

# Clinical examinations to validate self-completion questionnaires: dermatitis in the UK printing industry

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A self-completion questionnaire sent to 2600 Nottinghamshire members of the Graphical Paper and Media Union elicited a 62% response. Forty one per cent of respondents reported suffering a skin complaint at some time and 11% had a current skin problem on the hand. This paper reports the validation stage of the study. Samples of 45 'cases' of self-reported dermatitis and 60 'controls', who reported they had never suffered a skin complaint, were clinically examined. All 45 self-reported cases were clinically confirmed as dermatitis. Occupationally related irritant contact dermatitis (ICD) was diagnosed in 20 (44%); 26 (58%) complaints were thought to be induced or exacerbated by occupation. Of the controls, 21 (35%) were also diagnosed with a skin complaint, the majority being mild, with an occupational association in 17, the majority (15) being ICD. Sixteen ICD cases were patch tested resulting in positive reactions to colophony, neomycin, nickel and potassium dichromate (2 of each). Two cases of basal cell carcinoma on the face were also identified, of which the participants were unaware. Although there was no false positive self-reporting there was a considerable number of false negatives, demonstrating the importance of clinical validation of questionnaires relating to industrial skin disease. This study has highlighted the need for improvement in skin care provision in the printing industry.

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Occupational dermatitis is a considerable burden to industry. Over the past decade, the Self-Reported Work-Related Illness Surveys, conducted by the UK Health and Safety Executive (HSE), have reported a continuing rise in the number of cases of self-reported occupational skin disease (1). Results from reports by dermatologists to EPID-ERM, the surveillance scheme for work-related disorders, have indicated a rate in printers of approximately 85.8 dermatitis cases per 100,000 (2).

There have been many individual case reports describing different chemicals in the printing industry that have been associated with dermatitis (Table 1). Potential skin irritants within the printing industry include alcohols, alkalis, developers, etching solutions, greases, waxes and inks, and contact allergens such as potassium dichromate, formaldehyde, hydroquinone glues and gums. There are three main categories of occupation in the printing industry, namely prepress, printing

and finishing processes. Many of the case-reports and other studies (3, 4) have identified the printing processes as being particularly associated with contact dermatitis.

A study to investigate the prevalence of skin problems in the UK printing industry has been carried out in two stages during 1999. In the first stage, a detailed self-completion questionnaire was sent to approximately 2600 members of the Graphical Paper and Media Union (GPMU) living in Nottinghamshire. The results from this survey have been published in detail elsewhere (5). Briefly, the overall survey response was 62%. Eighty five per cent were men, and the majority of respondents were between 30 and 50 years old (59%), with 31% aged over 50 and only 10% aged under 30. Of those directly involved in the printing industry ( $n = 1189$ ), 25% participated in prepress preparation, 46% in the printing process and 42% in finishing.

Of respondents, 41% (490) reported that they

Table 1. Selected case reports of dermatitis in printing workers

| Reference                     | Chemical                                            | Disease diagnosis  | Occupation     |
|-------------------------------|-----------------------------------------------------|--------------------|----------------|
| Spruit & Malten (16) 1975     | Potassium bichromate & cobalt chloride              | Contact dermatitis | Offset printer |
| Tilsley (21) 1975             | Nyloprint                                           | Dermatitis         | Printer        |
| Pye & Peachey (22) 1976       | Nyloprint                                           | Contact dermatitis | Platemaking    |
| Bjorkner et al. (23) 1980     | Acrylates                                           | Dermatitis         | Printer        |
| Nethercott (24) 1981          | Epoxy acrylate                                      | Dermatitis         | Printer        |
| Pedersen et al. (25) 1982     | Acrylamides                                         | Contact dermatitis | Typographer    |
| Nethercott et al. (26) 1983   | Urethane acrylates                                  | Contact dermatitis | Printers       |
| Freeman (27) 1984             | Benzisothiazolinone                                 | Contact dermatitis | Lithoprinter   |
| English et al. (28) 1986      | 1-Methylquinoxalinium- <i>p</i> -toluene sulphonate | Contact dermatitis | Printer        |
| Whitfield & Freeman (29) 1991 | UV-cured inks                                       | Dermatitis         | Screen printer |
| Rycroft & Neild (30) 1992     | MCI/MI biocide                                      | Contact dermatitis | Printer        |
| Kanerva et al. (31) 1995      | Polyfunctional aziridine                            | Dermatitis         | Printer        |
| Kanerva et al. (32) 1996      | Cobalt-2-ethylhexoate                               | Contact dermatitis | Offset printer |
| Wahlberg (33) 1998            | NAPP printing plates                                | Severe dermatitis  | Printer        |

had suffered a skin problem on the hands, face or forearms at some time and 26% of these had a current skin problem on the hand. The most frequently reported symptom was itching (61%), followed by rough skin or rash (58%), dry skin with flaking (56%), redness (55%) and cracks and crusting (51%). Burning, prickling or stinging affected 28% of respondents and 17% also reported pain. Prevalence was highest in those involved in printing processes (49%), although over 90% of them wore personal protective equipment such as gloves. The most commonly affected parts of the hand, face and forearm were fingers or webs between the fingers, closely followed by the back of the hand. A large proportion of those suffering reported that work-related substances appeared to aggravate a skin condition.

This paper reports the results of the second stage of the study, which aimed to validate the self reported responses from the questionnaires and further investigate the true prevalence of current skin problems.

### Methods

All respondents, 'cases', who had reported on their questionnaire that they had suffered from a skin complaint at some time and that this was current, together with a random sample of 'controls' who had reported that they had never suffered from a skin complaint, were invited to attend a skin clinic for a short dermatological examination. Invitation to the clinics was by letter, with a clear explanation of the aims and clinical procedures, including potential patch testing. A form providing a choice of appointment dates and a prepaid return envelope were also included. Clinics were scheduled in both the morning and evening to accommodate different shift patterns in the industry. Upon the return of a completed form stating the preferred clinic

date and confirmation of a home telephone number, each participant was telephoned to finalize an appointment time and clarify any issues.

A volunteer information sheet was distributed to all participants at the start of the clinic visit. Each participant, having understood the purpose of the clinics and the ultimate aim of the research project, was then asked to complete a consent form. Travel expense forms to enable individuals to recover costs for attending the clinic were also distributed.

The same experienced dermatologist undertook the clinical examinations and patch testing. The morphological criteria used were clinical, namely the presence of erythema and papules/vesicles or erythema and scaling and fissures/lichenification. If a diagnosis other than dermatitis was made, then the clinical features normally used to make the diagnosis were employed. For example, a diagnosis of psoriasis on the hand would include the presence of psoriasis elsewhere, a history of psoriasis and morphological features of the hand, such as well defined scaly lesions with no history or signs of vesicles.

Two main criteria were used to categorize the severity of the dermatitis including (i) the extent of the dermatitis on the hand, face or forearms (less than one third, one to two thirds, more than two thirds), and (ii) the presence of secondary features: vesicles greater than a 20p coin; intense redness; more than one fissure; crusting/oozing greater than a 20p coin; lichenification. Severity was defined as follows:

- mild severity – the presence of dermatitis but no secondary features;
- moderate – any secondary features and dermatitis involving less than one third;
- severe – any secondary features and dermatitis involving one to two thirds;

- very severe – any secondary features and dermatitis involving over two thirds.

Patch testing was carried out on 16 of self-reported cases diagnosed with irritant contact dermatitis (ICD). A modified 'printer series' for patch testing was devised, in addition to the use of the standard European battery series. The chemicals of prime concern to be patch tested were decided on the basis of previous reports and frequency of use in the printing industry. The series was: hydroquinone, abitol, propylene glycol, turpentine oil, methyl methacrylate, 2-hydroxyethyl methacrylate, triethyleneglycol dimethacrylate, diurethane dimethacrylate, bis GMA, and cycloaliphatic epoxyresin. Patch testing, when required, was performed on an individual's back. After 48h occlusion, any positive results were marked by a spouse or partner. Final diagnostic readings were taken by the consultant dermatologist on the return of the printer to the clinic after 72h.

The clinical diagnosis, including patch testing results if carried out, and the distribution of the dermatitis, together with questioning during the examination on the nature of the tasks carried out at work and the process and chemicals encountered, were all used by the dermatologist to determine whether the dermatitis was likely to be occupationally related.

### Results

Forty five cases of self-reported current skin problems and 60 control subjects were seen out of 127 and 253 invited, respectively; response rates of 35% and 24%. All 45 cases of self-reported current skin problems were confirmed as dermatitis by clinical diagnosis. Occupationally related irritant contact dermatitis was diagnosed in 20 (44%), of whom 3 also suffered from psoriasis. The severity of dermatitis was assessed for these 20 ICD cases. Ten (50%) suffered a mild form of the disease and 9 (45%) were recorded with a moderate problem. Only 1 case was diagnosed as severe. Overall, 26 (58%) of the 45 cases were thought by the dermatologist to be suffering from a complaint that was induced or exacerbated by their occupation. Of those who had reported they had never had a skin complaint, 21 (35%) were diagnosed with a skin problem (Table 2) with an occupational association thought likely in 17 (28%). All were of mild or moderate severity. Other skin diseases that were diagnosed but not considered to be occupationally related included polymorphic light eruption (1 case, 1 control), rosacea (3 cases), sebaceous or other eczema (5 cases), poikiloderma (1 case), seb-

Table 2. Clinical diagnosis of cases and controls

|                                   | No. of patients |          |
|-----------------------------------|-----------------|----------|
|                                   | Cases           | Controls |
| Occupational                      |                 |          |
| Irritant contact dermatitis (ICD) | 17              | 15       |
| ICD and psoriasis                 | 3               | –        |
| Psoriasis                         | 3               | 1        |
| Warts                             | 1               | –        |
| Seborrhoeic dermatitis            | 2               | –        |
| Callouses                         | –               | 1        |
| Total occupational                | 26 (58%)        | 17 (28%) |
| Non-occupational                  |                 |          |
| Psoriasis and eczema              | 1               | –        |
| Psoriasis                         | 7               | –        |
| Other skin diseases               | 11              | 4        |
| Total non-occupational            | 19 (42%)        | 4 (7%)   |
| No skin problem                   | –               | 39 (65%) |
| Total                             | 45              | 60       |

aceous cyst (1 control), otitis externa (1 control) and tinea manium (1 case).

The largest proportion of workers with ICD in both groups were involved in the printing process: 50% and 53%, respectively, and in particular machine minders, printers and reelstand operators. Job titles reported by those in finishing processes included guillotine or folding operator, finisher and cut/grease operator. Of ICD cases, 45% reported daily involvement cleaning litho rollers and cylinders, 25% using inks containing solvents and 20% using UV-cured inks. This compared with 33%, 27%, and 13%, respectively, in the controls with ICD. In addition to ICD, other skin problems, such as psoriasis, were clinically diagnosed as being occupationally related. Guillotining and handling consumables in finishing processes also accounted for a number of occupationally related problems.

Sixteen of the self-reported cases diagnosed with ICD were patch tested. Only the most severe cases or those whose exposure pattern was likely to increase their chances of sensitization were tested. It was felt that patch testing of the milder cases might have increased the risk of sensitizing them to allergens which they might encounter at work. Positive reactions were found to colophony, neomycin, nickel and potassium dichromate (2 of each). Positive reactions to nickel occurred in two finishing workers, both of whom reported handling press room consumables on a daily basis for over 3 years. An occupational relationship was also determined in the 2 patients who showed a positive patch test reaction to potassium dichromate. Both patients recorded that the skin problem had appeared since the age of 16, but occupations and symptoms differed. The first was found in a machine minder who reported daily cleaning of litho rollers and cylinders in a sheet

printing company. The problem affected the fingers, hands and elbows and cleared up during periods away from work. Despite a past history of eczema and previous patch testing, an allergy had never been previously identified. The second positive reaction was found in a guillotine operator in a digital printing company. Use of personal protective equipment including gloves, and skin care products (barrier creams) appears to have failed to prevent these problems.

Two cases of basal cell carcinoma (BCC) on the face were identified at the clinics and treated appropriately. Neither worker reported any skin problem on the face in the questionnaire. One worker was in the control group and the other had been selected as a case, having self reported a problem of dry skin on his hands. Both had a history of over 30 years in the industry. The case worked as a sheet printing machine minder who cleaned litho rollers and cylinders and came into daily contact with inks containing solvents. The control participant was a prepress platemaker involved in photographic reproduction systems, platemaking and correcting litho plates. Both reported using personal protection (wearing gloves). Similarly, both reported suffering from an allergy, though each had a different type, the case having asthma and the control, hayfever. The dermatologist concluded that neither of the BCCs was likely to have been occupationally related.

### Discussion

The response rate of 62% compares well with other postal surveys of individuals in the general population. For example, the Trent Health Lifestyle Survey, which targetted the adult population in the Trent Health Region, which included Nottinghamshire, achieved a response rate of 61% (6). In other similar surveys, the response rate has varied between 55 and 70% (7). There were no major differences in age distribution between responders and non-responders.

The prevalence of 11% self-reporting a current skin problem on the hand (26% of those reporting a skin complaint at some time) is very much higher than the incidence reported by EPIDERM of 85.8 cases per 100,000 in printers seen by dermatologists (2). About two-thirds of the reports to the EPIDERM surveillance system are from consultant dermatologists (with a 75% response rate) and occupational health physicians (with a 87% response rate), who see only a small proportion of all cases and probably the most severe. It is therefore not strictly comparable with the present study. In addition, it is interesting to note that, whereas

printers have the second highest rate per 100,000 workers estimated from reports by dermatologists to EPIDERM, they do not appear in the ranking from reports by occupational physicians (2). This indicates a general lack of occupational health provision in the printing industry.

The clinical validation of self-reported prevalence of skin complaints was restricted by the number of clinics it was possible to hold in the available time following each questionnaire distribution. Only those self-reporting a current dermatitis problem were considered for invitation, and just over a third of those invited took up the offer of a clinic appointment. A control group was selected by taking a random sample of those reporting no skin problems at all. Approximately one-quarter of these people took up the offer of a clinic appointment. Clinics were specifically arranged for each group and thus the dermatologist was not blinded to whether each patient was a self-reported case or control. It should be noted that there was an intermediary group of individuals who reported having had a skin complaint at some time but who did not have a current problem. These respondents were not invited for a clinical examination. It is possible that the prevalence of occupationally related skin complaints in this group lies somewhere between those of the cases and controls described here. Future work could include an investigation of this in addition to a more detailed study of the non-responders to both the original questionnaire and the clinic invitation.

The importance of a clinical examination to validate self-reporting of dermatitis has been demonstrated in other studies (8). In studies of self-reported hand eczema in car mechanics, dentists and office workers, 80–90% were confirmed by clinical diagnosis (9–11). Similarly, considerable numbers of those not self-reporting a skin problem have been found in other studies to have dermatitis when clinically examined. For example, Smit et al. (12) found that 7.7% of those not reporting hand dermatitis were in fact diagnosed as having this problem on dermatological examination. In a study of production workers in a plant producing binders for paints and glues, 23% who had denied they had a problem in a questionnaire were diagnosed clinically with hand dermatitis (13).

Although only a selection of respondents with a self-reported current skin complaint were seen by a dermatologist in this study, the clinical results show that the self-reporting questionnaire was successful in identifying the high prevalence of skin complaints in this group. All those self-reporting a current problem had this confirmed, i.e. there were no false positive results in this study. However, there was a large proportion of false negative re-

sults, in that 35% of the 'controls', i.e. those self-reporting never having had a skin problem, were diagnosed with a skin problem. It may be that within the general population, including the workforce, there is a small proportion who appear to accept a minor skin irritation or may wish to deny that they have a problem. This study thus had a high specificity (all of those diagnosed with no skin complaint self-reported no skin complaint) and a sensitivity of 68% (of the 66 diagnosed with a current skin problem, 45 self-reported this). It may also be possible that, given the opportunity of a clinical examination, those who had mild skin disease in the control group were more likely to respond. A clinical examination of all the workforce would be needed to confirm the true sensitivity.

The interpretation of results from self-reported questionnaires depends partly on their intended use (14). If they are intended for estimation of prevalence or as a screening tool for early signs of disease then it is important to have high specificity and negative predictive value, i.e. the proportion of patients self-reporting no problems who are correctly diagnosed. In this study, although the specificity is high, the negative predictive value is only 65% (39/60), indicating underestimation of true prevalence and suggesting that a large number of potential cases would be missed if the questionnaire was used as a screening tool. However, if the questionnaire was intended to identify high risk individuals and those with overt symptoms, then the lack of false positive results from this study indicates that it would be useful for this purpose.

In this study, 58% and 28%, respectively, of the cases and controls were diagnosed at clinical examination to be suffering from an occupationally caused or exacerbated skin problem. Using the size of the groups of cases and controls selected for a clinical examination as weights, the overall prevalence of occupationally related skin complaints for the cases and controls can be estimated to be around 40%. Over the past decade the Self-Reported Work-Related Illness Surveys conducted by the UK Health and Safety Executive have reported a continuing rise in the number of cases of self-reported occupational skin disease. Industries in which the prevalence of dermatitis has been identified and which are also regarded as high risk professions include cleaning, construction, vehicle maintenance, catering and metal working (15). Dermatitis is reported to affect from 15% to 20% of the UK population generally (15).

For most of the workers suffering from a clinically diagnosed case of occupational ICD this was classified as mild, in terms of severity. It is therefore likely that the condition would disappear after

a period away from work. Disappearance of symptoms away from work was reported by three-quarters of all those with a skin complaint, suggesting that the symptoms were indeed occupational. Many previously reported studies and case reports have identified substances of concern, such as sensitizers (see Table 1). It was felt inappropriate in this study to ask about exposure to specific chemicals as a self-completion questionnaire was used. Although only a small amount of patch testing was carried out, nickel and potassium dichromate were identified as potentially important sensitizers that are present in the printing industry. This corresponds to the relatively early research findings by Spruit & Malten (16) of an association between potassium dichromate and contact dermatitis in printing workers. It should be noted that in this current study of printing workers, patch testing for acrylic allergens was not carried out to avoid the risk of active sensitization to acrylates.

In this study, 2 cases of skin cancer (BCC) were identified during the clinical examinations, although these were not thought to be occupationally related. A Danish study by Lynge et al. (17) found an increased incidence of a variety of cancers that was related to various sections of the printing industry.

A number of workers in this study reported skin problems on the fingers and hands, although they also reported using gloves. Those involved in printing processes tended to have a high self-reported prevalence of problems on the forearms. The need to extend personal protection to the forearm has thus been highlighted. In addition, the provision of effective protective equipment is vital. As Reitschel et al. (18), demonstrated, nitrile gloves provide adequate protection from UV light cured acrylate resin systems, whereas latex and neoprene gloves do not. It is, however, important for those providing protective equipment to be aware of the potential problems that the equipment itself may cause, such as irritation to damaged skin from gloves and allergy to substances such as latex (19). In this present study several respondents also commented on the inconvenience of wearing gloves and that some tasks or jobs were made difficult or even potentially dangerous if gloves were worn.

In a postal survey of UK companies by Douglas et al. (20) to investigate the provision of skin care facilities, the person responsible for health and safety had a recognized health and safety qualification in 34% of the companies surveyed. In the printing companies surveyed, this was only 14%. The study by Douglas et al. recommended the establishment of a minimum training qualification in health and safety, in particular for skin care, and

the development of guidelines on how to design and implement a skin care policy, select and use appropriate gloves and skin care products, and detect and manage workers with skin problems. The present study has confirmed the need for implementation of these recommendations.

### Conclusions

This study has highlighted the difficulties of establishing the true prevalence of skin problems through self-reporting, in that there was a considerable proportion who had a mild skin condition but who chose to ignore it or did not mention it for other reasons. It has demonstrated that validation through clinical examination is essential. The finding of 2 cases of BCC, although not occupationally caused, highlights the need for the increased provision of occupational health services in the printing industry, in which regular skin examinations are carried out. More information and advice on the development of skin care policies should be disseminated to management and those with responsibility for health and safety. Individual workers could be further encouraged to make effective use of appropriate skin care provision, such as creams, and the use of protective measures, such as gloves and overalls. A study is now underway to develop effective and acceptable strategies to reduce the risk of dermatitis in the UK printing industry.

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