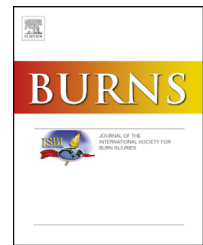


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Validation of the burns itch questionnaire



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ABSTRACT

Itch (pruritus) is a common multidimensional complaint after burn that can persist for months to years. A questionnaire able to investigate itch and its consequences is imperative for clinical and research purposes. The current study investigated the factor structure, internal consistency and construct validity of the Burns Itch Questionnaire (BIQ), a questionnaire particularly focusing on itch in the burns population. The BIQ was completed by 195 respondents at 3 months after burn. An exploratory factor analysis (EFA) was performed to investigate the factor structure. EFA showed the BIQ comprised three latent factors: itch severity, sleep interference and daily life interference. This was re-evaluated in a confirmatory factor analysis that yielded good fit indices after removing two items. The three subscales showed to have high internal consistency (.89) and were able to distinguish between patients with severe and less severe complaints. In conclusion, the BIQ showed to be useful in persons suffering from itch following burns.

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1. Introduction

Itch (pruritus) is a common complaint after burn wounds have healed. Prevalence rates are high, ranging between 93% at discharge and 67–73% 24 months after the burn event [1–4]. For some time, there were no burn specific itch scales available. In the first studies on burn itch the only aspect measured was itch intensity using a visual analogue scale, or a 7-point scale [2,5]. To capture the multidimensionality of itch, scales were developed in various patient populations [6,7], some of which were also validated for patients with burns [8–10]. A broader range of itch-related aspects such as duration of

itch, sensations, consequences and effects were incorporated in these questionnaire, contributing to a broader picture of itch complaints in the aftermath of a burn.

The adoption of an itch questionnaire designed to measure itch complaints in other patient groups has the advantage that burn-related itch can be compared to itch in other patients groups. This may yield insight in underlying mechanisms that may be similar or different from other diseases. A disadvantage may be that irrelevant questions have to be filled in by the respondent, needlessly lengthening the scale. Moreover, specific burn-related aspects may not be comprised in the questionnaire. For example, burn severity or depth of the wound has consistently shown to be associated with itch

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severity [2–4], although it should be noted itch can also appear in smaller and superficial burns [11]. Therefore, a new scale was developed that incorporated this aspect to enable this distinction.

The aim of this paper is to present some psychometric properties of the Burns itch questionnaire (BIQ), i.e., internal consistency and construct validity, including structural validity [12]. Concerning the structural validity of the BIQ it was hypothesized that the scale would comprise two or three factors, including itch severity (e.g., intensity and occurrence during different parts of the day) and impact on other activities, either combining or dividing sleep and daily activities interference. Concerning construct validity we hypothesized that respondents qualifying their itch as more severe ranging from annoying to worrisome, score higher on the scale factors and we hypothesized that respondents with more severe burns score higher on the scale factors.

2. Methods

2.1. Participants

Participants were patients admitted to one of the regional burn centres in the Netherlands (Rotterdam, Beverwijk, Groningen) or in Belgium (Antwerpen, Gent, Brussels). Data were collected in two waves: January 2005 – January 2009 and April 2010 – October 2012. Inclusion criteria were 18 years or older, sufficient Dutch proficiency, hospitalized for 48 h or longer. Persons suffering from cognitive disorders were excluded.

2.2. Procedure

As part of two larger prospective studies on psychological problems and pain following burns respectively, respondents received questionnaires in-hospital and follow-ups by mail at several occasions. The 3-month measurement was chosen to examine the structure of the questionnaire presented in this paper. Both studies were approved by ethical boards in the Netherlands and Belgium. Participants were invited to participate during their stay in hospital by a local researcher of the burn centre. Oral and written information was provided and the participant gave written informed consent. Once participants left the burn centre, the local researcher continued the follow-up by regular mail. A prepaid envelop was included.

2.3. Measure

The Burns Itch Questionnaire (BIQ) was designed starting 2005 to measure itch complaints following burns. After reviewing the literature on itch, itch in patients with burns and then existing itch rating scales for other patient populations [6,7], and different aspects of itch assumed to be important for the patient with burns were identified and included in the scale. In the BIQ overall itch intensity during the last seven days was assessed using a 10-point scale ranging from 0 (labelled 'no itch') to 9 (labelled 'most itch you can think of'). Four questions inquiring about when the itch occurs and ten statements about the temporal patterns/duration of itch, impact on sleep and daily activities were included.

Additionally, an item was added referring to four qualifications that best describe the itch they experience can be ticked: 'annoying', 'irritating', 'unbearable' or 'worrisome'. Furthermore, respondents can report itch intensity at the various affected locations allowing the investigation of itch related to burn depth and body location. A personalized picture can be derived when the affected body locations including depth of the burn are marked on the picture. The respondent can report the itch intensity in the marked areas, allowing the follow-up of all body areas. An additional item inquires after itch in other areas than those affected with burns. Finally, three qualitative questions were added to inquire about situations that induce or increase itch complaints, medication use and alternative methods applied to alleviate itch complaints. Results from the qualitative part of the questionnaire and itch across different body locations were earlier published [13]. The translation of the Dutch BIQ was performed by two bilingual (English–Dutch), native English speakers. A consensus version was composed and back-translated to Dutch. The English version of the BIQ is included in [Appendix 1](#). The instrument is available free of charge for clinical and research use.

2.4. Demographic and injury characteristics

Demographic and medical data such as age, gender, length of hospital stay were recorded from the medical file. Injury characteristics were specified by percentage total body surface area burned (TBSA) which is the sum of the estimated percentage of partial and full thickness burns, and the number of surgical procedures during the (sub) acute hospitalization which is considered an indicator of extensive and deep dermal injury.

2.5. Statistical analyses

Means, median, standard deviation, percentage endorsement (% endorsement is the percentage of item response greater than zero) and number of missing values for all items were presented. To study the structural validity of the BIQ, an exploratory factor analysis was performed in SPSS 21 [14] and re-evaluated by performing a confirmatory factor analysis in Mplus 6.1 [15].

First, Bartlett's test of sphericity was carried out to test the null hypothesis that the correlation matrix is an identity matrix. The test should be significant to conclude there are relevant inter-correlations that may be manifestations of underlying latent factors, i.e., clusters of variables that measure the same underlying construct [16]. The number of factors to be retained was based on the Guttman-Kaiser rule that proposes that only eigenvalues larger than 1 should be retained. Factor rotation was applied to improve the interpretation of the factors. Because it was theorized that the factors would be related (a higher score on itch severity is assumed to have a higher impact on daily life), oblique rotation (i.e., promax was used in this study) has to be preferred. Oblique rotation allows inter-correlation between the factors whereas orthogonal rotation does not.

Second, an exploratory factor analysis (EFA) was performed. EFA is a statistical method used to uncover underlying relationships of items included in the questionnaire. It is used

to evaluate factor structures in new scales as there are no firm assumptions about patterns. For example, it is not known beforehand if the BIQ is a 1, 2, or 3-factor scale. Questionnaire items that measure the same underlying (also called latent) construct are assumed to form a common factor. The EFA solution was re-evaluated in a confirmatory factor analysis (CFA) to test the model adequacy. CFA can be used to test whether the data fit the hypothesized measurement model. Model fit indices give an indication of the adequacy of the model. The model has to be rejected when model fit is poor or can be accepted when model indices show moderate to good fit. Because the items were not normally distributed, a robust maximum likelihood (MLR) estimator was used. Full information maximum likelihood (FIML) was used to deal with missing values. Several fit indices were calculated to test goodness-of-fit of the model. Presented fit indices include the Tucker Lewis Index (TLI), the Comparative Fit Index (CFI) and the Root Mean Square Estimate of Approximation (RMSEA). Conventional guidelines suggest that TLI and CFI should be larger than .90 and RMSEA should be smaller than .08 to indicate sufficient model fit [17]. To compare the fit of the competing models, Akaike information criterion (AIC) was inspected. A decrease is an indication of a better model in terms of goodness of fit relative to model complexity. A one-way ANOVA was used to test between-group differences in terms of itch qualifications and burn severity groups.

Finally, Cronbach's alpha was computed to test reliability i.e. the internal consistency of the factor scores. These statistics were computed using SPSS 21.

3. Results

A total of 384 patients gave their informed consent. We obtained 3 months follow-up data for 335 persons (87%). The 49 respondents lost to follow-up were younger ($M = 33$ vs 42 , $t(380) = -3.72$, $p < .001$) and they had lower TBSA burned ($M = 7$ vs 11 , $t(380) = -2.74$, $p = .006$) but no gender differences appeared ($\chi^2 = 1.36$, $df = 1$, $p = .24$). Out of these 335 respondents, 140 (42%) reported to have no itch complaints at 3 months

after burn and therefore did not complete the questionnaire, leaving 195 respondents for the analyses. The sample included 135 (70%) males, mean age was 41.7 years ($SD = 15.11$), mean TBSA was 13.5 ($SD = 12.0$; min 1–max 75), mean length of stay in hospital was 26.8 days ($SD = 29.9$) and mean number of surgeries was 1.3 ($SD = 1.7$). Fifty five (28%) respondents did not need skin grafting procedures, 95 (49%) underwent one surgical procedure and 45 (23%) needed two or more surgeries.

Means, standard deviations and endorsement of single BIQ items are presented in Table 1. The first part of the BIQ assessing intensity and temporal patterns showed higher scores and higher endorsement relative to items that assess impact on sleep and daily life.

3.1. Structural validity

First, the Bartlett's test of sphericity showed to be statistically significant ($\chi^2 = 1933.58$, $df = 105$, $p < .001$), indicating the correlation matrix is not an identity matrix. Second, all items were included in the EFA which yielded a solution with four factors. Item 8 'I had an itch now and then', however, was isolated into a single factor. Therefore, we decided to exclude this item and to re-run the EFA. It now showed three factors with an eigenvalue >1 , accounting for 74% of the variance. The eigenvalues and variances of the separate factors were 7.4 (53%), 1.7 (12%) and 1.2 (9%). The three factors appeared to be theoretically sound. Factor 1 included items addressing itch intensity and the occurrence of itch complaints over 24 h. Factor 2 and factor 3 comprised items addressing daily activity interference and sleep interference respectively. Table 2 presents the factor loadings of this model showing high factor loadings on average. Only the factor loading of the items 'I had itch continuously' and 'Itch restricts my daily routine' were substantially lower, indicating a lower contribution of these items to the underlying factors.

In a next step, CFA was conducted with the aim to test if this item pool allocated to the three factors could be reproduced in a good-fitting model. Model 1 including 14 items as produced in the EFA showed borderline fit indices representing a moderate model fit (see Table 3). Therefore, the

Table 1 – Means and standard deviations of the single items.

Itch	Mean	Median	SD	%Endorsement	Missing
Intensity during last 7 days	3.63	3	2.19	99	1
During the day	2.70	2	2.19	85	1
During the evening	3.21	3	2.40	85	6
During the night	1.99	1	2.50	57	5
During periods of relaxation	2.73	2	2.41	82	5
Itch continuously	1.82	1	2.52	54	2
Itch now and then	4.52	4	3.18	91	2
Difficult to go to sleep	1.91	0	2.71	49	2
Woke me up at night	1.37	0	2.41	38	1
To wake up early	1.03	0	2.11	31	1
Restricts my daily routine	1.41	0	2.26	42	1
Influenced my mood	1.73	0	2.56	47	1
Influenced my work	1.25	0	2.17	36	4
Influenced relationship with my partner	0.78	0	1.81	25	5
Influenced my social life	1.38	1	0.61	28	1

Note: % endorsement is the percentage of item response greater than zero.

Table 2 – EFA factor loadings.

Itch	Itch severity	Interference daily life	Interference sleep
During the day	.95		
During the evening	.87		
Intensity during last 7 days	.87		
During periods of relaxation	.79		
Continuously	.55		
Influenced my social life		.97	
Influenced relationship with my partner		.92	
Influenced my work		.85	
Influenced my mood		.68	
Restricts my daily routine		.54	
Woke me up at night			.99
To wake up early			.87
During the night			.79
Difficult to go to sleep			.71

two items with the lowest factor loading were removed in two steps. Model 2, excluding 'Itch restricts my daily routine' and Model 3, additionally excluding 'I had itch continuously' showed a decrease in χ^2 and AIC and an increase in the fit indices, reflecting an improvement in model fit from Model 1 to Model 3. Furthermore, the internal consistency was high as Cronbach's alpha was .89 for the three factors.

Table 4 shows the Pearson inter-correlations between the three total factor scores (sum scores). As expected the factors showed to be correlated, ranging from .52 to .60. Of notice, the mean score of the severity factor was substantially higher relative to the two other factors, indicating that itch indeed occurs very often but the impact on sleep and life appears to affects less people.

3.2. Construct validity

Four descriptions were provided qualifying the itch complaints: annoying, irritating, unbearable and worrisome. Most respondents ($N = 132$; 69%) qualified their itch complaints as annoying, 46 (24%) respondents found it irritating and 13 (7%) found it unbearable and no one found their itch worrisome. It was hypothesized that along the different qualifications, the factor scale scores should be higher. As shown in Fig. 1 respondents qualifying their itch as annoying scored lower on the three factors, as compared to those qualifying their itch as irritating or unbearable. A one-way Anova showed the means

were statistically significantly different across the three itch qualifications. Regarding 'itch severity' ($F(2, 187) = 25.1$, $p < .001$) statistically significant differences were observed between those classifying their itch as annoying compared to those classifying it as irritating or unbearable. The latter two did not differ statistically significantly. Statistically significant differences were observed across the three qualifications regarding 'sleep interference' ($F(2, 187) = 16.0$, $p < .001$) and 'daily life interference' ($F(2, 187) = 42.5$, $p < .001$). This indicates the BIQ is able to distinguish groups with more severe itch complaints (Fig. 2).

Furthermore, we hypothesized that respondents with more severe burns, defined by number of surgeries (no, 1, 2 or more than 2), would score higher on the different factors. The factor 'itch severity' showed to confirm this hypothesis ($F(2, 186) = 5.51$, $p = .01$) and post hoc tests indicated there was a statistically significant difference across the three severity groups. This difference was not found for the sleep interference subscale ($F(2, 189) = 2.11$, $p = .124$), but was partly supported in the daily life interference subscale ($F(2, 188) = 3.02$, $p = .03$), showing a statistically significant difference between the group not needing surgery and those who underwent two or more operations.

4. Discussion

The current study tested the BIQ regarding internal consistency, structural validity, and construct validity. The results showed the questionnaire consists of three separate subscales that can be theoretically interpreted, have good internal consistency, and are able to differentiate between groups of patients based on subjective (patient's qualification) and objective severity measures such as number of surgeries, in line with prior hypotheses.

The EFA showed that three factors could be retained when one item 'I had itch continuously' was excluded. This item had the lowest mean score (1.82) and the lowest endorsement (54%) within the group of items inquiring about itch occurrence, indicating it was a rather rare complaint compared to other occurrence descriptions. Continuous itch seems to occur but with a lower intensity on average and may therefore not concur with the other items that are reported by more respondents and have a higher intensity. Therefore we decided to exclude this item from the model.

The three factors or latent constructs retained from the EFA were labelled 'itch severity', 'sleep interference' and 'daily life

Table 3 – Fit indices for the confirmatory factor analyses.

Model	χ^2	df	p	RMSEA	CFI	TLI	AIC
Model 1	192.43	74	<.001	.09	.89	.87	10,380.71
Model 2	144.84	62	<.001	.08	.92	.89	9647.23
Model 3	119.60	51	<.001	.08	.93	.90	8838.41

Note: RMSEA = rootmean square error of approximation; CFI = - comparative fit index; TLI = Tucker-Lewis index; AIC = Akaike information criterion.

Table 4 – Means, SD and Pearson correlations between the factor scores.

	Itch severity	Interference sleep	Interference daily life
Itch severity	–		
Interference sleep	.60	–	
Interference daily life	.52	.56	–
Mean factor scores	12.3	6.4	4.7
SD factor scores	7.9	8.5	7.5
Range factor scores	0–36	0–36	0–36

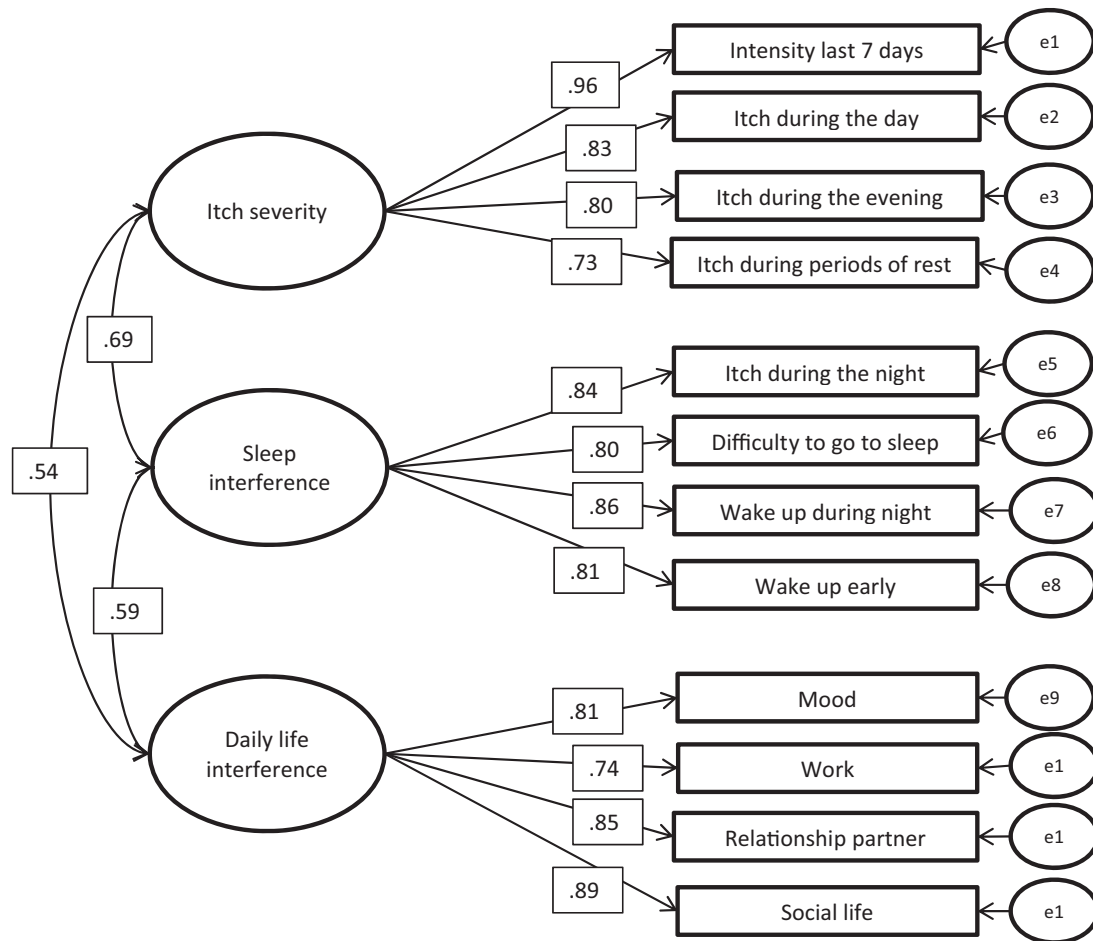


Fig. 1 – CFA standardized factor loadings.

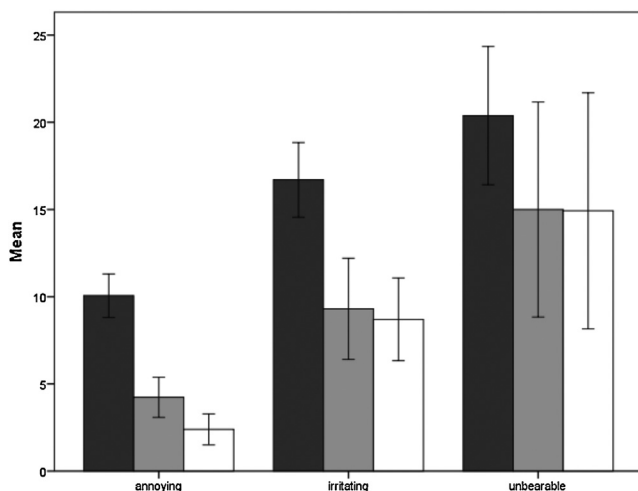


Fig. 2 – Bar chart representing mean factor scores according to itch qualification. Black bars represent mean factor score 'itch severity'; gray bars represent mean factor score 'sleep interference' and white bars represent mean factor score 'daily life interference'. Error lines show ± 2 standard errors.

interference'. The first comprised the intensity item and items inquiring about when itch was experienced. The item 'itch comes and goes' had the lowest factor loading, indicating this item had a lower contribution to the factor. Like the item 'I had itch continuously', it reflects a pattern and may therefore not fit into this factor as it seems only marginally adding to itch severity. These items were taken together into a single descriptive item. The factor reflecting interference of itch with daily activities also included the item 'Itch restricts my daily routine' that only marginally contributed to the factor. This item may be formulated too general thereby losing its specificity and variation. Outcomes from the CFA confirmed the model fit improved when removing the aforementioned items. This resulted in a good fitting model. The final item pool of the BIQ is presented in [Appendix 1](#).

Of notice, compared to the itch severity factor, sleep and daily activity interference was scored substantially lower. This was somewhat surprising as previous reports have suggested that itch in patients with burns substantially affects the quality of life [4]. This seems to be true for only a relatively small subgroup of patients which can be explained by the lower burn extent in our cohort. In this cohort, measured 3 months after burn, only 46 (24%) out of 191 respondents found

their itch irritating and 13 (7%) qualified their itch as unbearable. They scored significantly higher on the interference scales. It indicates that in this study only for a small group of patients with burns, itch appears to interfere with sleep and daily life despite the frequent occurrence of itch complaints. The finding that a subgroup of patients with burns suffers from severe itch underscores the importance to have measures that are able to identify these patients.

The BIQ was able to distinguish a difference in itch severity and interference with daily activities along with burn severity. Consistent evidence documents that more severely burned patients, particularly those who needed skin grafting procedures, are more troubled with severe itch [2,3]. Furthermore, respondents who qualified their itch as annoying, irritating or unbearable also scored differently on the three factors of the scale. This supports the construct validity of the BIQ. Reliability was tested only as internal consistency, not by repeated measurements. This is a limitation, however, it is questionable whether the construct itch in patients with burns is stable enough over the time period required to eliminate recall bias in test-retest reliability. Testing responsiveness would be a valuable addition.

The additional information that can be derived from the drawing in which a personalized picture of the affected body zones and depth of the locations can be registered, makes the scale applicable for the burn-specific situation. For the purpose of this study the BIQ was filled in once during hospitalization but it may be recommended to complete the scale on a weekly basis to evaluate the applied (non-)pharmacological interventions. Whether it may be relevant to fill in (parts of) the scale more frequently during hospitalization remains subject of research or clinical experience. In outpatient situations, it is recommended to complete the scale preceding the clinical visit and evaluate the answers with the patient. The subjective qualification of itch can give a quick impression of how bothersome the complaints are for the patient which may help the clinician to tailor interventions. For research purposes it may assist in studying differences across body locations and distinguish between burn depth in relation to itching after burn as described by Kuipers et al. [13].

Compared to other itch questionnaires used in burn populations (e.g. [8,10]) there are some differences worth noting. The Questionnaire for Pruritus Assessment [8] is

considerably longer, taking more time to complete and to interpret. The Leuven questionnaire [10] is of about the same length, on average addressing similar issues as the BIQ. However, neither of these questionnaires has been tested regarding factor structure, leaving unidentified underlying dimensions or irrelevant questions for the burns population. To our knowledge, the BIQ is the only scale validated in a relatively large sample size of patients with burns. Despite this advantage, recent insights in itching after burn document that neuropathic (pain) symptoms often co-occur with itch [18,19]. These symptoms were not included in the BIQ in contrast to the aforementioned questionnaires. A supplementary item to be developed or adopted from the Leuven itch questionnaire (item 9: sensory characteristics of itching) may be of additional value for both clinical practice and research. As it is a descriptive item, it does not affect the factor structure.

In conclusion, the BIQ is a valid and reliable scale that can be used to evaluate the severity of itch following burns and its possible impact on sleep and daily activities. In combination with the additional items, e.g. on medication, it provides a practical document to organize information relevant for patients after burn who experience itch.

Conflict of interest

There is no conflict of interest to report by any of the authors.

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Appendix 1

Burns Itch Questionnaire

Itch can be a troublesome complaint following burns. The following questions inquire after itch related issues **during the past 7 days and today**. Please circle one number that best describes your situation.

Date:

- | | no
itch | | | | | | | | | worst
itch |
|---|------------|---|---|---|---|---|---|---|---|---------------|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1. To what extent did you experience itching? | | | | | | | | | | |

Please go to **the following questions** in the case you experienced itch
Please go to **question 20** in the case your score is 0.

- | To what extent did you experience itching: | no
itch | | | | | | | | | worst
itch |
|--|------------|---|---|---|---|---|---|---|---|---------------|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 2. During the day | | | | | | | | | | |
| 3. During the evening | | | | | | | | | | |
| 4. During the night | | | | | | | | | | |
| 5. During periods of relaxation | | | | | | | | | | |

To what extent do you agree on the following statements:

Please circle one number that best describes your situation:

- | | totally don't
agree | | | | | | | | | completely
agree |
|---|------------------------|---|---|---|---|---|---|---|---|---------------------|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 6. It was difficult to go to sleep because of the itch | | | | | | | | | | |
| 7. The itching woke me up at night | | | | | | | | | | |
| 8. The itch caused me to wake up early | | | | | | | | | | |
| 9. The itch influenced my mood | | | | | | | | | | |
| 10. The itch influenced my work | | | | | | | | | | |
| 11. The relationship with my partner is influenced by the itch | | | | | | | | | | |
| 12. The itch influenced my social life (contact with friends, family) | | | | | | | | | | |

13. Which description of itch describes your feelings best?

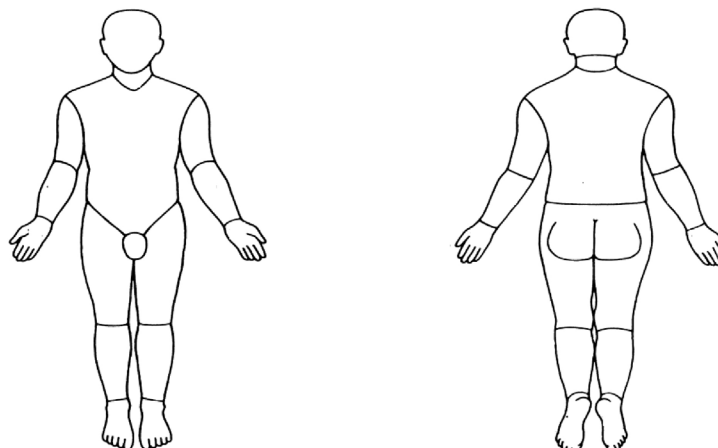
The itch is: ☐ annoying ☐ irritating ☐ unbearable ☐ worrying

14. Which description describes your itch best?

Itch is present: ☐ hardly ever ☐ now and then ☐ most of the time ☐ continuous

15. Can you indicate on the drawing below, the areas of your burns and the severity of itch in each area? Please highlight grafted areas, if this was not already done by the Burn center.

Score the severity of itch for each area on a scale of 0-9 where 0 = no itch and 9 = worst itch.



16. Did you experience itch in areas other than those specified, i.e. outside your burn areas?

- ☐ No
- ☐ Yes. Please indicate on the drawing where, and the severity of itch in that area

17. Can you specify situations that cause itch to start or to increase when present?

- ☐ No
- ☐ Yes, please specify:
.....

18. Are you taking medication for your itching?

- ☐ No
- ☐ Yes, please specify (include dose)::
.....

What is the result of this?

- ☐ No improvement
- ☐ Minimal improvement
- ☐ (Practically) complete reduction of itching

How long does relief last after taking medication?

- ☐ less than 30 min
- ☐ 30 to 60 min
- ☐ more than 60 min
- ☐ Longer, please specify how long:.....

19. Do you use other means and/or ways of combating itch?

(For instance, application of lotions or creams, taking a bath, acupuncture, pressure garments)

- ☐ No
- ☐ Yes, please specify::
.....

What is the result of this?

- ☐ No improvement
- ☐ Minimal improvement
- ☐ (Practically) complete reduction of itching

How long does relief last after taking medication?

- ☐ less than 30 min
- ☐ 30 to 60 min
- ☐ more than 60 min
- ☐ Longer, please specify how long:.....

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