative. The studies found were classified according to the hierarchy of evidence[9]. The level of evidence was not considered as an exclusion criterion due to the existence of few studies with better evidence and the heterogeneity of the designs.

The analysis of the results was made descriptively so that a synthesis of each of the primary studies included in the present review was presented.

Results

Of the nine articles included in the review, eight were published in English and one in Spanish. Regarding the journals, two were related to nutritional aspects, two to mechanical and rehabilitation principles, another three focused on gerontology, and only one was specific for chronic and acute wounds. Only one study came from a Brazilian journal: Revista Brasileira de Geriatria e Gerontologia (Brazilian Journal of Geriatrics and Gerontology).

The studies were classified according to the hierarchy of scientific evidence: 4 (44.44%) were classified as level of evidence 3; 2 (22.22%) as

the level of evidence 4; and 3 (33.33%) as the level of evidence 6. All studies were classified as quantitative.

The population evaluated in the studies totaled 805 participants, including adult and elderly patients, with or without injury, and healthy volunteers.

The included primary studies were classified into two thematic categories, which addressed the relationship of PU with nutritional classification (category 1) and interface pressure (category 2). Studies 1 to 5 and study 7 were grouped into the first category; studies 6, 8 and 9 into the second category. Following, a summary of each of the articles included in the review is presented in detail.

Study 1 was conducted in Italy and aimed to investigate the nutritional status, body composition and energy metabolism in 52 institutionalized elderly women divided into two groups, namely: 23 elderly women with advanced PU and 29 without injury. They also identified possible hypermetabolic conditions and their relationship to the area and lesion volume. Patients were evaluated for BMI, fat-free mass, fat mass, resting energy expenditure, and PU area and volume. These were evaluated, respectively, in centimeters and by saline injection, which was measured by their amount. The results showed that BMI and amounts of fat and fat-free mass were similar in both groups; however, patients with PU had higher energy expenditure. When the groups were compared, the injured patients had no reduction in fat-free mass but presented protein deficiency[12].

In order to determine the causes and possible risk factors that predispose to PU, study 2 was conducted in Portugal with 40 institutionalized elderly, of which 12 had PU and 28 did not. For this, body composition, laboratory data, nutritional status, and comorbidities were evaluated. The results showed that, in the body composition analysis, the group without lesion presented lower values of body fat and higher serum albumin. There was a statistically significant difference (p=0.05) between the groups for body hydration, and it was greater in patients without PU[13].

The third study was conducted in Switzerland with 32 elderly patients from a geriatric hospital after ten days of hospitalization and classified with low risk for developing the lesion. Viscoelasticity and skin hydration in different areas prone to PU was investigated by correlating these data with measurements taken on the forearm. Patients were evaluated for the following characteristics: viscoelastic properties of the skin and hydration of the inner forearm, sacrum, and trochanter; body composition by BMI and bioelectrical impedance; laboratory parameters with fasting blood collection; risk for development of PU by the Braden Scale; and nutrition by the Mini Nutritional Assessment Questionnaire. The results showed that women and men did not differ in age, BMI, nutritional score, laboratory parameters, and Braden. However, men had higher total body water and lean mass, as well as lower fat mass. As for viscoelastic properties, skin elasticity differed by location. Overall elasticity in both women and men was higher in the trochanter, sacrum, and forearm. Pure or biological elasticity or viscoelasticity of the skin did not differ for both sexes. By correlating the biophysical properties of the skin at different body sites, there was no association with skin hydration; however, the overall elasticity of the forearm correlated significantly with the trochanter and sacrum elasticity measurements. This pilot study showed that age-related changes in mechanical properties – such as reduced skin elasticity and turgor – are a risk factor for the development of superficial pressure injuries[14].

The authors of the fourth study hypothesized that body fat could prevent risks related to malnutrition and morbidity and mortality. Thus, they aimed to evaluate the relationship between body composition and morbidity and mortality in hospitalized elderly. To this end, they established the relationship between fat mass and morbidity and mortality, considering as complications the PU and infections (pneumonia, urinary tract infection, except cystitis, septicemia, erysipelas, enteritis, infectious arthritis, and parotitis). The reason for this is due to the fact that these are complications related to hospital malnutrition,

prevalent in hospitalized elderly and contributing to high morbidity and mortality rates. The study was conducted in France and 125 elderly participants were evaluated for nutritional status (weight, BMI, and body composition), albuminemia, and C-reactive protein. These patients were evaluated at admission and followed for six months to identify possible complications using a technique that the authors consider the gold standard: dual-energy x-ray absorptiometry and bioelectrical impedance analysis (BIA). During the six-month follow-up, 31 (25%) patients had infectious complications, PU, or both. Eleven patients (9%) developed these lesions and two of these were associated with infectious complications. Fourteen patients had totally impaired mobility at the time of admission. Among these, 3 (21%) evolved with PU. However, the risk of developing these lesions was not significantly increased in cases of immobility. In addition, fat mass indexes did not differ between immobile patients and those without mobility impairment. Patients were stratified into three categories according to fat mass index: below the 30th percentile, between 30 and 70, and above the 70th percentile. The risk of death (OR=0.30; p=0.049) and the risk of death or complications (OR=0.25; p=0.02) were significantly lower for patients with a fat mass index above the 70th percentile. The study found that fat mass was associated with a decreased risk of adverse events, including pressure injuries. It should be noted that, in fact, obesity is a risk factor for adults and that the study results only apply to hospitalized elderly people[15].

In order to prevent malnutrition, study 5 was conducted in Germany to identify a screening tool to determine nutritional status. For this, for 8 months, 484 elderly with various diseases in subacute conditions were selected after 48 hours of hospitalization in a German geriatric institution. Patients were evaluated in different aspects: PU according to the staging of the European Pressure Ulcer Advisory Panel (EPUAP); risk for developing PU by the Norton scale; nutritional status by Mini Nutritional Assessment; anthropometric measurements and body composition analysis by bioelectrical impedance. The results showed that patients with PU had significantly longer hospital stays than those who did not ($p < 0.001$). The prevalence of PU was 16.7% and the average risk of developing PU, according to the Norton scale, was 20 points, classified as moderate risk. From the Mini Nutritional Assessment, the nutritional status of patients with PU was significantly lower when compared to patients without lesions. In addition, nutritional status did not influence the body composition of patients with PU. Fat mass, total body water, and cell mass decreased significantly in PU patients; thus, cell mass was reduced by about 20% in injured patients. There was also a significant correlation between the risk of developing PU and body cell mass. The Mini Nutritional Assessment instrument has been used as a screening and evaluation tool and is easily applied to determine the nutritional status of geriatric patients with PU at hospital admission[16].

With the intention of evaluating the correlation between seat interface pressure and body composition factors of weight, BMI, skeletal muscle and body water, study 6, conducted in Korea, investigated the effects of airbag type and several seat postures on seat interface pressure changes. For this, the results among a group of 20 patients with spinal cord injury were compared with another 20 patients without musculoskeletal or nerve injuries. To compare body composition between control and injured groups, and total and segmented skeletal muscle mass, weight, BMI, and total and segmented body water were evaluated. Seat interface pressure was measured in four situations, namely: no cushion, low-cost cushion, and 5 cm and 10 cm air cushions. In addition, the pressure was measured in three positions: erect, posterior inclined at 20º and forward flexion at 20º for 10 seconds in each position. The total and lower limb muscle masses in the control group were significantly higher when compared to the injured group; however, the trunk muscle mass was similar. Body fat was significantly higher in the injured group, but lower limb body water was higher for the control group. Bodyweight, BMI and trunk body water were not statistically different. All body mass composition

variables did not show significant correlations with interface pressure in either group. All three types of cushion showed a significant reduction in seat interface pressure. The measurement of the three different positions, with and without air cushion, showed no statistically significant pressure difference between the postures. Thus, the study concluded that body mass composition had no direct effect on seat interface pressure for either group. It should be emphasized that the reduction of musculoskeletal mass and water inherent to spinal cord injury patients have influence on the occurrence of PU[17].

Study 7 was conducted in the United States and was designed to determine whether bioelectrical impedance (BIA) could measure local tissue characteristics, which would lead to the identification of patients at risk for developing PU. In addition to BIA, tissue biopsy was performed in groups of individuals classified as high risk for developing PU (n=10), according to the Braden scale, and in healthy individuals (n=10), which represented the control group. The total BIA analysis showed no significant difference between groups. However, segment analysis showed significantly lower mean reactance, resistance and phase angle in the high-risk group compared to the control group ($p<0.01$, $p<0.01$, $p<0.05$, respectively). Dermopathological differences could not be determined because biopsies were discontinued due to the risk associated with the procedure. Regarding the multiple linear regression analysis, local trochanteric tissue reactance was the indicator most related to the high risk of developing PU[18].

The quasi-experimental design research 8 was conducted in the United Kingdom and aimed to propose a mathematical model to predict the risk of PU formation by combining Waterlow's risk assessment and physiological parameters (age, weight, and height). The convenience sample consisted of 11 adult individuals with a BMI of 25.04 ± 3.01 kg/m^2. The interface pressure of the heel, sacral and elbow bone prominences with the individual in horizontal decubitus was evaluated under relaxing conditions. The pressure of each area was verified by four flex force sensors (model A201) in each region evaluated, besides age, weight, height, and BMI. The mathematical model was created using scores for each evaluated criterion and it allows users to define surface property along with the individual's physiological parameters. It was evidenced, in different age groups and bone prominences, because the percentage of risk for PU formation is higher for extreme BMI and is lower for eutrophic individuals. In addition, the risk was higher in the sacral region compared to the elbow and heel regions. Regarding the interface pressure analyzed on viscoelastic polymer, there was an increase in the interface pressure as the BMI increased, except for the 35-year age group, which presented higher interface pressure in eutrophic in relation to overweight. When comparing age groups for the same nutritional classification, a heterogeneous behavior of interface pressure was observed, in which the interface pressure values differed for the same BMI[19].

The aim of study 9, carried out in France, was to analyze the sensitivity to softness stiffness of the buttocks using the finite element model in the sitting position. The model was built based on the segmentation of a computed tomography, which provided the surfaces of the skin, muscles, and bones. These evaluations showed that the skin layer had little influence on the maximal strains. This is probably due to the fact that such a layer is very thin and quite rigid. On the other hand, due to the great thickness and inferior stiffness, the fat and muscle layers had much more influence. Sensitivity analysis showed that the maximum Von Mises (VM) strain measurements are located mainly below the sciatic tuberosity in the fat layer near the muscle/fat interface. This tissue will, therefore, be predisposed to more PU. Maximum MV strain measurements occasionally appear within the muscle layer near the bone/muscle interface, but

only when Young's modulus of muscles is similar to Young's modulus of fat, which is probably the case for paraplegics or older people[20].

Charts 2 and 3 below present the characterization of the articles in objectives, research design, number of subjects involved, description of the main results, and conclusions.

Chart 2 – Summary of articles selected in research by title (year), objectives, design, and patients number

Title (Year)	Objectives	Design / number of patients
1. Resting energy expenditure and body composition in bedridden institutionalized elderly women with advanced-stage pressure sores[13] (2007)	To investigate nutritional status, body composition and energy metabolism in institutionalized elderly women with and without injury.	Quantitative, descriptive, comparative study / 52 elderly (23 with advanced PU and 29 without injury).
2. Mini nutritional assessment and screening scores are associated with nutritional indicators in elderly people with pressure ulcers[14] (2008)	Determine the causes and risk factors that predispose PU.	Descriptive study / 40 patients (12 with PU and 28 without injury).
3. Assessment of biophysical skin properties at different body sites in hospitalized old patients: results of a pilot study[15] (2012)	Investigate whether viscoelasticity, hydration or friction differ among areas important for the risk of developing PU.	Pilot, descriptive, comparative study / 32 elderly (14 men and 18 women) without injuries and at low risk for developing PU.
4. Fat mass protects hospitalized elderly persons against morbidity and mortality[16] (2009)	To evaluate the relationship between body composition and morbidity and mortality in hospitalized elderly.	Descriptive follow-up / 125 elderly followed up for six months.
5. Nutrition status and pressure ulcer: what we need for nutrition screening[17] (2007)	Compare different screening tools to assess nutritional status.	Descriptive / 484 elderly with various diseases in subacute conditions.
6. The Effects of Body Mass Composition and Cushion Type on Seat-Interface Pressure in Spinal Cord Injured Patients[18] (2015)	Investigate the effects of body mass and cushion type composition on seat interface pressure in patients with and without spinal cord injury.	Quasi-experimental / 40 patients (20 spinal cord injured and 20 healthy).
7. Bioelectrical impedance as a discriminator of pressure ulcer risk[19] (1996)	Identify objective tissue structure and function characteristics associated with the risk of PU.	Experimental Laboratory / 20 patients (10 at high risk for PU and 10 healthy volunteers).
8. Modeling of pressure ulcer (PU) risk prediction system[20] (2015)	Develop a mathematical model to predict the risk of developing PU.	Quasi-experimental / 11 volunteers.
9. Biomechanical modeling to prevent ischial pressure ulcers[21] (2014)	To analyze the soft tissue stiffness sensitivity of the buttocks using the seated finite element model.	Experimental Lab/tomography of a healthy young male.

Source: Created by the authors.

Chart 3 – Summary of articles selected in the search, by description and outcomes

Title (Year)	Description	Outcomes
1. Resting energy expenditure and body composition in bedridden institutionalized elderly women with advanced-stage pressure sores[13] (2007)	Biochemical analysis, BMI, fat-free mass, fat mass, resting energy expenditure, and PU area and volume were evaluated.	BMI, lean mass and fat mass were similar between both groups. PU patients had higher energy expenditure and protein deficiency.
2. Mini nutritional assessment and screening scores are associated with nutritional indicators in elderly people with pressure ulcers[14] (2008)	Body composition assessment, laboratory data, nutritional status, and comorbidities.	Patients without injury presented lower values of body fat and higher serum albumin and body hydration.
3. Assessment of biophysical skin properties at different body sites in hospitalized old patients: results of a pilot study[15] (2012)	Viscoelastic properties of skin and hydration, body composition, laboratory analysis, the risk for development of PU and nutritional status were determined.	Men had higher total body water and lean mass, as well as lower fat mass. Age-related reduction of skin elasticity and turgor is a risk factor for developing PU.
4. Fat mass protects hospitalized elderly persons against morbidity and mortality[16] (2009)	Body composition, albuminemia, C-reactive protein, and development of complications (PU and infections) were evaluated.	The risk of death or complications was lower for patients with a fat mass index above the 70th percentile. Fat mass was associated with decreased risk for PU.
5. Nutrition status and pressure ulcer: what we need for nutrition screening[17] (2007)	Assessment of nutritional status, bioelectrical impedance, daily living activities, risk and staging of PU.	Patients with PU had longer hospitalization, lower nutritional status and decreased fat mass, total body water, and cell mass. Mini Nutritional Assessment can determine the nutritional status of elderly with PU.
6. The Effects of Body Mass Composition and Cushion Type on Seat-Interface Pressure in Spinal Cord Injured Patients[18] (2015)	Body composition and interface pressure were evaluated.	Body mass composition had no direct effect on seat interface pressure for either group.
7. Bioelectrical impedance as a discriminator of pressure ulcer risk[19] (1996)	Bioelectrical impedance analysis and tissue biopsy.	Bioelectrical impedance values by segments were related to PU risk, especially the trochanteric region. Tissue biopsies did not differ between groups.
8. Modeling of pressure ulcer (PU) risk prediction system[20] (2015)	Measurement of interface pressure of bony prominences (heel, sacrum, and elbow), as well as assessments of age, weight, height, and BMI.	The risk for PU was higher for extreme BMIs and in the sacral region. Interface pressure increased as BMI increased, except for the 35-year age group. The model allows defining the surface property with the physiological parameters of the individual.
9. Biomechanical modeling to prevent ischial pressure ulcers[21] (2014)	Creation of finite element mesh based on tomography of a young adult male. The effects of interface pressure on three different postures were evaluated.	Fat and muscle layer have a major influence on the strain variations generated by stress, while the skin is less influential. Simulation of different seat postures with changes in muscle layer thickness resulted in variations in internal tensions.

Source: Created by the authors.

Discussion

The primary studies included in the first category highlighted specific aspects regarding nutritional status and development of pressure injuries. Nutritional therapy with high protein and immunomodulatory nutrient content is recommended for the treatment of PU. National Pressure Ulcer Advisory Panel (NPUAP) recommends 1.2 to 2 g of protein per kilogram of patient body weight[21].

A controlled study of 23 patients with stage II, III, or IV PU showed that the use of specialized amino acid protein supplementation improved lesion tissue viability after two weeks for the group of patients under treatment (n=11), although differences were not evidenced in lesion size reduction for both treatment and control groups[22].

On the other hand, another study involving 200 malnourished adults with stage II, III and IV PU showed that supplementation with the protein-enriched formula for the treatment group (n=101) resulted in a greater reduction in the area of PU and its use for eight weeks improved wound healing[23].

Primary studies included in the first category investigated the relationship between PU and body composition. It is noteworthy that most studies were conducted with elderly patients. For this age group, two studies showed a protective relationship against PU and the amount of fat mass[15-16]. In addition, reduced body water was related to increased PU risk[13-14,16].

A study conducted with elderly people with and without PU showed that there was no divergence in the body composition of the groups. However, there was a change in serum protein levels[12], which in the long run could interfere with the loss of cell mass and, consequently, the muscle mass of elderly patients with PU. As hospitalization progresses, a study found a 20% loss of cell mass in elderly patients with PU.

BMI was considered as a risk assessment parameter for PU in the quasi-experimental study, in which a mathematical model for the determination of PU risk was developed[19].

Research that has evaluated best practices for the prevention of PU in surgical patients considers that a risk determining the criterion for PU is BMI <19 or >40 kg/m^2. BMI is important for choosing perioperative positioning and choosing the support surface to be used. Most support surfaces provide pressure redistribution in thin patients, but may not be effective for obese patients[24].

In the other studies presented in this review, despite finding a relationship between body composition and the occurrence or risk of PU, BMI was not a factor to be considered.

The study that aimed at revealing consistent risk factors that may contribute to the development of PU in patients undergoing surgical procedures was developed with two groups, one of which presented PU in the first week after the procedure and the other did not. The mean BMI was 29.6 kg/m^2 in the PU group, while in the group without PU it was 31.8 kg/m^2[7].

A longitudinal study conducted in northern Italy, which evaluated the incidence of PU and associated risk factors in surgical patients, found no association between the presence of PU and BMI values[25].

A prospective cohort study that identified the prevalence and risk factors associated with the development of PU in patients undergoing surgical procedures lasting longer than three hours showed a higher incidence of PU in men compared to women. The authors considered that this finding may be related to the presence and distribution of adipose tissue that males have in smaller amounts in the sacral region[26]. This characteristic was observed in study 3, in which men presented a higher amount of lean mass and lower amount of fat mass[14].

Regarding category 2, it was observed that study 6[17] did not observe an interface pressure. However, study 8[19] showed a divergent behavior between the risk of PU for a group of individuals with the same BMI, which may suggest that the composition of lean mass, water, and fat interferes with this relationship.

Regarding the experimental study 9[20], different behaviors of the layers of fat and

muscle tissue were observed when exposed to mechanical stress. This behavior changed as the thickness of the muscle layer changed. Therefore, it can be assumed that the amount of lean mass and fat mass may have an influence on the action of stresses and, consequently, on the etiology of PU.

It is noteworthy the importance of nurses' knowledge regarding the risk factors associated to the etiology of PU, regardless of the patients' level of complexity, since they have a high prevalence not only in hospitals but also at home. A recent study identified the prevalence and characterized chronic wounds among the elderly assisted in primary care, obtaining a prevalence of 8%, of which 5% were PU, with a mean time of existence of three years[27]. These results deserve to be emphasized, since PU is a reality, even at home, which requires nurses to be able to implement preventive actions and provide safe and free care from adverse events.

As limitations of the research, the delimitation of the language in Portuguese, English, and Spanish is considered. This may lead to the exclusion of articles that would answer the guiding question, to the scarcity of studies that related body composition or interface pressure to the occurrence of pressure injury in adult individuals, and also to the heterogeneity of the designs of the included primary studies, a fact that did not allow comparisons between the results.

This review provides relevant evidence for the construction of knowledge about nurses' clinical practice, as it highlights body composition factors, as well as body mass index, which may influence the risk of pressure injury. The identification of patients at higher risk of developing pressure injury favors the elaboration of care plans based on the incorporation of scientific evidence into clinical practice and the decision-making process to provide safe and quality care.

Conclusion

Among the evidence found, it can be observed that most studies had a descriptive-analytical design. In these studies, the focus of the evaluation was the nutritional aspects of the elderly, including body composition and serum evaluations. These evaluations were performed in elderly with and without injury.

In these studies, the amount of body water was related to the occurrence of PU. Higher body fat was considered a protective factor for the occurrence of PU in elderly patients.

Three studies have evaluated interface pressure in relation to the occurrence or risk of PU. These studies had quasi-experimental or experimental laboratory designs. It was found that the amount of muscle mass and water interferes in the formation of PU. Moreover, in groups of individuals of varying ages, the same nutritional classification obtained heterogeneous interface pressures. Muscle layers present greater deformation when subjected to interface pressure near the muscle-bone interface.

It was concluded that there was a relationship between body composition and the occurrence of pressure injury, showing differences between adults and the elderly.

It is important to highlight the need to strengthen evidence-based nursing for quality of care and patient safety. Future studies on the subject of the present review with methodological rigor to prevent pressure injury and improve health care are suggested.

Collaborations:

1 – conception, design, analysis, and interpretation of data: Jéssica Gomes da Silva, Karoline Faria de Oliveira, Maria Beatriz Guimarães Ferreira, Flávia Ana Pacheco, Isadora Braga Calegari, and Maria Helena Barbosa;

2 – writing of the article and relevant critical review of intellectual content: Jéssica Gomes da Silva, Karoline Faria de Oliveira, Maria Beatriz Guimarães Ferreira, Flávia Ana Pacheco, Isadora Braga Calegari, and Maria Helena Barbosa;

3 – final approval of the version to be published: Jéssica Gomes da Silva, Karoline Faria de Oliveira, Maria Beatriz Guimarães Ferreira,

Flávia Ana Pacheco, Isadora Braga Calegari, and Maria Helena Barbosa.

References

1. McInnes E, Jammali-Blasi A, Bell-Syer SEM, Dumville JC, Middleton V, Cullum N. Support surfaces for pressure ulcer prevention. Cochrane Database Syst Rev. 2015;3(9):CD001735. doi: 10.1002/14651858.CD001735.pub5

2. Scott SM. Creating a strategic plan for perioperative pressure ulcer prevention. AORN J. 2016 Apr;103(4):13-14.

3. Kwong EW, Hung MS, Woo K. Improvement of pressure ulcer prevention care in private for-profit residential care homes: an action research study. BMC Geriatr [Internet]. 2016 [cited 2017 Apr 17];16(1):192. Available from: https://www.ncbi.nlm.nih.gov/pubmed/27884131

4. Nguyen KH, Chaboyer W, Whitty JA. Pressure injury in Australian public hospitals a cost-of-illness study. Aust Health Rev [Internet]. 2015 May [cited 2017 May 14];39(3):329-36. Available from: https://www.ncbi.nlm.nih.gov/pubmed/25725696

5. Coleman S1, Nixon J, Keen J, Wilson L, McGinnis E, Dealey C, et al. A new pressure ulcer conceptual framework. J Adv Nurs [Internet]. 2014 Oct [cited 2017 Apr 12];70(10):2222-34. Available from: https://www.ncbi.nlm.nih.gov/pubmed/24684197

6. Association of periOperative Registered Nurses. Guideline for positioning the patient. In: Guidelines for Perioperative Practice. Colorado, EUA; 2017.

7. Engels D, Austin M, McNichol L, Fencl J. Pressure ulcers: factors contributing to their development in the OR. AORN J [Internet]. 2016 Mar [cited 2017 Apr 17];103(3):271-81. Available from: https://www.ncbi.nlm.nih.gov/pubmed/26924365

8. Mendes KDS, Silveira RCCP, Galvão CM. Integrative literature review: a research method to incorporate evidence in health care and nursing. Texto Contexto Enferm [Internet]. 2008 [cited 2017 May 12];17(4):758-64. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0104-07072008000400018

9. Melnyk BM, Fineout-Overholt E. Making the case for evidence-based practice. In: Melnyk BM, Fineout-Overholt E, editors. Evidence-based practice in nursing and healthcare: a guide to best practice. Philadelphia: Lippincott Williams and Wilkins; 2005. p. 3-24.

10. Ursi ES, Galvão CM. Perioperative prevention of skin injury: an integrative literature review. Rev Lat Am Enfermagem [Internet]. 2006 [cited 2017 Jun 10];14(1):124-31. Available from: http://www.scielo.br/scielo.php?script=sci_abstract&pid=S0104-11692006000100017&lng=en&nrm=iso&tlng=en

11. Politi DF, Beck CT. Fundamentos de pesquisa em enfermagem: avaliação de evidências para a prática de enfermagem. 7a ed. Porto Alegre: Artmed; 2016.

12. Sergi G, Coin A, Mulone S, Castegnaro E, Giantin V, Manzato E, et al. Resting energy expenditure and body composition in bedridden institutionalized elderly women with advanced-stage pressure sores. J Gerontol A Biol Sci Med Sci [Internet]. 2007 [cited 2017 Apr 17];62(3):317-22. Available from: https://www.ncbi.nlm.nih.gov/pubmed/17389730

13. Lobo A. Factores de riesgo en el desarrollo de úlceras de presión y sus implicaciones en la calidad de vida. Rev bras geriatr gerontol [Internet]. 2008 [cited 2017 Jun 10];11(3):405-18. Available from: http://www.scielo.br/scielo.php?pid=S1809-98232008000300405&script=sci_abstract&tlng

14. Fiedler M, Gerhardt LC, Derler S, Bischofberger G, Hürny C, Münzer T. Assessment of biophysical skin properties at different body sites in hospitalized old patients: results of a pilot study. Gerontology [Internet]. 2012 [cited 2017 Apr 17];58(6):513-7. Available from: https://www.ncbi.nlm.nih.gov/pubmed/22487874

15. Bouillanne O, Dupont-Belmont C, Hay P, Hamon-Vilcot B, Cynober L, Aussel C. Fat mass protects hospitalized elderly persons against morbidity and mortality. Am J Clin Nutr [Internet]. 2009 [cited 2017 May 12];90(3):505-10. Available from: https://www.ncbi.nlm.nih.gov/pubmed/19640947

16. Hengstermann S, Fischer A, Steinhagen-Thiessen E, Schulz RJ. Nutrition status and pressure ulcer: what we need for nutrition screening. JPEN J Parenter Enteral Nutr [Internet]. 2007 [cited 2017 Apr 17];31(4):288-94. Available from: https://www.ncbi.nlm.nih.gov/pubmed/17595437

17. Cho KH, Beom J, Yuk JH, Ahn SC. The Effects of Body Mass Composition and Cushion Type on Seat-Interface Pressure in Spinal Cord Injured Patients. Ann Rehabil Med [Internet]. 2015 [cited 2017 Apr 17];39(6):971-9. Available from: https://www.ncbi.nlm.nih.gov/pubmed/26798612

18. Wagner DR, Jeter KF, Tintle T, Martin MS, Long JM. Bioelectrical impedance as a discriminator of pressure ulcer risk. Adv in Wound Care [Internet]. 1996 [cited 2017 Jun 10];9(2):30-7. Available from: https://journals.lww.com/aswcjournal/Abstract/1996/09020/Bioelectrical_Impedance_as_a_Discriminator_of.7.aspx

19. Mishu MC, Schroeder JW. Modelling of pressure ulcer (PU) risk prediction system. Science and Information Conference. 2015 July:650-6. doi: 10.1109/SAI.2015.7237211

20. Luboz V, Petrizelli M, Bucki M, Diot B, Vuillerme N, Payan Y. Biomechanical modeling to prevent ischial pressure ulcers. J Biomech [Internet]. 2014 Jul [cited 2017 May 12];47(10):2231-6. Available from: https://www.ncbi.nlm.nih.gov/pubmed/24873863

21. National Pressure Ulcer Advisory Panel. European Pressure Ulcer Advisory Panel. Pan Pacific Pressure Injury Alliance. Prevention and Treatment of Pressure Ulcers: Quick Reference Guide. Haesler E, editor. Cambridge Media: Osborne Park, Western Australia; 2016.

22. Wong A, Chew A, Wang CM, Ong L, Zhang SH, Young S. The use of a specialised amino acid mixture for pressure ulcers: a placebo-controlled trial. J Wound Care [Internet]. 2014 May [cited 2017 Apr 17];23(5):259-60, 262-4, 266-9. Available from: https://www.ncbi.nlm.nih.gov/pubmed/24810310

23. Cereda E, Klersy C, Serioli M, Crespi A, D'Andrea F, OligoElement Sore Trial Study Group. A nutritional formula enriched with arginine, zinc, and antioxidants for the healing of pressure ulcers: a randomized trial. Ann Intern Med [Internet]. 2015 Feb [cited 2017 Jun 10];162(3):167-74. Available from: https://www.ncbi.nlm.nih.gov/pubmed/25643304

24. Cherry C, Moss J. Best practices for preventing hospital-acquired pressure ulcer injuries in surgical patients. Can Oper Room Nurs J [Internet]. 2011 Mar [cited 2017 May 12];29(1):6-26. Available from: https://www.ncbi.nlm.nih.gov/pubmed/21434513

25. Bulfone G, Marzoli I, Quattrin R, Fabbro C, Palese A. A longitudinal study of the incidence of pressure sores and the associated risks and strategies adopted in Italian operating theatres. J Perioper Pract [Internet]. 2012 Feb [cited 2017 Apr 17];22(2):50-6. Available from: https://www.ncbi.nlm.nih.gov/pubmed/22724304

26. Primiano M, Friend M, McClure C, Nardi S, Fix L, Schafer M, et al. Pressure ulcer prevalence and risk factors during prolonged surgical procedures. AORN J [Internet]. 2011 Dec [cited 2017 Apr 17];94(6):555-66. Available from: https://www.ncbi.nlm.nih.gov/pubmed/22118201

27. Vieira CPB, Furtado AS, Almeida PCD, Luz MHBA, Pereira AFM. Prevalência e caracterização de feridas crônicas em idosos assistidos na atenção básica. Rev baiana enferm [Internet]. 2017 [cited 2019 Jul 18];31(3):e17397. Available from: https://portalseer.ufba.br/index.php/enfermagem/article/view/17397

Received: December 2, 2018

Approved: August 20, 2019

Published: January 23, 2020