CLINICAL MANAGEMENT

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Characteristics of Chronic Wounds that Itch

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This continuing educational activity will expire for physicians on July 31, 2014.

PURPOSE:

To enhance the learner's competence with knowledge of characteristics of chronic wounds that itch.

TARGET AUDIENCE:

This continuing education activity is intended for physicians and nurses with an interest in skin and wound care.

OBJECTIVES:

After participating in this educational activity, the participant should be better able to:

1. Summarize information about the physiology of wound itch and problems caused by scratching wounds.
2. Interpret the design and results of the study presented.
3. Predict which wounds are associated with increased wound itch.

ABSTRACT

OBJECTIVE: This study was designed to explore characteristics of chronic wounds that present with wound-related itch.

BACKGROUND: Although wound-related itch is recognized clinically, little is known about the phenomenon. Recent scientific advances have enabled the study of itch physiology, yet the clinical problem is not well described in the literature.

DESIGN: The study was observational, descriptive.

METHOD: Persons (N = 200) with wounds being followed up at a hospital-affiliated wound care center were interviewed and assessed. Instruments included a health history tool, Paul-Pieper Itching Questionnaire, Bates-Jensen Wound Assessment Tool, and 10-g monofilament for assessment of sensation in the area of the wound.

RESULTS: Participants were aged 21 to 98 years (mean, 66.82 [SD, 14.02] years); 56% of the participants were men, and 85% were white. One-fourth (56/200) of the participants reported wound-related itch. Wounds that itched were generally larger ($t_{77.74} = -3.27$; $P = .002$; d = 0.63; 95% confidence interval [CI], −1.01 to −0.25), had more tissue edema ($t_{88.38} = -2.19$; $P = .031$; 95% CI, −0.93 to −0.47), and demonstrated more granulation tissue in the wound base ($t_{98.71} = 2.03$; $P = .045$; 95% CI, 0.01–0.87), compared with wounds without itch. Greater itch was associated with wounds that had a moderate amount of exudate ($P = .02$) or necrotic tissue in the base.

CONCLUSIONS: Wound itch was present in more severe wounds as evidenced by larger size, more tissue edema, and necrotic tissue. Understanding wound itch could promote wound healing and improve quality of life for persons with chronic wounds.

KEYWORDS: chronic wounds, wound healing and itch, itch phenomenon

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INTRODUCTION

Itch associated with wounds is recognized clinically, but is not well described in the literature related to wounds commonly encountered in wound care practices. Wounds commonly followed in wound care centers include vascular, neuropathic, traumatic, pressure related, and wounds of mixed etiology. Characteristics of wounds that itch, measures taken by persons with wounds to manage itch, and the effect that wound itch has on wound healing and quality of life are not known.

BACKGROUND

The purpose of this study was to examine itch associated with chronic wounds. Results of this study should enhance the clinician's current understanding of itch so that, ultimately, therapies can be developed to manage wound itch. Management of wound itch would promote wound healing, resulting in improved quality of life for persons with chronic wounds and cost savings related to wound care.

Rationale for the Study

Itching causes a nocifensive withdrawal response to remove an offending irritant and protect the skin and integrity of the body.[1] The itch-scratch cycle is described as an itch that elicits a scratch response.[2,3] The scratching causes inflammation and further stimulation of nerve fibers, thus resulting in the sensation of itch. The sensation of itch then prompts further scratching or rubbing. Although scratching and rubbing can provide relief, both can also lead to further trauma and delayed healing.[3,4]

Persons with wounds that itch report they experience suffering and distress. An itch can be so disturbing that the person with a wound succumbs to scratching, which may cause further wound and periwound deterioration. Because wound care practice emphasizes healing, prevention of such wound deterioration is crucial.

This study was innovative in that it explored the phenomenon of wound itch, which is documented clinically, but is not described in the literature. Itch is a multifactorial problem involving the skin, nervous system, endocrine system, and immune system.[5] A greater understanding of itch must be gained before options for therapy can be determined. Nurses need to work collaboratively with other healthcare providers to manage the problem of wound itch.

Recent physiologic developments in itch research make this study timely. Andrew and Craig[6] documented histamine-selective spinothalamic tract neurons specific for itch sensation. They identified itch as a sensation distinct from pain. Sun and Chen[7] published information on an itch-specific mediator, gastrin-releasing peptide. In addition, recent advances in neuroimaging techniques have enabled observation of centers of brain activity in response to induction of pruritus.[8,9]

Chronic wounds affect 0.78% of the population, with most of those affected being older than 60 years.[10] The percentage of adults with chronic wounds is likely to increase with the aging of society; thus, the number of persons experiencing wound itch may also increase. Function, psychological state, social interaction, somatic sensation, and financial stability are impacted by a wound.[11] Assessment of wound itch and identification of effective treatment and preventive strategies should improve quality of life for patients with chronic wounds. In addition, wound care may be less costly as trauma from scratching existing wounds and development of new wounds due to scratching can be prevented.

Specific Aim

The specific aim of this study was to determine which wound characteristics (including location, size, depth, type, color) were associated with itch.

Research Questions

What is the relationship between wound characteristics and itch?

Variable Definitions

Wound

A wound is defined as "a disruption of the integrity and function of tissues in the body."[11] Chronic wounds include vascular (arterial and venous), neuropathic, traumatic, and pressure-related wounds, as well as wounds of mixed and other etiologies as may be found among people seeking treatment at wound care centers. An arterial wound results from tissue ischemia resulting from inadequate blood supply; this typically presents as a painful, pale wound with well-defined wound edges.[12] A venous wound results from chronic venous insufficiency and typically presents as a ruddy wound with irregular wound edges.[12] Neuropathic wounds are often found on the feet of persons with diabetes mellitus and are often surrounded with callus.[13] A traumatic wound results from an event that causes injury to the skin and, possibly, deeper tissues and underlying structures. A pressure-related wound results from sustained pressure to an area to such a degree or length of time that injury to underlying skin occurs.[14] Pressure-related wounds of interest include those classified as Stage II through Stage IV.[15] Stage II ulcers involve partial-thickness loss of dermis, which presents as a shiny or dry shallow ulcer. Stage III ulcers involve full-thickness tissue loss without visible muscle, tendon, or bone. Stage IV ulcers involve full-thickness skin loss with exposed bone, tendon, or muscle. Stage I pressure ulcers do not involve any open wounds in the skin and so are not included. Other types of wounds are burns (tissue trauma due to thermal injury), fungating wounds as those that develop with malignancies, and wounds with mixed etiology (as with concomitant arterial and venous disease). Extensive burns are usually not followed at wound care clinics because persons with extensive burns are typically referred to a burn center. Wounds are described by many defining characteristics, including location, size (length, width, and depth), periwound descriptors (color, integrity, temperature, and texture), color, odor, moisture, drainage, and base material (eg, granulation tissue, eschar, slough, subcutaneous tissue, muscle, bone, and tendon). Wounds commonly followed in wound care practices are considered chronic in that they do not follow the normal and timely process of healing to return to a normal anatomic and functional result.[16] This definition of chronic wounds has been accepted by the Wound Healing Society.[17] Acute wounds, such as surgical wounds that heal in an orderly and timely manner, are not typically followed in wound care practices.

Itch

More than 340 years ago, a German physician, Samuel Hafenreffer, defined itch as an unpleasant sensation that elicits the desire to scratch.[18] Although the adjective "unpleasant" is very subjective, the definition has persisted. Greaves and Khalifa[19] further clarified that itch is "a complex, multidimensional experience involving a range of different qualities of sensation, such as pleasurable relief by local physical intervention, which leads to itch/scratch cycles and modulation by cognitive and psychological functions from higher centers." Itch can be defined as "(1) an irritation of the skin, (2) an impatient desire: a hankering."[20] *Stedman's Medical Dictionary*[21] defines itch as "an irritating sensation in the skin that arouses the desire to scratch." Some distinctions have been made between *itch* and *pruritus*. Waxler et al[22] specify that pruritus is a condition in which itch is present without a specific cause. Often *pruritus* is used to indicate itch without visible skin lesions; however, arguments can be made for itchy conditions in which rubbing enables tolerance without visible skin lesions.[23] *Itch* and *pruritus* are synonymous[23]; throughout this article, the 2 terms are used interchangeably. Itch is generally a sensation of the skin, but in this study, itch was related to wounds, which were often through the skin and deeper than the skin. *Wound itch*, then, is the irritating sensation or disturbing feeling related to an open wound, including the wound bed and the skin immediately surrounding the open wound. *Wound itch* is synonymous with *wound-related itch*. Although wound itch might be impacted by systemic conditions that cause itch, steps were taken to distinguish wound itch from itch due to other causes.

PHYSIOLOGY OF ITCH

Until 1997, the sensation of itch was thought to follow the same pathways that painful stimuli followed, but with a less intense stimulus eliciting itch rather than pain. Subsequently, itch-selective neurons were found in humans.[24] Itch can be inhibited by painful stimuli, such as thermal (hot water), mechanical (scratching), or chemical (histamine) means. Analgesia (by reducing inhibition) may actually cause itch.[21,24] Slow-conducting C-fibers that originate in the skin (a subclass of C-nociceptors for pain) pass sensory information to the dorsal horn of the spinal cord and, via the spinothalamic tract, on to the thalamus in the somatosensory cortex.[1,21,25,26] The slow-conducting C-fibers (pruriceptors) account for approximately 5% of all afferent C-fibers in human skin.[25] These itch-sensing C-fibers are similar to, but functionally distinct from, pain fibers. The C-fibers are responsive to histamine and other pruritogens (itch triggers) but

are insensitive to mechanical stimuli.[25] Pruritogens that are likely present in open wounds include histamine, which is released from granulation tissue, and growth factors.[2,26,27] When free nerve endings of the specialized C-fibers are stimulated by pruritogens, itch is induced.

In a breakthrough study, Schmelz et al[28] reported that iontophoresis with histamine induced the itch sensation. The study involved 53 healthy (human) volunteers. Iontophoresis was accomplished by delivery of current through an electrode that was within an applicator. The applicator contained histamine dihydrochloride dissolved in a gel. The current went to a reference electrode on the skin. Microneurography (a method involving electrical search stimuli) showed discharge patterns matching the time course of itch. These discharge patterns for the itch sensation were found in 8 neuronal units that had 3 distinguishing characteristics: mechanical insensitivity, slow conduction velocities (average 0.5 m/s), and large innervation territories. These neuronal units were determined to be the afferent units responsible for mediating the itch sensation. Burning pain, heat, and itch are transmitted through these C-fibers.[2] However, it is not likely that all types of itch sensation are transmitted through these C-fibers. Johanek et al[29] were interested in itch induction by pruritogens that did not produce the characteristic flare that accompanies histamine. They looked for differences in reactions to histamine versus cowhage spicules. Doppler results showed large areas of vasodilation around histamine versus vasodilation only at the site of cowhage application. Topical capsaicin abolished cowhage-induced itch but had no effect on histamine-induced itch, whereas pretreatment of skin with an antihistamine prevented itch at the site of histamine application, but did not prevent cowhage-induced itch. The researchers' findings implicate a group of afferent fibers that are separate from the histamine-sensitive, mechano-insensitive C-fibers for itch sensation.

RESEARCH RELATED TO ITCH OCCURRING WITH CHRONIC WOUNDS

Research related to xerosis (dry, rough skin commonly found in older adults), venous ulcers, and burns is sparse. Itch related to arterial, neuropathic, traumatic, and pressure-related wounds could not be found.

Norman[30] looked at diagnoses with *International Classification of Diseases, Ninth Revision* code 1556 nursing home residents to determine common problems for such persons. Pruritus (n = 1002) and xerosis (n = 772) were found to be the 2 most common problems among those persons. Norman described xerosis (dry skin) with pruritus in older adults, most commonly in the legs, but also in the hands and trunk. Xerosis follows a pattern of flaking, fissuring, inflammation, dermatitis, and infection. Methods and results were not well described, but pharmacologic treatment options were discussed.

Shai and Halevy[31] questioned and reviewed medical records of 91 persons who had a total of 110 venous ulcers to determine what actually causes ulceration in persons with venous insufficiency. The nonexperimental study involved history taking and chart review. They concluded that 5.4% of the ulcers were triggered by dry skin with subsequent scratching. No trigger was identified in 26.3% of the ulcers.

Duque et al[32] conducted a study among 100 (89% women) persons with mild to moderate venous insufficiency to estimate prevalence of itch, pain, and burning sensations; to examine characteristics of the symptoms and their relation to severity of venous disease; to identify factors that aggravate or alleviate the symptoms; and to determine impact of itch on quality of life in these persons. The Clinical, Etiology, Anatomic, and Pathophysiology classification system was used for determining eligibility to participate and for grading venous disease. Sixty-six percent of subjects had itch at the time of the interview. Itch did not correlate with severity of venous disease, but there was a significant negative relationship between itch intensity and quality of life.

Matheson et al[33] were looking for a method to reduce itch that is experienced with burns. They assessed the itch rating of 35 acute burn patients who tried 1 of 2 bath oils: 1 with colloidal oatmeal and 1 without. Persons using the bath oil with colloidal oatmeal reported a daily mean itch value that was half as much as the mean itch value reported by those using the oil without colloidal oatmeal.

METHODS

Design

The study used an observational design, as that is appropriate for the state of the science; although itch is a familiar phenomenon, little is known about itch as it occurs with chronic wounds.

Setting

The study was conducted at a wound care center that is affiliated with a large teaching institution located in Southeastern Michigan. The wound care center is staffed with plastic surgeons, peripheral vascular surgeons, general surgeons, podiatrists, a nurse practitioner, and staff nurses.

Sample

The sample included 200 outpatients with wounds who were visiting the hospital-affiliated wound care center for wound treatment. Consecutive sampling involved recruiting persons 2 to 3 days each week who were visiting the wound care center on those days. After 100 participants had been interviewed, it became apparent that approximately one-fourth of persons being

seen at the wound care center had wound-related itch. Wound characteristics were assumed to have a disproportionate sample size. This disproportionate sample size reduced power relative to the same sample divided equally. Power and sample size were computed for a 2-sample *t* test power analysis. A target sample size of 225 allowed for a power of 0.86 with a medium effect size and α set at .05. A refusal rate of approximately 5% was expected related to patient unwillingness to discuss negative sensations related to wounds, so a resulting sample size of 200 was sought. Children, persons younger than 18 years as distinguished legally in Michigan (Michigan Children's Protection Registry Act of 2004, S.241, 92nd Legislature), were excluded as the interview questionnaires were designed for adults. Pregnant women were not likely to be followed up at the wound care center, and pregnancy predisposes a woman to a multitude of pregnancy-related pruritic conditions,[34] so pregnancy was an exclusion criterion. Inclusion criteria allowed for patients (*a*) with open wounds including vascular (arterial or venous), neuropathic, traumatic, or pressure-related wounds (as determined by each patient's medical history and/or wound presentation); (*b*) age 18 years or older; and (*c*) able to understand and speak English. Exclusion criteria included (*a*) pregnancy, (*b*) closed surgical wounds, (*c*) rash in the area of the wound, or (*d*) a pruritic skin condition involving more than 20% of body surface area. The participant was not excluded if sensation in the area could not be confirmed, as itch could potentially be perceived without sensation in the area of the wound according to an understanding of a central, in addition to peripheral, origin of itch as previously described. Patients with surgical wounds and extensive burns are not typically followed up at the wound care center.

DATA COLLECTION PROCEDURE

All patients who met inclusion criteria and were followed up at the wound care center were considered for inclusion in the study. Data were collected by the primary investigator who introduced the study to patients and determined eligibility. Once eligibility was determined, the primary investigator reviewed the content of an information sheet with the patient. Each person willing to participate was assessed and interviewed in a private room. All questionnaires were read to the participants for response. One wound for each patient was assessed for wound characteristics and itch: either the largest wound with associated itch or the largest wound when itch was not described. Wound assessments were conducted concurrently with the wound care center staff to avoid unnecessary discomfort associated with dressing changes and wound assessments. This protocol followed standard procedure, so the risk of injury was small. Participants were each given $10 at completion of the interview and wound assessment in appreciation of their time and cooperation.

Instruments

Bates-Jensen Wound Assessment Tool. The Bates-Jensen Wound Assessment Tool (BWAT) was developed cooperatively by Bates-Jensen with Bolton et al[35] for documentation of wound assessments. The instrument was formerly known as the Pressure Sore Status Tool with a content validity index of 0.91 and mean interrater reliability coefficients of 0.915 among enterostomal therapy nurses and 0.78 among practitioners.[36,37] The Pressure Sore Status Tool was subsequently modified to accommodate all types of wounds.[35] Cronbach α (internal consistency reliability coefficient) for this instrument is .96.[35] It was used to document wound characteristics (such as size, surrounding tissue, exudate, presence of necrotic or granulation tissue, and epithelialization) as obtained during clinical wound assessments. The instrument contains 2 items for documentation of wound location and shape, 13 numbered assessment items, and a ''Wound Status Continuum.'' The descriptors for each assessment item are scored and ranked on a modified Likert scale (1 being the healthiest attribute of the characteristic and 5 being the least healthy attribute of the assessment item). A higher score indicates a more severe wound status. The 13 assessment items scores are added to determine a numerical indicator of wound health or degeneration.[38] Two items were added to the BWAT: an item for recording sensation in the area of the wound and an item for recording current dressing. Permission to use the instrument was obtained from Drs Bates-Jensen and Bolton.

Paul-Pieper Itching Questionnaire. The Paul-Pieper Itching Questionnaire, an instrument developed specifically for the evaluation of wound itch and persons' treatment of it, was developed by Dr Barbara Pieper and the primary investigator of this study. It consists of 15 interview questions: 3 rating scales and 12 multiple response items concerning itching around the wound, itching on the wound, timing of wound itch, and treatments used for wound itch. Reliability of this instrument could not be calculated because it is a survey versus a summative rating scale.

Demographic and Health. A demographic and health tool was used to record demographic information, as well as wound type/diagnosis, dermatologic diagnoses, medical history, current medications, and allergies. Information was obtained from participants and their medical records. The instrument had face validity.

Medical (10-g) Monofilament. A disposable 10-g monofilament was used, following the procedure as described by Driver et al,[39] to determine sensation in the area of the wound. The American Diabetes Association recommends annual screening for diabetic neuropathy using the 10-g monofilament[40] with intrarater reliability established for assessment of cutaneous sensitivity in feet.[41] The monofilament is a handheld device with a short filament (fishing line) attached

to a paper handle. The instrument has been standardized to deliver a 10-g force to an area of the skin. Before assessment of sensation, the procedure was explained to the participant. According to the procedure, the participant was positioned for comfort and so that the area of the wound was accessible. The monofilament was first used on the participant's hand so that the participant knew what to expect. The participant was instructed to say yes when the monofilament was felt against the skin. The monofilament was applied perpendicular to the surface of the skin, within 2 cm of the wound margin, avoiding callus or open skin, and with enough force to cause the filament to bend. The monofilament was applied to a maximum of 3 areas and only until sensation was confirmed, totaling approximately 1 to 2 seconds to approach, contact, and release each time. Sensation around the wound was recorded as a numbered response on the BWAT: 3 if sensation was felt in all 3 areas, 2 if sensation was felt in 2 areas, 1 if sensation was felt in only 1 area, and 0 if sensation was not confirmed in any area.

Ethical Considerations

Approval to conduct this study was obtained from the hospital's Commission of Nursing Scholarship and Research and Human Investigation Committee and the university's Human Investigation Committee.

Data Analysis

Data were analyzed using Statistical Package for the Social Sciences (version 19 [IBM, Armonk, New York]) software. Characteristics of wounds were assessed with the BWAT, which assesses 13 wound characteristics with ordinal response scales coded 1 through 5, with higher scores indicating more serious wound status. The association of each characteristic to wound itch was evaluated. Four types of analyses were performed: (*a*) independent group *t* tests were used to compare mean ratings across itch and nonitch groups. This analysis treats the ordinal categories numerically and is a sensitive test when the probability of itch is linearly related to wound characteristics. Student *t* tests column proportions were reviewed to further explore significant categories within wound characteristics, but did not provide meaningful results. (*b*) χ^2 Tests of association were used to identify significant associations between itch and wound characteristics. The χ^2 test can detect associations that are not linear. (*c*) Bar plots were examined to determine the possibility of nonlinear functional relationships that would not be identified with either *t* test or χ^2. (*d*) Logistic regression analysis was used to test nonlinear functional relationships when descriptive plots showed nonlinearity in column proportions (eg, when the conditional probability of itch, given the level of wound characteristic, could be described as a trend that first increased, then decreased).

The logistic regression used 4 predefined contrasts. Each contrast compared the first wound characteristic category with 1 of the succeeding categories. Binary logistic regression was used to analyze wound itch associated with each subsequent category against the lowest (best) category for each wound characteristic on the BWAT. Logistic regression was also used to provide 95% confidence intervals (CIs) for category proportions.

Spearman rank order correlations and point-biserial correlations were calculated and compared to determine the magnitude of linearity of each Bates-Jensen wound characteristic. Spearman rank order correlation is a nonparametric index in which all data are first ranked for each of the 2 variables, and the ranked data are subsequently correlated. The point-biserial correlation coefficient is appropriate when 1 measure is on an interval scale (Bates-Jensen wound characteristic) and the other measure is dichotomous (wound itch present or not present).

RESULTS

Sample Characteristics

Participants. Persons (N = 200) with wounds being followed up at the wound care center were interviewed, and their wounds assessed. Data from 1 participant were excluded from data analysis because of the extent of missing data: data from 199 participants were included in the analysis. Their ages ranged from 21 to 98 years with a mean age of 67 years. Participants included 112 males (56%), 170 white persons (84%), and 95 (48%) who were married. Wound-related itch, determined by combining positive responses about itch in or around the wound, was reported by 56 of the 199 participants (28%). Mean age of those with wound-related itch was 62.73 (SD, 14.44) years, which was lower (but not significantly lower, $P = .52$) than the mean age of those without itch, 68.42 (SD, 13.63) years. The itch and no-itch groups were similar in terms of participant characteristics (Table 1). The group with wound-related itch included 30 males (53%), 45 white persons (80%), and 32 (51%) who were married.

Using χ^2 test of independence, a significant difference was found between groups in terms of employment status (χ^2_2 [n = 172] = 13.15, $P = .02$) with fewer participants with itch (n = 20, 35.7%) being retired compared with participants without itch (n = 76, 53.1%), and more participants with itch (n = 19, 33.9%) being unemployed compared with participants without itch (n = 24, 16.8%). No other significant differences were found between groups for other characteristics including gender, race, marital status, education, or general health status.

Participants presented with varying medical conditions. The most frequent comorbidities as reported in the medical record are listed in Table 2. More than 62% were identified with a history of

Table 1.
PARTICIPANT CHARACTERISTICS

Participant Characteristic (χ^2)	Wound-Related Itch (n = 56)	No Itch (n = 143)	Total (n = 199)
Gender (χ^2 = 0.23, *P* = .63)			
Male	30	82	112
Female	26	61	87
Race (χ^2 = 3.51, *P* = .32)			
White	45	124	170
Black	9	18	27
Hispanic	1	0	1
Country (χ^2 = 10.89, *P* = .37)			
United States	52	135	187
Canada	1	1	2
Marital status (χ^2 = 5.37, *P* = .25)			
Married	32	63	95
Widowed	10	33	43
Never married	10	22	32
Education (χ^2 = 4.5, *P* = .72)			
Completed 2-4 years of college	19	41	60
Completed high school	14	44	58
Employment status (χ^2 = 13.15, *P* = .02)[a]			
Retired	20	76	96
Unemployed	19	24	43
Employed full time	13	20	33

[a]Denotes significance: $P \leq .05$.

hypertension. χ^2 tests of association were used to compare participants with and without wound-related itch based on 26 medical diagnoses. Wound-related itch occurred significantly more in persons with deep vein thrombosis (χ^2_1 [n = 199] = 5.11, *P* = .02) and with intravenous drug abuse history (χ^2_1 [n = 199] = 4.43, *P* = .04). Although a total of only 4 participants had a history of intravenous drug abuse, proportionally more (n = 3, 5.4%) reported wound-related itch.

Wounds. Each participant's largest or most bothersome wound was assessed. Table 3 depicts wound parameters, including wound type, wound location, and wound age. Wound type was determined by physician diagnosis as included in the patient record or by presentation if a diagnosis was not documented. There were proportionally more venous wounds with wound-related itch (n = 14, 55%) than wound-related itch in other types of wounds. χ^2 analysis showed a greater likelihood for wounds in the lower extremities to be itchy versus wounds in other areas of the body (χ^2_1 [n = 198] = 4.14, *P* = .04). Only 3 of upper body wounds (11.5%) itched compared with 53 of lower extremity wounds (30.8%) that itched. There were no significant findings related to wound shape, wound age, or sensation in the area of the wound.

Relationship Between Wound Characteristics and Itch

Wound Measurement. Measurement of wound surface area ranged from 0.01 to 176 cm^2 (mean, 9.05 [SD, 21.9] cm^2) for wounds without itch, compared with 0.16 to 567 cm^2 (mean, 20.95 [SD, 78.4] cm^2) for wounds that itched. This difference was not significant ($t_{58.4} = -1.78$, *P* = .08). The presence of 1 very large wound among the wounds that itched could have skewed this comparison. With this outlying measurement replaced with the next smallest value in the distribution, 176 cm^2, by the process of Winsorizing, a significant difference was found between wounds that itched and those that did not ($t_{72.71} = -2.38$; *P* = .02; *d* = 0.50; 95% CI, −21.88 to −1.92).

Size Category. Wound size (length width) was categorized on a 1- to 5-point scale from 1 for length width of less than 4 sq cm^2 to 5 for length width of greater than 80 sq cm^2. There was a significant linear association between wound size category and itch: point-biserial correlation = 0.269, *P* < .001. Treating the size categories as nominal, there was a significant association between itch and wound size category (χ^2_4 [n = 199] = 13.54, *P* = .009). Itch was reported significantly more often in categories 4 and 5 than in category 1. These results are shown in Figure 1.

Undermining. χ^2 analysis of wound itch and undermining was not significant (χ^2_4 [n = 198] = 8.79, *P* = .07). Too few wounds had undermining for analysis. However, the independent-samples *t* test showed that significantly more wounds with

Table 2.
FREQUENCY OF MOST COMMONLY OCCURRING COMORBIDITIES

Comorbidity	Wound-Related Itch (n = 56)	No Itch (n = 143)	Total, n (%) (n = 199)
Hypertension	33	91	124 (62.3)
Diabetes mellitus	19	60	79 (39.7)
Arthritis	23	51	74 (37.2)
DVT	17	23	40 (20.1)
IVDA	3	1	4 (0.20)

Abbreviations: DVT, deep vein thrombosis; IVDA, intravenous drug abuse history.

Table 3.
WOUND PARAMETERS

Wound Parameter (χ2)	Wound-Related Itch	Wound-Related No Itch	Total, n (%)
Wound type (χ^2 = 10.24, P = .12)			
Traumatic	10	27	37(18.9)
Pressure	6	27	33(16.8)
Diabetic/neuropathic	5	26	31(15.8)
Venous[a]	14	17	31(15.8)
Arterial	7	16	23(11.7)
Mixed vascular	0	3	3(1.5)
Other	13	25	38(19.4)
Wound location (χ^2 = 4.14, P = .04)[a]			
Head/trunk/upper extremities	3	23	26(13.1)
Lower extremities	53	119	172(86.9)
Wound age (χ^2 = 4.88, P = .56)			
<1 wk	2	7	9(4.8)
1 wk to 1 mo	6	19	25(13.3)
>1–6 mo	19	60	79(42.0)
>6 mo to 1 y	11	14	25(13.3)
>1–5 y	10	23	33(17.6)
5–10 y	3	4	7(3.7)
>10 y	3	7	10(5.3)
Sensation around wound (χ^2 = 9.35, P = .03)[a]			
3 areas sensed	25	50	75(38.9)
2 areas sensed	12	25	37(19.2)
1 area sensed	12	22	34(17.6)
0 areas sensed	5	42	47(24.4)

[a]Denotes significance: $P \leq .05$.

related itch had no undermining ($t_{195.05}$ = 2.38; P = .02; d = 0.29; CI, 0.04–0.42).

Necrotic Tissue Amount. The amount of necrotic tissue in the wound base did not differ between wounds that itched and those that did not itch ($t_{104.20}$ = −1.24; P = .22; d = 1.65; 95% CI, −0.83 to 0.19). Greater itch, however, was associated with category 4 than with category 1 (Figure 2).

Exudate Amount. There was a significant association between exudate amount and itch (χ^2_4 [n = 198] = 11.68, P = .02). Greater itch was associated with category 4, moderate amount, than with category 1, none, P = .05 (Figure 3).

Peripheral Tissue Edema. Wounds with edema were more likely to itch ($t_{88.38}$ = −2.20; P = .03; d = 0.37; 95% CI, −0.93 to −0.05). A significant difference in column proportions was found between those in the category of "pitting edema <4 cm around the wound" and those in the category of "no swelling or edema" (Figure 4).

Induration. Although the Student t test showed a linear relationship between wound itch and induration, only 7 wounds demonstrated induration. χ^2 analysis showed no significant difference between wounds that itched and those that did not itch related to induration (χ^2_3 [n = 197] = 5.55, P = .14).

Granulation Tissue. Wounds with granulation tissue present in the base were more likely to itch ($t_{98.71}$ = 2.03; P = .045; 95% CI, 0.01–0.87). Compared with those in the skin intact category, a higher probability for itch was associated with the categories of "beefy or filled 75% to 100%" (P = .035) and "beefy or filled 25% to 75%" (P = .044) (Figure 5).

Inspection of the condition probabilities in the crosstabs tables showed a general tendency for itch to be more highly associated with the middle rather than the end categories. This was apparent in significant logistic regression findings for necrotic tissue amount, exudate amount, peripheral edema, and granulation tissue (Figures 1–5).

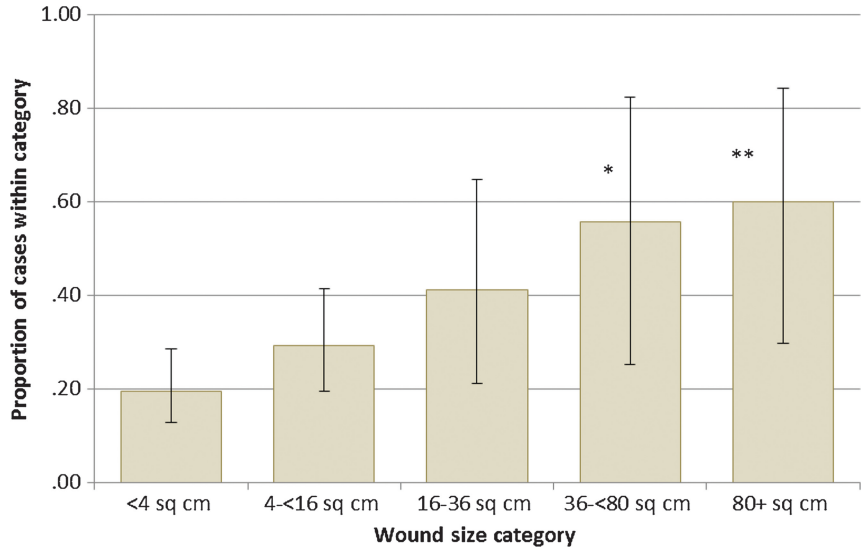
Total scores of the BWAT ranged from 15 to 46 along the Wound Status Continuum with no significant difference found between wound itch and total score (χ^2_7 [n = 197] = 10.85, P = .15).

DISCUSSION

The relationship of each BWAT wound characteristic to wound-related itch is discussed in this section. Characteristics of wounds and their relationship to itch have not been described prior to this study. No association between wound itch and wound depth, edges, necrotic tissue type, exudate type, skin color, or epithelialization was found. Linear relationships between wound size, tissue edema, and tissue induration are discussed. Significantly elevated itch categories as found with necrotic tissue amount, exudate amount, peripheral tissue edema, and granulation tissue are also discussed.

Wound Size. Wounds that itched were larger than those that did not itch. The linear association of wound size with itch contrasts with the understanding that itch is specific to the skin,[42] as skin is damaged or missing in open wounds. Metze[43] reported that itch could not be induced where epidermis had been removed. In addition, itch is not transmitted by nerves in the deeper layers of the dermis and subcutaneous fat,[44] so the tissues in the base of the wound are likely not the source of the itch sensation. The larger wound border may produce more pruritogens, such as histamine and growth factors that may explain the greater itchiness of larger wounds.

Figure 1.
PROPORTION OF WOUND ITCH CASES WITHIN CATEGORIES OF WOUND SIZE

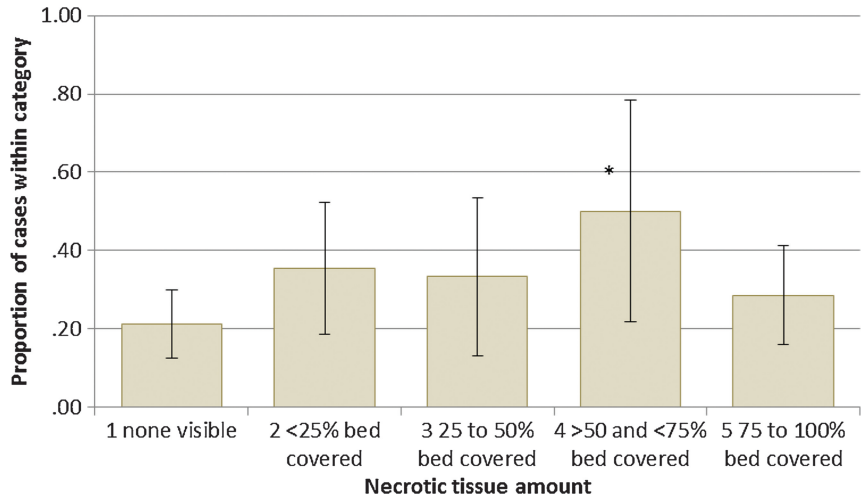


Proportion of cases with itch within each wound size category. The larger the wound is, the greater the itch. Compared with <4 sq cm category, a higher probability of itch was associated with 36 to <80 sq cm, $P = .022$; and 80+ sq cm, $P = .008$. Also shown are the 95% confidence intervals, n = 199. *$P < .05$, **$P < .01$.

Undermining. Wounds with undermining were less likely to itch. Generalizations about undermining and itch should not be made because only a few wounds were found with undermining.

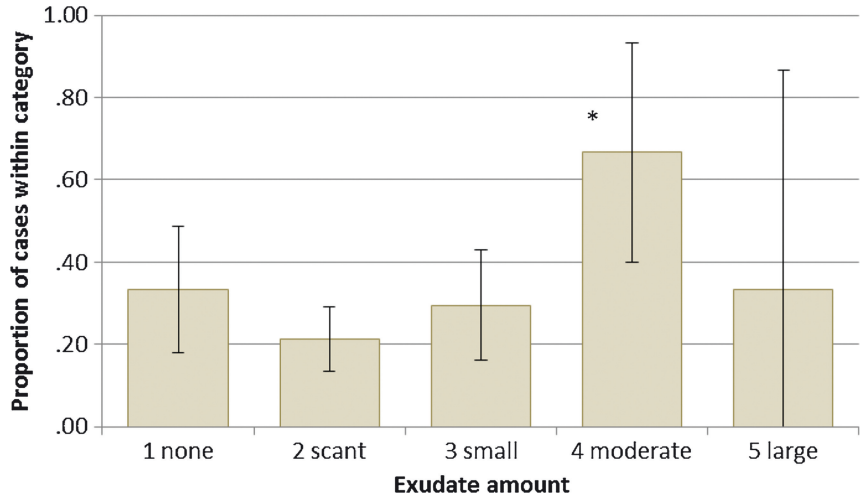
Necrotic Tissue Amount. Necrotic tissue is dead tissue, which is typically brown or black.[45] It forms a blockage for wound healing; thus, removal of necrotic tissue promotes wound healing. Although itch and necrotic tissue amount were not significantly associated, greater itch was found associated with the category of *''>50% and <75% of wound covered.''* Itch leads to scratch, which is a withdrawal response.[44] Although potentially damaging, scratching

Figure 2.
PROPORTION OF WOUND ITCH CASES WITHIN CATEGORIES OF NECROTIC TISSUE AMOUNT



Proportion of cases reporting itch within each category of necrotic tissue amount. Compared with none visible, more itch was reported for category 4, >50% and <75%, $P = .039$. Also shown are the 95% confidence intervals, n = 199. *$P \leq .05$.

Figure 3.
PROPORTION OF WOUND ITCH CASES WITHIN CATEGORIES OF EXUDATE AMOUNT

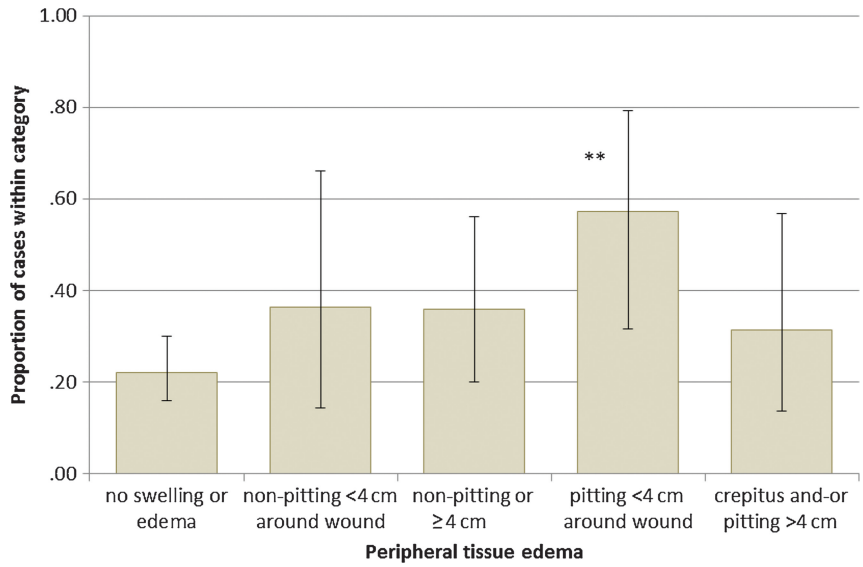


Proportion of cases reporting itch within each exudate amount category. Compared with the amount of itch reported for wounds with no exudate, more itch was reported for wounds with a moderate amount of exudate, $P = .050$. Also shown are the 95% confidence intervals, n = 199. *$P \leq .05$.

may serve a physiologic purpose of removing necrotic tissue by functionally debriding the wound to enable wound healing.

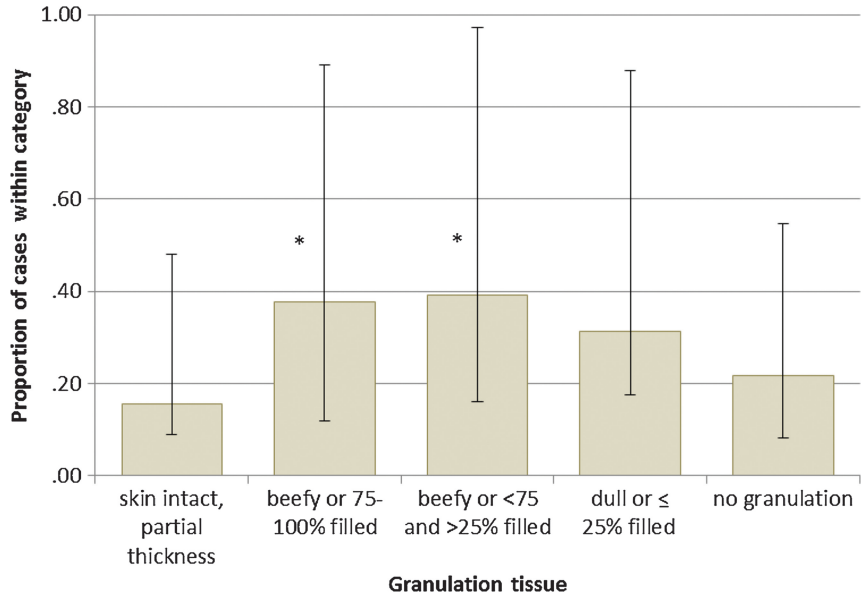
Exudate Amount. More itch was noted at the fourth level, *moderate,* compared with other categories of wound exudate, very possibly implicating maceration. Maceration is softening of skin surrounding a wound because of excess drainage or moisture.[45] Moderate wound drainage can moisten and macerate the peri-wound area, which may trigger itch.

Figure 4.
PROPORTION OF WOUND ITCH CASES WITHIN CATEGORIES OF PERIPHERAL TISSUE EDEMA



Proportion of cases with itch within each edema category. Compared with no swelling, a higher probability of itch was associated with pitting <4 cm, $P = .008$. Also shown are the 95% confidence intervals, n = 197. **$P < .01$.

Figure 5.
PROPORTION OF WOUND ITCH CASES WITHIN CATEGORIES OF GRANULATION TISSUE



Proportion of cases with itch within each amount of granulation category. Compared with skin intact, a higher probability of itch was associated with beefy or 75% to 100 % filled, $P = .035$; and beefy or <75% and >25% filled, $P = .044$. Also shown are the 95% confidence intervals. Note the asymmetry of the interval because proportions cannot be less than 1, n = 198. *$P < .05$.

Peripheral Tissue Edema. Edema mechanically stretches cells and tissues, which may exacerbate itchiness. Although histamine-sensitive C-nerve fibers are mechanically insensitive, edematous changes of nerve fiber bundles that occur with mast cell invasion may provoke or aggravate itchiness.[46] In addition, other C-nerve fibers exist, which are mechanically sensitive and are able to transmit itch.[44] Histaminergic, as well as nonhistaminergic, mechanisms for itch have been found.[47] Protease-induced itch is transmitted via mechanically sensitive C-nerve fibers.[48] A high probability of itch was associated with ''*pitting edema <4 cm around wound*'' compared with other categories of edema. The differences between response categories for edema on the BWAT range from ''*nonpitting edema*'' at one end to ''*extensive pitting and/or crepitus*'' on the other; this finding may explain the category-associated increase in itch probability. Itch might be minimized by controlling edema.

Induration. Induration is firmness of the tissue indicative of further tissue damage in the periwound area.[45] Induration was significantly associated with wound itch; however, analysis is limited as only 7 wounds demonstrated induration. Induration is most likely related to inflammatory processes initiated by tissue damage and pruritogens as released with mast cell degradation.[45] The inflammatory phase of wound healing is prolonged in chronic wounds,[49] so itchiness with induration follows.

Granulation tissue. Granulation tissue is the beefy, red, velvety tissue found in actively healing wound and is the hallmark of the proliferative phase of wound healing.[49] It is composed of capillary loops and connective tissue proteins with fibroblasts and inflammatory cells within them. Granulation tissue in the base of the itching wound fits the physiological understanding of itch in that granulation tissue indicates active wound healing. Wound healing brings histamine, nerve growth factor, and other pruritogens into the wound.[48] Friable granulation tissue that bleeds easily can be produced excessively in cases of wound infection,[50] so itching with excessive, friable granulation tissue and tissue induration (previously described) could indicate an infectious process that may impair wound healing.

Almost any substance has the potential to be a pruritogen to someone. Medications have great potential to have itch as an adverse effect or to have antipruritic effects. The impact of medications on participants' wound-related itch was not explored in this article, but should be considered in future work. Medications, even antihistamines, did not exclude participants from the study, as this study was designed to explore wound-related itch, even if it was being treated.

''It's itching; it must be healing'' is a phrase heard frequently from healthcare providers, as well as patients with wounds. The accuracy of this saying remains unknown. In this study, greater

itch found in upper categories of wound characteristics meant greater wound itch in more severe wounds. Total scores of itching wounds fell along the Bates-Jensen Wound Status Continuum in the areas of regeneration, as well as degeneration.

LIMITATIONS

Research subjects were patients who were followed up at a suburban wound care center. The sample may be representative of a more educated population with a higher socioeconomic status than other populations. Participants were approached consecutively, not with any randomization, so that generalizability of the findings is limited. This study relies on recall and self-report related to the very subjective experience of wound-related itch. In addition, the validity of the results depends on the validity of the instruments and the scoring as done by the primary investigator. There is much need for further investigation of the phenomenon of wound itch with alternative populations, instruments, and researchers.

CONCLUSIONS

This study was innovative in that it explored wound itch, which is documented clinically, but is not well described in the literature. Linear associations of wound itch with wound size and peripheral edema were found. Greater itch was described with more severe wounds as evidenced by greater wound size, more necrotic tissue, and moderate wound exudate. These findings indicate negative implications of wound itch, as these wound characteristics do not correspond to wound healing and may indicate wound deterioration. Greater itch associated with more granulation tissue may reflect the associated pruritogens in the base of granulating wounds. Granulation tissue may represent wound healing and thus a positive implication of wound itch, or, if it is overproduced and friable, as with infection, may represent a negative implication of wound itch. If wound itch is experienced, associated wound characteristics should be considered. More needs to be learned about wound-related itch, its implications, its causes, and its outcomes.

This study confirms the presence of wound-related itch as a clinical concern for persons with chronic wounds. Findings of this study indicate the need to assess and manage wound itch to promote wound healing. Addressing the problem of wound itch may positively affect the course of chronic wounds, quality of life, and healthcare costs.

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