

SKIN REACTIVITY IN WORKERS WITH AND WITHOUT ITCHING FROM OCCUPATIONAL EXPOSURE TO GLASS FIBRES

Alf Björnberg,¹ Gun-Britt Löwhagen² and Jan Egon Tengberg³

¹Department of Dermatology, University Hospital, Lund, ²Department of Dermatology, Sahlgren's Hospital, Gothenburg, and the ³Industrial Health Department, Gullfiber AB, Billesholm, Sweden

Abstract. 98 workers at a glass-wool factory were divided into three comparable groups: those with persistent troublesome itching from the fibres, those without itching, and those who had become 'hardened' to the itching. The three groups were compared with respect to the results of patch testing with glass fibres and six chemical irritants, a rubbing test with fibres, the Trafuril test, and provocation of dermatographism. Anamnestic data with respect to atopy, itching from wool and synthetic fibres, sweating, and reactions to the sun were evaluated, as also was the general skin pigmentation. No statistically significant differences between the three groups were found in respect of any of these tests or factors except for a subjectively increased sensitivity in the rubbing test with fibres for the itching group. It is possible that similar itch-provocation tests might be useful for pre-employment assessment to predict severe occupational itching from glass fibres.

Key words: Glass fibres; Itching; Irritants; Predictive tests; Skin reactivity

It is well known that contact with glass fibres can provoke intense itching and that this symptom may be so troublesome that workers are forced to leave their jobs in factories producing glass-fibre products (8). The sensitivity to fibre itching varies greatly between different individuals, whereas some people seem to be almost resistant to this type of pruritic stimulus.

This study has been performed in an attempt to characterize the skin of workers in a glass-wool factory (Gullfiber AB, Billesholm) in relation to their tendency to suffer from itching due to the glass fibres. Results of skin testing, certain anamnestic data and the general pigmentation have been compared in workers with and without itching from glass fibres.

MATERIAL AND METHODS

Selection of subjects

Workers with moderate or heavy exposure to coarse glass-wool fibres with a mean diameter of 6 or 12 μm ,

which are known to cause subjective discomfort, were selected for the study. None had any signs of allergic contact dermatitis, psoriasis or any other major skin disease. These subjects were divided into three groups, A, B and C, exclusively on the basis of itching during work with glass fibres. Objective skin reactions from the fibres thus did not influence the selection. Group A consisted of individuals who still had itching from the fibres after finishing their daily work. Group B comprised those with no or only minor itching, which ceased as soon as the workday was over. Group C consisted of individuals who had symptoms as in group A when starting work at the factory but who became 'hardened' to the itching after a few days or weeks and then behaved as in group B. The total material comprised 98 subjects (69 men and 29 women) aged 18–65 years (mean age 31 years). The three sub-groups had similar distributions by age and sex. 31 subjects were allocated to group A, 36 to group B and 31 to group C.

Interviews

All subjects were interviewed by the same nurse according to a standardized questionnaire about (a) earlier flexural dermatitis, (b) dryness of the skin of the hands, (c) itching from wool, "synthetic" textiles and after hot baths, (d) tendency to sweat, and (e) sensitivity to sunburn and suntan. The questions were formulated so as to elicit the answers "yes", "no" or "do not know".

General pigmentation

All subjects were Caucasians. They were examined by the same investigator with respect to general skin pigmentation (fair, moderately pigmented, or dark), the colour of the eyes (blue-grey, green or brown) and hair colour (blond and red, fair, or dark).

Skin testing

The tests were performed during approximately one year, avoiding the warm summer months. The test methods, test substances, test sites, exposure times, reading times and scoring of the skin reactions are shown in Table I. All tests were performed on normal skin and each test was carried out on the same body site in all individuals. The amounts of test substances were standardized by means of dosage pipettes for the fluids, and syringes for the petrolatum bases and Trafuril liniment. For the patch tests with fibres, an amount just sufficient to cover the inner

Table I. *Test methods*

Test method	Test substance	Test site	Exposure time	Reading time	Scoring of skin reactions
<i>Patch tests</i>					
Al-test (Fregert)	Uncoated glass fibres 12 µm	Upper back	48 h	72 h	0-6
	Coated glass fibres 12 µm	Upper back	48 h	72 h	0-6
	Uncoated glass fibres 6 µm	Upper back	48 h	72 h	0-6
Chamber test (Rokstad)	Cantharidin 0.005% acetone	Thigh	24 h	72 h	0-6
	Benzalkonium chloride 1% water	Thigh	24 h	72 h	0-6
	Croton oil 0.5% in petrolatum	Thigh	24 h	72 h	0-6
	Hydrochloric acid 5% in water	Thigh	24 h	72 h	0-5
	Sodium lauryl sulphate 5% in water	Thigh	24 h	72 h	0-4
	Sapo kalinus 50% in petrolatum	Thigh	24 h	72 h	0-3
<i>Rubbing test</i>	Uncoated glass fibres 12 µm	Volar forearm		10 min	0-4
<i>Dermographism</i>		Back		10 min	0-3
<i>Trafuril reaction</i>	Trafuril® (Ciba)	Back		10 min	0-5

part of the test unit was used. The patches were removed by the subjects themselves after 24 and 48 hours for the chemical irritants and the fibres, respectively, and the results were read after 72 hours. Coated as well as uncoated glass fibres were used in the patch testing. The coating consisted of phenol-formaldehyde. This resin is completely cured by heat. The addition of the resin gives the white glass-wool a yellow colour.

In the rubbing test, 12 µm uncoated fibres were rapidly rubbed 15 times, with moderate pressure, on a 3.5×5 cm area on the volar aspect of the wrist, after which the remaining fibres were gently removed. After 10 min an objective evaluation of the skin reactions was carried out. The time until onset of itching as well as the duration of itching was registered. For provocation of dermographism the skin was gently stroked with a blunt rod. Registration of skin reactions was made after 10 min. In the Trafuril test 0.03 ml of liniment was applied to a circular area, 2.5 cm in diameter. Trafuril® (Ciba) liniment contains: tetrahydrofurfuryl. nicotin. 1 g, methyl. et aethyl. salicyloyloxiacet., methyl. salicyl., camphor., acid. salicyl., menthol., Pluornic F68, cholesterol. et paraffin. liquid. q.s., natr. carboxinethylcellulos., aq. purif. ad 100 ml.

Registration of skin reactions

All skin reactions were registered in detail by the investigators who, after a long training period, judged the skin reactions in the same way. The reactions were scored (Table I), a weak reaction with a low number and stronger reactions with higher numbers. Details of the scoring system for patch testing with the fibres and for the irritants have been outlined elsewhere (1, 2). In the rubbing test with glass fibres the scale points were defined as: 0=normal skin, 1=slight erythema, 2=moderate erythema, 3=strong erythema and 4=erythema and weals. The scale in the Trafuril test was: -1=white reaction, 0=normal skin, 1=slight erythema, 2=erythema covering the test area, 3=erythema even outside the test area, 4=erythema and small weals, and 5=erythema and a large weal cover-

ing the test area. The provocation of dermographism was rated as: -1=white reaction, 0=normal skin, 1=slight erythema, 2=erythema and 3=erythema and weal.

Statistical methods

The different variables (test results, anamnestic data and pigmentation) were compared between the three groups A (permanent severe itching), B (no itching), and C (hardening). The statistical evaluation was performed using Fisher's non-parametric permutation test (7). Age was used as a background variable. Fisher's test variable was determined within each group and the results of the different groups were pooled into a summarizing test. *P*-values were determined by means of the Edgeworth expansion. Values of *p*<0.05 were considered significant.

RESULTS

I. Skin Testing

A. Fibre testing

(a) *Patch tests.* The results of the patch tests with three types of glass fibres, 6 µm uncoated, 12 µm uncoated, and 12 µm coated, are shown in Table II. No statistically significant differences were registered in any of the comparisons between group A, B and C.

(b) *Rubbing test.* In the *subjective* assessment, 20 subjects (63%) in group A, 11 (31%) in group B and 17 (57%) in group C complained of itching in connection with rubbing with fibres. The difference between A and B is statistically significant (*p*=0.993). The latency time until itching and the duration of itching are shown for the three groups in Table III. The latency time is significantly longer in group B than in C (*p*=0.981). In the *objective* evaluation of the skin reactions to rubbing, no sta-

Table II. Percentage skin reactions in patch testing on the back with three different types of glass fibres in subjects with and without occupational itching from glass fibres

(A=itching; B=no itching; C=hardening)

Score	6 μ m uncoated Group			12 μ m uncoated Group			12 μ m coated Group		
	A (n=31)	B (n=34)	C (n=31)	A (n=31)	B (n=34)	C (n=31)	A (n=31)	B (n=34)	C (n=31)
0-1	48	44	62	39	38	32	22	32	42
2-3	39	35	19	29	32	39	52	32	26
4-6	13	21	19	32	30	29	26	36	32

tistically significant differences between the three groups were found.

B. Dermographism

Dermographism with wealing was observed in only 4 subjects, 2 in group A and 2 in group C. No statistically significant differences were found between groups A, B and C with respect to the intensity of the erythematous skin response.

C. Trafuril

The intensity of skin reactions to Trafuril showed the same score distribution in the three groups and no statistically significant differences were registered.

D. Chemical irritants

No statistically significant differences between groups A, B and C were found in the skin reactivity to the six chemical irritants used, except that subjects in group B reacted more strongly to cantharidin than those in group A ($p=0.984$).

II. Anamnestic Data

Flexural dermatitis (atopic dermatitis) was found in only one subject. Very dry skin on the hands was considered to occur in 13% of the subjects in group A, 11% in group B and 13% in C. Itching from wool occurred in 39%, 11% and 31% respectively; itching from synthetic textile fibres in 19%, 6% and 10%; itching after a hot bath in 16%, 2% and 10%; and pronounced sweating in 45%, 37% and 42%. The proportions of subjects easily sunburned in the three groups were 37%, 34% and 38%. The proportion easily suntanned were 66%, 75% and 64%. The differences between the three groups in respect of these variables are not statistically significant.

III. General Pigmentation

No statistically significant differences were found between groups A, B and C with respect to general skin pigmentation or hair or eye colour.

DISCUSSION

Patch testings with fibres

Patch testing with glass fibres with a diameter exceeding 4 μ m can provoke skin reactions of an irritant type, with epidermal and dermal changes (2, 3). Fibres with a mean diameter of 6 and 12 μ m were used in the present study. Considerable individual differences in the skin reaction to patch testing with glass fibres have been demonstrated. Patch testing with glass fibres of 9-12 μ m provoked skin reactions in only about 33% of the tested subjects (3) and testing with mineral fibres of 4-10 μ m in 25% (2). In the present series the great differences between individuals in their skin response to these fibre tests were confirmed. However, no statistically significant difference between the three defined groups of workers could be demonstrated. This means that, as a group, individuals with occupational itching from glass fibres do not react more

Table III. Latency time before itching and duration of itching in the rubbing test with glass fibres in subjects with and without occupational glass fibre itching

	Group A (n=20)	Group B (n=11)	Group C (n=17)
Latency time before itching	113 (± 107)	206 (± 162)	106 (± 69)
Duration of itching	359 (± 337)	184 (± 276)	250 (± 238)

intensely to the fibre tests than those without itching.

Rubbing tests with fibres

When the coarse glass fibres are rubbed into the skin an immediate skin reaction is sometimes observed, with erythema, papules and weals. It is usually combined with subjective itching or soreness of the skin. The reaction may last more than 30 min. This rubbing test is more similar to the natural exposure to glass fibres during work than the 48-hour patch test with the fibres.

In the present series the skin of some subjects did not react at all, while others (33%) had visible reactions. No statistically significant differences were demonstrated between groups A, B and C in respect of the objectively registered skin reactions, however. In the *subjective* evaluation two statistically significant differences were found between the three groups: workers with persistent itching during their work with glass fibres reacted more frequently to the test than those without itching, and those who had become hardened had a shorter latency time before onset of itching than those without itching.

Dermographism

It has been claimed in the literature that dermographism indicates a predisposition to itching and that people with this reaction should be advised not to work with glass fibres (5, 8). In the present series 4 subjects showed dermographism: 2 (5%) belonged to the group of subjects with itching and 2 (5%) to the group that had become resistant to itching. About 5% of normal individuals show dermographism (6). Comparison of the intensity of the erythematous response on stroking the skin revealed no significant differences between workers with and without occupational itching from the glass fibres.

Trafuril test

When tetrahydrofurfuryl nicotinate (Trafuril) is put on the skin 95% of normal persons will develop an erythematous skin reaction, often with weals within 5–10 min (4). This corresponds to the findings in all three groups in the present study. The workers with itching did not show any special pattern of skin reaction to Trafuril when compared with the workers without itching.

Chemical irritants

Patch testing with cantharidin, benzalkonium chloride, sodium lauryl sulphate, croton oil, sapo kalinus and hydrochloric acid was included in this study because these substances had earlier been shown to serve as indicators of an irritable state of the normal skin in connection with active eczematous lesions (1). In the comparison between the three groups no statistically significant differences in the reactivity to the six irritants were found, except for an unexplained greater skin reactivity to cantharidin in group B. Thus, a characteristic "profile" of reactivity to irritants was not found in the people with itching from the glass fibres in comparison with those without itching.

Anamnestic data

Only one individual with atopic dermatitis was included in the study. This low frequency may be explained by the fact that individuals with a flexural dermatitis are usually advised not to work with such a heavy exposure to coarse glass fibres as was used as a criterion in the selection of workers for this study.

Itching from wool, synthetic textile fibres and hot baths did not correlate significantly to the tendency for itching from the glass fibres. Thus, a positive history in respect of these variables is of no value for predicting itching from future contact with glass fibre, nor is excessive sweating or dry skin on the hands, as judged by the workers themselves. The variables caused by *sunburn* and *suntan* also showed no correlation to the tendency for itching from the glass fibres.

The *general pigmentation* has often been correlated to skin reactivity, and dark people are usually considered less sensitive to irritants. Red-headed and blond people, for example have been advised not to work in contact with petroleum products (9). In the present study no significant differences were found in respect of general skin pigmentation or eye or hair colour when the groups with and without itching from fibres were compared. It is thus not possible to advise any Caucasian against working with glass fibres on account of a special type of pigmentation.

Thus, with a single exception, no statistically significant differences have been demonstrated with respect to the skin tests, anamnestic factors or general skin pigmentation between those individuals who have continuous severe symptoms of itching

from working with glass fibres, those who have no itching and those who have become resistant to itching from the fibres.

The exception is the rubbing test with fibres, where subjectively those workers with permanent itching from the fibres reacted more often than those without itching and where the workers who had become resistant had a longer latency time before onset of itching than those without itching. These differences in the *subjective* evaluation of this rubbing test do not correspond to differences in the objective evaluation of the skin reactions to this test.

This one test, found to be of discriminatory value for selecting those individuals with severe and constant occupational itching from the glass fibres, is thus based on subjective evaluation by the workers themselves and cannot be utilized as a *solitary* pre-employment test in the glass-wool-industry. It may, however, indicate that other types of tests based on the principle of provocation of itching might be useful for this purpose.

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A. Björnberg, M.D.
Department of Dermatology
University Hospital
S-221 85 Lund
Sweden