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FACIAL SKIN COMPLAINTS AND WORK AT VISUAL DISPLAY UNITS

Epidemiological, clinical and histopathological studies

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To Ing-Marie

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ABBREVIATIONS

CI - Confidence interval. The 95% confidence interval for the relative risk is used in the studies.

cp. - compare

CRT - Cathode ray tube

ET - Erythematotelangiectatic (rosacea)

n.s. - not significant

PP - Papulopustular (rosacea)

RR - Relative risk

VDT - Visual display terminal

VDU - Visual display unit. In this context VDT is used synonymously with VDU.

ABSTRACT

Only in Sweden is skin disease reputedly caused by working at visual display units (VDUs) a considerable problem. In the present work facial skin complaints in VDU-exposed persons have been studied by means of epidemiological, clinical and histopathological methods. The results can be summarized as follows.

Half the patients referred for dermatological examination because of facial skin complaints they attributed to working at VDUs had rosacea. Most of them claimed that they had pronounced symptoms, but their skin lesions were mild. When they were followed up most of the patients reported improvement without pharmacological therapy in spite of continued VDU work.

Individuals exposed to VDUs had significantly more self-reported skin complaints than a nonexposed control population of office employees, but no more visible signs. Skin tumours with malignant potential and unilateral facial skin signs were found in the same frequencies in both categories. Rosacea was the most common facial skin condition (10%) in the 809 randomly selected office employees (mean age 43 years) examined, and this condition as well as the occurrence of telangiectases (found in 57% of the examined population) was no more common among the exposed persons.

The answers in the self-administered questionnaires (n=3745), used when studying the office employees, corresponded poorly to skin status (only 46% correlated), but were reasonably accurate as regards the occurrence of more clear-cut symptoms, such as in atopic or seborrhoeic dermatitis.

Patients with skin complaints they said were associated with VDUs had no characteristic histological changes in facial skin. Histological changes of varying degree were also common among the control subjects without skin complaints or exposure to VDUs. This is particularly true of the degree of degenerative change in elastic fibers, which increased with age.

Rosacea was more common in women, and there was a strong association between rosacea and migraine, as well as between migraine and patients with symptoms thought to be related to work at VDUs. In contrast to previous assumptions, most subjects with rosacea in this study experienced no impairment due to exposure to sunlight.

This work shows that people exposed to VDUs had subjective skin symptoms more often than a nonexposed control population. The design of the study does not per-

mit an analysis of the cause of this phenomenon. The occurrence of skin signs in persons exposed to VDUs is, however, fortuitous from an epidemiological viewpoint.

Key words: epidemiology, questionnaire, rosacea, skin complaints, telangiectases, unilateral skin signs, visual display terminals, visual display units

INTRODUCTION

Computer technology constitutes one of the most important parts of current technical development. One or more visual display units (VDUs, also called visual display terminals, VDTs) of a cathode ray tube (CRT) type are as a rule integrated into the computer system. As they are one of the corner stones of modern information technology computers and VDUs are being used with increasing rapidity in most areas in our society, e.g. industry, services and administration, and it has profoundly changed the nature of work for many people. This technology has been introduced very rapidly in most countries, not just in Sweden. There are no exact data about how many people in Sweden today are working with VDUs, but in 1984 1.9 million people were engaged to some degree in VDU work (personal communication from the Swedish National Board of Statistics, Stockholm), i.e. half the total population in active work, and 0.6 million people worked daily at VDUs.

The most common picture unit in the VDU is a CRT with magnetic beam deflection. It is essentially a device which displays information received from a computer system, and physically is it rather similar to the picture tube in a television set. The VDU contains in addition the electronic circuits required to deflect the electron beam in the CRT and to modulate the light intensity on the screen. Some users of VDUs have accused the VDUs of causing ill effects on their health. It has been suggested that electrostatic charging of the operator causes these effects (Cato Olsen, 1981), but such electrostatic charging is due mainly to friction between materials in contact with the operator (Bergqvist, Wibom & Nylén, 1987; Frankenhaeuser, 1987; Wedberg, 1987). Public discussions has also focused on the effects of ultraviolet and ionizing radiation from the VDU, but investigation has shown that these can be discounted as health risks originating from VDUs (Berg et al, 1988; Bergqvist, 1984; Guy, 1987; Knave et al, 1985; Lidén C, Bergqvist & Wennersten, 1986; Paulsson et al, 1984; Paulsson, 1987; Zuk et al, 1983). However, the most persistent claim has been that the electromagnetic fields in the vicinity of the VDUs are the culprits. Electromagnetic fields can briefly be described as an electric and a magnetic field. The electric field around VDUs is mainly constant (i.e. a frequency of zero Hz), and it has a minor peak at 50 Hz. The static field penetrates a few nanometers only into the human body. The 50 Hz peak (i.e. the electric alternating current (AC) field) is so minor that it can be ignored (Frankenhaeuser, 1987; WHO, 1984). The magnetic field is caused by the currents in the horizontal and the vertical deflection coils, and in some transformers in the VDU. Alternating electric and magnetic fields, in contrast to static fields, generate currents in a conductive body within the field. The currents generated by the VDU in the operators' body tissues are orders of size smaller than the currents in all the body tissues generated by

normal biological activity (Frankenhaeuser, 1984 and 1987; Hodgkin, 1963; Repacholi, 1985; Saunders & Smith, 1984; Stuchly et al, 1983). This includes electrically inactive tissues also, because the currents from excited tissues (e.g. the heart, the brain, the muscles and the nerves) pass through all the neighboring tissues (Bernhardt, 1979; Frankenhaeuser, 1984 and 1987).

Reports of skin complaints in people exposed to VDUs first appeared from Norway (Lindén & Rolfsen, 1981; Nilsen, 1982; Tjønn, 1984), and a few cases have also been reported from the United Kingdom (Rycroft & Calnan, 1984), the United States (Feldmann & Eaglstein, 1985; Fisher AA, 1986), Sweden (Lagerholm, 1986; Stenberg, 1987 and 1989) and Japan (Matsunaga et al, 1988).

There have, furthermore, been reports or suspicions of possible health effects involving organs other than the skin (for a review, see: Beijan et al, 1987; Bergqvist 1984; Evans, 1985; Marriott & Stuchly, 1986), e.g. pregnancy outcome (Goldheber, Polen & Hiatt, 1988; Tuthill, 1985), vision problems (Böös et al, 1985; Howarth & Istance, 1986; Nyman, Knave & Voss, 1985; Shen et al, 1988), musculoskeletal disorders (Arndt, 1983) and stress reactions (Cohen, Smith & Stammerjohn, 1981; Cox & Cox, 1986; Johansson & Aronsson, 1984; Nemeth & Childress, 1987).

There are a few studies of an epidemiological nature regarding VDU work and dermatological problems. In a questionnaire study from the United States (Murray et al, 1981), the incidence of self-reported skin problems was 44% among the VDU operators as opposed to 30% in the nonexposed group. In another study from the same country (Frank, 1983) no difference as regards self-reported skin problems was found between exposed and nonexposed persons. The response rate in these two studies, however, was low (less than 50%), significantly more exposed subjects participated in the studies, the subjects were not personally examined, and no further analyses of the materials were conducted. In a Swedish survey of the consequences of working with VDUs among office employees, the dermatological factors were investigated (Lidén C & Wahlberg, 1985A). This study indicated that a relationship might exist between VDU work and aggravation of seborrhoeic dermatitis, acne, rosacea and perioral dermatitis. Only individuals with self-reported skin complaints, however, were called to the dermatologic examination, not those without, and the examined cohort was rather small and did not permit any clear-cut conclusions to be drawn. The same authors investigated an out-patient population of 179 patients with rosacea or perioral dermatitis with respect to the occurrence of VDU work (Lidén C & Wahlberg, 1985B). Of these patients, 42 had worked with VDUs, and eight of those 42 suspected aggravation due to exposure to VDUs. Rosacea is a common facial skin disorder (cp. Neves, 1966), especially in women aged 30-50

(Marks, 1976; Ramelet, 1986). This disorder mainly affects the facial skin (Marks, 1976), but may also occur in other regions (Ayres, 1987; Dupont, 1986A; Fisher I, 1974; Fountain & Sarkany, 1967; Gajewska, 1975; Marks & Wilson Jones, 1969; Röckl, Schröpl & Schefer, 1969; Starr, 1969; Wilkin 1980). The pathogenesis of rosacea is not completely understood, but the disease is thought to stem from a labile regulatory mechanism of the blood vessels (Marks et al, 1967; Wilkin, 1981 and 1983).

When 100 referred patients were examined by a trained dermatologist (Wahlberg, 1986; Wahlberg & Lidén C, 1988) only common facial dermatoses were found, and no patients had specific dermatosis related to work with VDUs. Two medical officers (Svensson & Svensson, 1987) examined 415 employees working with and without VDUs. They stated that signs of mild seborrhoeic dermatitis, dry skin (cp. Piérard, 1987; Werner Linde, 1989) and "red eyes" (cp. Howarth & Istance, 1986) were more common among those exposed to VDUs. However, the methods and the figures for prevalence are not unambiguous (e.g. in some of the examinations the physician knew whether or not the subjects were exposed, and the subjects who worked very little with VDUs had fewer skin signs than the nonexposed people). A provocation study (Swanbeck & Bleeker, 1989) did not yield any relation between the symptoms of the patients and electrostatic or magnetic fields from the VDUs. A questionnaire study from the Philippines (Koh et al, 1989) confirms that magnetic and electrostatic fields are not of major importance for skin complaints in people exposed to VDUs. Another provocation test (Sandström, Stenberg & Hansson Mild, 1989) indicates that the magnetic fields caused by horizontal deflection coils are probably not of importance for skin problems associated with work at VDUs.

As mentioned earlier the first reports of these problems came from Norway, but there have been no new cases reported from there since 1984, and apart from Sweden there are only a few isolated case reports from other countries. When C Lidén and Wahlberg (1985 A and B) at the Department of Occupational Dermatology at the Karolinska Hospital carried out their studies at the beginning of the decade, skin complaints reputedly associated with work at VDUs had not yet become a particular problem in Sweden. However, since the fall of 1985 there has been extensive public debate in Sweden on the health effects of exposure to VDUs, and it has been stated that skin disease from VDU work is common. This debate started when one case (Lagerholm, 1986) was accepted as an occupational disease by the National Insurance Board. During the period 1979 to October 1985 only seven cases were referred to the Department of Occupational Dermatology with skin disease suspected of being related to work at VDUs. However, from November 1985 to May 1986, 100 new and consecutive cases were referred and examined (Wahlberg, 1986; Wahlberg & Lidén C, 1988). Many employees working at VDUs have thus become worried about skin da-

mage, which is why we considered it essential to study the possibility of skin disease associated with work at VDUs.

AIMS OF THE STUDY

The aims of the present study were to

- * describe symptoms and skin lesions in patients who were referred for dermatological examination with skin disease suspected of being related to work with VDUs, and to follow the course of their skin complaints (I).
 - * investigate whether skin diseases are more common in people exposed to VDUs than among a nonexposed control population, through questionnaires (II,III) and a personal examination and interview of part of them (II-IV).
 - * evaluate the usefulness of self-administered questionnaires in studies of dermatological problems in a population (II).
 - * study the most common facial skin disease in adults - rosacea - by means of epidemiological methods (IV).
 - * compare facial skin biopsies from patients with skin complaints which - in the view of the patients - were associated to work at VDUs, with biopsies from a nonexposed control population with a similar skin status (V).
-

SUBJECTS AND METHODS

SUBJECTS

(I) Consecutively referred patients (n=201) with skin complaints they suspected were associated with work at VDUs were examined by the same dermatologist (MB). Their mean age was 41 years and 91% were women. As control subjects for some comparisons we used the 333 subjects first examined and interviewed (mean age 45 years, 62% women) in the epidemiological study of office employees (II-IV). A follow-up was carried out for 75% of the patients for an average period of eight months. Most of the patients did not receive any pharmacological therapy for their skin complaints.

(II-IV) A questionnaire was sent to 3877 randomly selected office employees with varying degrees of VDU exposure. They were recruited from 36 companies in four Swedish cities: Stockholm (53% of the subjects), Gothenburg (33%), Södertälje (8%) and Sundsvall (6%). The participation rate was 96.6% (n=3745). The subjects were employed in industrial companies (33%), insurance companies (29%), trade union offices (15%), banks (10%), county council administrations (7%) or public administration offices (6%). Of those who answered the questionnaire, 879 people from 21 companies were called for an examination at their place of work; participation rate 92.0% (n=809). They were randomly selected irrespective of degree of exposure or their answers on the form. This selection, as well as the first selection of subjects, was carefully supervised by the main investigator (MB). An extra questionnaire inquiring about VDU exposure was afterwards sent to those who had answered the first form, but had not been personally interviewed. This questionnaire, together with the information from the interviews, gave us data about exposure to VDUs from 3697 (2888+809) subjects (Table I). There was no significant difference between exposed and nonexposed subjects as regards participation rates, answering the form or participating in the examination. The answers on the questionnaire did not significantly differ between those who were examined and those who were not examined, indicating that the examined subcohort is representative of the whole cohort.

Table I

The distribution of age, sex and VDU exposure of the total cohort of 3697 office employees and the 809 randomly chosen individuals from this population who were examined. The VDU exposure categories: 0, no VDU exposure; 1, up to 2 hours per week; 2, intermediate exposure between categories 1 and 3; 3, ≥ 20 hours per week over a period of at least 5 years.

Exposure categories	Total cohort		Examined subcohort	
	No/%	women-men,%	No/%	women-men,%
0	946/26	50-50	182/22	50-50
1	632/17	38-62	152/19	46-54
2	832/23	54-46	149/18	59-41
3	1287/35	63-37	326/40	63-37
total	3697/100	53-47	809/100	56-44

(IV) Those (n=81) in the examined cohort of 809 persons who were diagnosed as having either an erythematotelangiectatic (ET, n=66) or a papulopustular (PP, n=15) rosacea were given special attention. The people included had typical signs (papules and/or pustules, erythema, telangiectases and swelling) of a current rosacea or had a history of rosacea over the last two years. The lower limit of rosacea was set at statement of a recurrent stable (>24 hours) erythema, and a history that excluded other conditions. Individuals with telangiectases or erythema alone, with no history of rosacea, were not classified as belonging to the group. Most of the cases were, therefore, rather mild, and only 17% of the subjects had any on-going specific pharmacological therapy for their condition, and another 21% had previously had therapy. The telangiectases (I,III,IV) were classified into three degrees: +, only mild telangiectases, mostly situated on the nose; ++, moderate telangiectases, most often on both the nose and the cheeks; +++, marked telangiectases, often also at other sites than on the nose or on the cheeks. The examined subjects who were diagnosed as not suffering from rosacea (n=728) were chosen as a comparison group for certain parameters. The sun-reactive skin type was determined on the basis of the subject's response to the first moderate exposure to the sun in the sunny season without protection (Fitzpatrick, 1986 and 1988): skin type I, always burns - never tans; type II, always burns - minimal tan; type III, sometimes burns - always tans; type IV, never burns - always tans. Migraine (I,IV) was defined as a history of intense unilateral paroxysmal headache, often accompanied by nausea and visual symptoms (Pearce & Clough, 1985), and the condition was distinguished from e.g. ordinary tension headache.

(V) Skin biopsies from patients with skin complaints they attributed to working with VDUs, with (n=66) or without (n=17) facial skin signs, were compared to nonexposed control persons with similar (n=28) or without (n=23) facial skin signs or complaints (Table II).

Table II

The distribution of sex and age in the four groups of subjects, from whom facial skin biopsies were histologically examined.

Group	No	Women/Men %	Mean Age $\pm$ SD	Range
1. Signs, said to be VDU associated	66	88/12	46 $\pm$ 10	24-63
2. Signs, no VDU work	28	64/36	46 $\pm$ 12	20-59
3. Symptoms, said to be VDU associated, no signs	17	65/35	42 $\pm$ 9	21-58
4. No symptoms/signs, no VDU work	23	43/57	42 $\pm$ 11	28-67

QUESTIONNAIRES, INTERVIEWS AND CLINICAL EXAMINATIONS

(II-IV) We used a self-administered questionnaire to reach a relatively large population, in addition to interviews and examinations of a subgroup of individuals to provide a validation of the questionnaire (II). A preliminary study was carried out on 50 employees from an insurance company to evaluate the information obtained in a self-administered form compared to interviews. On the basis of the preliminary study we designed the main study. The individuals who received the questionnaire were not asked beforehand if they wanted to join the study, and the intention was not to state the main purpose of the study. These principles were applied in an attempt to ensure that the study population answering the questions was as unbiased as possible. By mistake, 1147 (31%) persons were informed by the trade union representatives of the purpose of the study. This added another aspect, namely the possibility of studying the effect of information on the subjects (II). The form (Table III) comprised only one page and contained questions to be answered with "yes" or "no" followed by squares to fill in.

To exclude observer-bias, the examination started with a recording of the facial skin status before the physician knew anything more about the subject than name and age. The skin status formed the basis of a "status diagnosis". This procedure was followed by an interview lasting for about 20 minutes. A special form was then used to obtain information about (in the following order during the interviews): inherited skin diseases, previous skin diseases, sun-reactive skin types, sunbathing habits, the use of internal drugs, cosmetics, emollient creams, soaps, tobacco, consumption of hot beverages including coffee, current skin complaints, occupation, VDU exposure, types of VDUs used, electrostatic shields and general information about the work environment. We did not, for reasons of integrity, ask about con-

RESULTS

REFERRED PATIENTS (I)

The diagnoses of the referred patients are shown in Table IV.

Table IV

Clinical diagnoses of 201 patients referred for dermatologic examination because of skin complaints they attributed to working with VDUs. Total number of diagnoses: 223.

Diagnoses	% of the 201 patients
rosacea	46 (papulo-pustular 33, erythematotelangiectatic 13)
seborrhoeic dermatitis	14
atopic dermatitis	10
acne vulgaris	6
lentigo solaris	3
contact dermatitis	3 (not reported in Paper I)
xerosis only	2
telangiectases only	1
intradermal naevus	1
non-classified	18
others	5 (urticaria, psoriasis, polymorphous light eruption, syringoma, pigmentation, atheroma, pedunculated naevus)
(not on face	1)

The objective findings were generally rather slight; e.g. 70% had telangiectases compared to 68% in the control population. Most of the patients had rather pronounced symptoms such as itching (61%), burning (34%) or pain, which contrasted to the relatively mild skin signs. However, only two patients said that their symptoms disturbed their sleep. No cases of malignant or premalignant changes were found. Of the 100 patients who exposed mainly only one side of the face to the VDU, 25 had their skin problems mainly on that particular cheek. Of those 25 subjects, 19 had unilateral visible signs on that side of the face when first examined. Three patients had signs only on the side of the face that was turned away from the VDU. A history of migraine-like headache was revealed by 40% of the patients, compared to 11% (women 15%) in the control population; $p < 0.001$. The results are not significantly changed if all 809 examined subjects in the epidemiological study of office employees (II-IV) are included as controls.

VDUs and electrostatic shields

Common monochromatic VDUs were used by 92% of the patients and 62% used electrostatic shields when first interviewed. No extreme value of electrostatic field strength was measured from the VDUs in the 30 working places that were examined. One unexpected finding was that out of 52 measured electrostatic shields used by

the patients, only 5 were working correctly (38 were defective, i.e. they had poor electric conductivity, and 9 were wrongly earthed). The patients with electrostatic shields that did not work properly, were instructed in how to eliminate the electrostatic fields in front of the VDU. However, those who worked at VDUs with eliminated electrostatic fields (confirmed by measurements or by the interview, $n=75$), reported fewer symptoms than before the elimination in only 45% of the cases.

Follow-up

At the last visit 14% of the patients no longer had any skin symptoms, another 52% had less severe symptoms, 28% were unchanged and 6% had more intense symptoms than when first examined. Only eight of them had stopped working with VDUs principally because of their skin symptoms. Of these, a group of five patients said that they were sensitive to all kinds of electricity, which limited their daily lives. They had, however, relatively mild objective skin signs.

QUESTIONNAIRE EVALUATION (II)

Some skin diseases (i.e. atopic and seborrhoeic dermatitis) with more marked signs/symptoms correlated well with the view of the physician, as shown in Table V, while others, e.g. rosacea, showed a rather poor correlation. The correlation between the two responses to the same questionnaire (Table VI) varied depending on type of question. When comparing the questions on the form with the history obtained by the examining dermatologist (i.e. what the physician thought that the subjects should have answered) the correlation also varied depending on the type of question (Table VII).

Table V

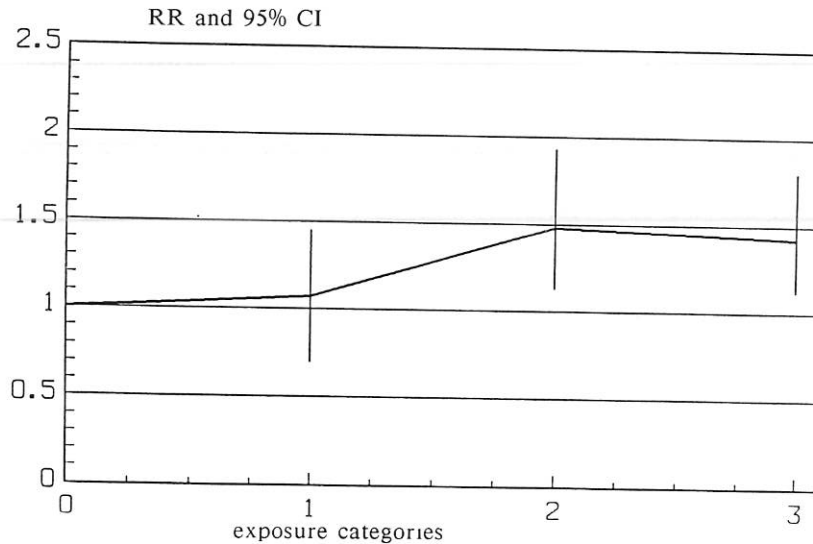
Relationship between self-reported facial skin complaints or rashes within the last two years and the clinical diagnosis and status diagnosis, respectively. The confirmation rate is taken as the proportion of individuals with clinical or status diagnosis, respectively, who also reported facial skin complaints or rashes on the questionnaire; 809 examined individuals.

diagnosis	clinical diagnosis		status diagnosis	
	No	agreement with the questionnaire	No	agreement with the questionnaire
rosacea*	81	0.69	31	0.45
atopic dermatitis	49	0.92	18	0.89
acne vulgaris	44	0.61	38	0.61
seborrhoeic dermatitis	37	0.86	17	0.82
dry skin only	71	0.75	6	0.17
skin carcinoma	3	0.33	3	0.33

* Clinical diagnosis; PP rosacea ($n=15$): confirmation rate=0.73. ET rosacea ($n=66$): confirmation rate=0.68. Rosacea was not subdivided into the PP and ET types as regards the status diagnosis.

Figure 2

Clinical diagnoses for 809 examined subjects. For explanation, see text to Figure 1.



Mantel-extension for trend: chi-square 4.37 ($p < 0.05$, two-tailed)

Table VIII

The most common clinical diagnoses, their prevalence within the last two years in the total examined population of 809 people, and a comparison between the highly exposed (cat. 3) and the nonexposed (cat. 0) groups.

diagnosis	prevalence %	RR and 95% CI comparing category 3 with category 0
rosacea	10	1.20 (0.69-2.10)
atopic dermatitis	6	0.86 (0.37-1.98)
acne vulgaris	5	0.72 (0.30-1.67)
seborrhoeic dermatitis*	5	2.19 (0.96-4.98)
dry skin alone	8	1.83 (0.92-3.62)
non-classified**	6	2.98 (1.25-7.07)

* A history of seborrhoeic dermatitis tended (n.s.) to be more common among exposed individuals. In contrast signs of seborrhoeic dermatitis were slightly more frequent in nonexposed people (RR, 0.93; 95% CI, 0.25-3.39).

** The only group of complaints (i.e. itching, burning sensations and pricking, but with few or no visible skin signs), that was significantly more common in highly exposed subjects. This group of people, however, had no more frequent skin signs than the rest of the examined population.

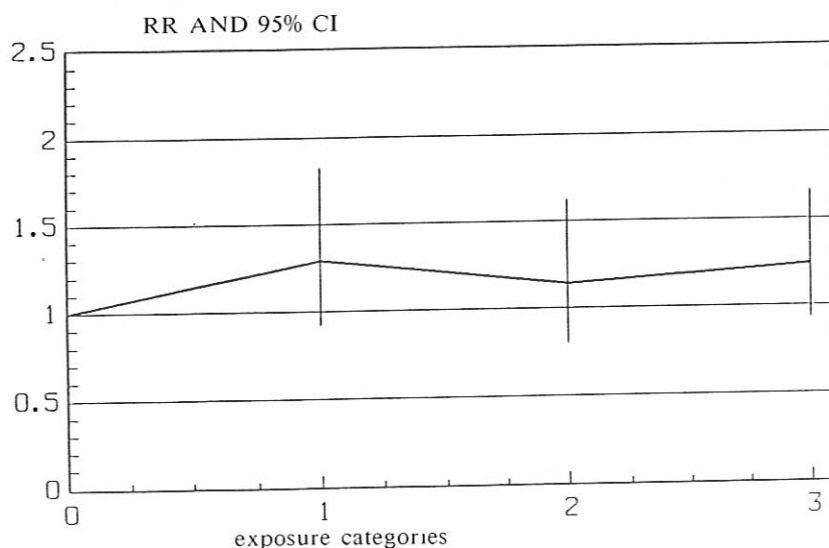
Unilateral signs

Unilateral lesions or most of the skin signs on one or other side of the face were found in 78 persons (9.6%); category 0: 9.9%, 1: 9.2%, 2: 12.8% and 3: 8.3%. In 36 of those 46 individuals from categories 2 or 3 with unilateral lesions, they occurred on the side of the face that was turned away from the VDU. Only one of the 10 remaining individuals who had the unilateral signs on the side of the face that was

turned toward the VDU had any subjective symptoms. Of the 78 subjects with unilateral signs, 32 were telangiectases only, 11 rosacea, 7 acne vulgaris, 4 atopic dermatitis, and 2 seborrhoeic dermatitis. The rest (n=22) were nonspecific papules or erythema. Of those diagnosed as rosacea, 14% had unilateral skin signs, of those with acne vulgaris 16%, atopic dermatitis 8%, and seborrhoeic dermatitis 5%.

Figure 3

All objective facial skin signs except telangiectases and tumours. For explanation, see text to Figure 1.



Mantel-extension for trend: chi-square 1.70 (p=0.2, two-tailed).

Skin carcinoma

Only three facial tumours with malignant potential were seen; two basaliomas and one actinic keratosis. Another nine individuals had previously had facial tumours with malignant potential; three basaliomas, three malignant melanomas, two actinic keratoses and one squamous cell carcinoma. There were no significant differences between VDU-exposed and nonexposed people (The mean VDU exposure time for the highly exposed was 9 years).

Possible confounders

Stratification on different variables (e.g. on smoking, wall-to-wall carpets, cosmetics or year of renovation of the offices) did not significantly change the results.

Physical factors

There were no significant differences between employees using different types of VDUs or electrostatic shields. There was a tendency (n.s.) for individuals working at VDUs with higher static and magnetic fields to have skin symptoms or visible signs

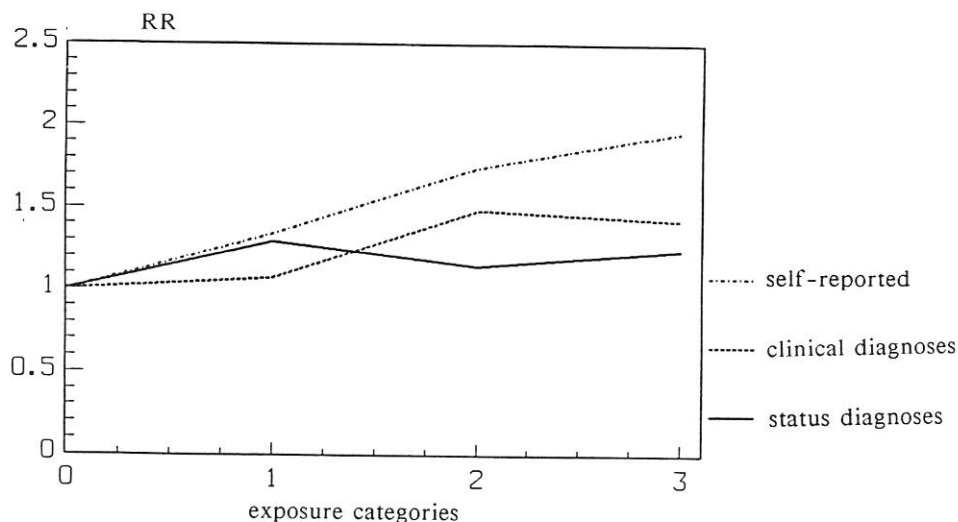
less frequently than other employees exposed to VDUs. No significant differences in the frequency of skin signs or symptoms were found for VDU users regarding the day of the week or season for the examination or as regards the city (on different latitudes) in which the employees worked.

Sex differences

Of the women 38% had self-reported skin symptoms and/or signs on the face, compared to only 22% of the men. The increasing tendency for a higher frequency of skin complaints in relation to VDU exposure was the same for women and men. There was, however, no significant difference between the sexes as regards visible signs.

Figure 4

The different measures of skin disease of increasing objectivity; 1) self-reported answers, 2) the clinical diagnoses, and 3) the status diagnoses. For information, see text to Figure 1.



ROSACEA (IV)

Of the 81 people (10% of the examined population) diagnosed as suffering from rosacea, 66 (82%) had an ET rosacea and the remaining 15 (18%) had the PP type. The distributions for age and sex are shown in Figure V. The average age was 46 years, range 29-64, but the PP type did not occur below 40 years of age. The frequency of rosacea was the same for nonexposed individuals as for employees exposed to VDUs (Table VIII), which was also true for each of the two subtypes PP and ET. The frequency of rosacea was of the same order of magnitude in the different groups of sun-reactive skin types, except for type IV which seems to confer some protection ($p=0.05$). However, only 17% of the subjects with rosacea felt that they were harmed by exposure to sunlight, while 26% thought such exposure brought

improvement. Furthermore, it was more common for the condition to become aggravated in the winter than in the summer. The people in the rosacea group flushed significantly more often than the rest of the population ($p < 0.001$). Migraine and rosacea showed a strong association (Table IX). The 728 subjects with no rosacea had subjective eye complaints (i.e. not eye status) as often as those diagnosed as suffering from rosacea (36%). Nor could any significant difference be discerned between the rosacea group and the rest of the study population as regards the use of tobacco, hot beverages, coffee, emollient creams, cosmetics, after-shave lotions or internal drugs.

Figure V
Prevalence of rosacea in different age categories.

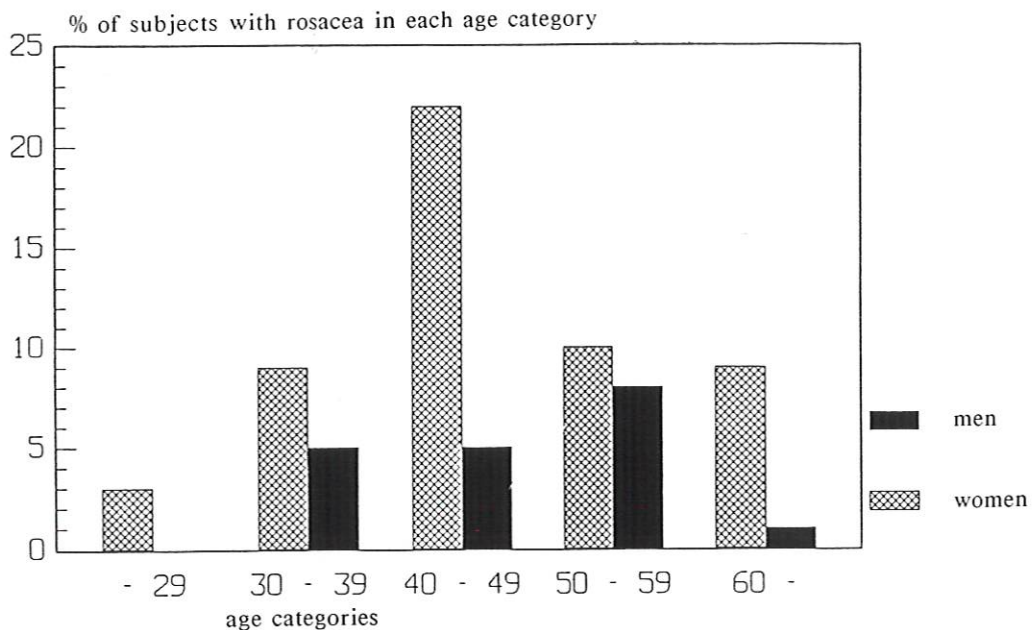


Table IX
Association between rosacea and migraine.

	rosacea (n=81)	not rosacea (n=728)	p<
total population (n=809)	10%	90%	
frequency of migraine	27%	13%	0.001
	migraine (n=116)	not migraine (n=693)	
total population	14%	86%	
frequency of rosacea	19%	8%	0.001

No histological parameter showed significantly more changes in VDU-exposed people compared to nonexposed controls with similar skin status. On the contrary the occurrence of telangiectases was significantly more common in patients with facial skin diseases without exposure to VDUs. Degenerative changes in elastic fibers increased with age ($p < 0.001$), but a few people > 55 years of age ($n = 29$) had mild ($n = 11$) or no ($n = 4$) degenerative changes of elastic fibers. People without skin complaints also had histological changes of varying degrees, and there was no statistical difference between VDU-exposed patients with skin complaints but without skin signs and controls without skin complaints, skin signs or VDU exposure. Hyperplasia of sebaceous glands was significantly more common in men ($p < 0.001$) and decreased with increasing age ($p < 0.001$).

DISCUSSION

The study shows that most of the patients referred for dermatologic examination of skin complaints they attributed to working at VDUs had common skin diseases, rosacea in half of the cases. This condition is common in an adult population working indoors (10%), and occurs more frequently in women than in men. However, the referred patients had, in my experience, more pronounced subjective symptoms than ordinary dermatological patients, but relatively mild skin lesions. Most of the patients improved without pharmacological therapy although 90% of them continued to work with VDUs. No characteristic histological changes were found in facial skin biopsies from patients exposed to VDUs. Histological changes of varying degrees were common even in people without skin complaints or VDU exposure. When comparing exposed subjects with a nonexposed control population, statistically significant changes appeared in subjective skin symptoms, but not in facial skin signs. Tumours with malignant potential and unilateral skin signs were found in the same frequencies in the two groups. The questionnaire used showed a reasonably good correlation to more clear-cut skin symptoms (such as in atopic and seborrhoeic dermatitis), but not to the presence of mild skin signs. Thus, when studying skin diseases in a population, less marked changes might not be picked up particularly well by using questionnaires alone.

The epidemiological study of office employees (II-IV) is the major part of this work. The aim of this study was to investigate whether skin diseases were more common in people exposed to VDUs than among nonexposed controls. As regards the most important measure of skin disease, i.e. skin signs, facial dermatoses were just as common in nonexposed people. The exposed individuals had nonspecific skin symptoms with or without mild skin lesions significantly more frequently than the nonexposed control population. However, these symptoms were subjective, in contrast to objectively registered skin lesions. To exclude observer-bias, and obtain objectivity in this respect, the facial skin status was registered before the examining physician knew anything about the person examined.

It was methodologically valuable for the study that the subjects were randomly selected and that no one who received the questionnaire was asked if he or she wanted to join the study. These principles were carefully supervised by the main investigator. It was important with a high participation rate to obtain an adequate result from the epidemiological study, and that exposed and nonexposed people joined the study in about the same frequencies. The unusually high participation figures in this work (97% and 92%, respectively) can be explained by the joint effects of influence from the trade-union representatives, easily completed forms, re-

peated (up to three) reminders, telephone and not postal notice to attend the interviews, and convenient locations for the interviews.

In contrast to the epidemiological studies of this topic mentioned earlier (Frank 1983; Lidén C & Wahlberg, 1985A; Murray et al, 1981) we used both questionnaires and examinations, interviewed a sub-group of the population, and called them for examination irrespective of degree of VDU exposure or answers on the form. In the evaluation of the questionnaire it was found that there were significant differences between the answers on the forms and the current status, and there was also some discrepancy between the self-reported answers and the history obtained by the physician. Furthermore, people who answered on the form that they had no facial skin problems, had signs nearly as often as those with self-reported skin complaints. This was partly due to individual differences in the tendency to report mild skin complaints, e.g. between the sexes, but VDU-exposed people might also be more prone to report symptoms.

VDU-exposed people in general may have been alerted to the possibility of skin problems and might be more prone to report them (cp. Hopwood & Guidotti, 1988; Sackett, 1979). The differences in the tendency to report mild symptoms led to the rather low sensitivity (Table VII) and reproducibility (Table VI) in the questionnaire. The difficulties in analysing the answers from people who answered that they have had no skin problems has previously been discussed in an epidemiologic study of hand eczema (Agrup, 1969). It is surprising that the confirmation rate between the two answers to the same question (Table VI) was no more than 0.37 regarding current symptoms/signs. This low correlation could not be due to a real change in the occurrence of skin problems during the period that elapsed between the two answers, because a real change occurred in only 2.5% of the cases (as many improved as impaired), as judged by the history. We suggest that the subjects misunderstood some questions and terms and that in many cases they were careless when answering the questions. Thus, it is concluded that the use of questionnaires alone cannot be recommended when studying mild skin problems due to a particular exposure in a population.

We thought that it might have been of significant importance that the subjects were not informed about the aim of the study. However, the results showed no systematic tendencies as regards information, although it is often believed that exposed and informed individuals may exaggerate symptoms. Nevertheless, it is possible that most of those who participated suspected the reason, because of the extensive attention drawn to the topic in the Swedish mass media. The results regarding information can be taken to suggest that information about the aims of a study may be less im-

portant than is usually thought, but in fact there is a lack of knowledge about how information about the purposes of a study influences responses given in questionnaire.

The employees were recruited from four cities. This was done partly to facilitate the recruitment of a large population, partly to see whether there were any regional differences, for example, depending on the climate. However, there were no significant differences between the symptoms and signs registered in the cold, dry winter climate in Sundsvall and the milder and more humid conditions in Gothenburg.

It is impossible to evaluate whether the result from our study was influenced by some kind of a "healthy worker effect" (Howe, Chiarelli & Lindsay, 1988; McMichael 1976; Melkild, 1989), which in this context might imply that people involved in VDU work and who had skin problems could have stopped working with VDUs. Modest skin disorders are hardly likely to cause people to change employment, a view which was also confirmed in our case study (I), since most people (91%) continued to work with VDUs, even though they suspected that the screens caused skin problems.

We made no systematic measurements because our major measure of exposure to VDU was hours and years spent in front of the VDU. Furthermore, it has been shown that different VDUs with the same trade-mark do not essentially differ in the strength of magnetic or electrostatic surrounding the VDU (Paulsson et al, 1984).

The subjects diagnosed as suffering from rosacea were of special interest (IV), because this disorder was found to be the most common facial dermatosis, and rosacea is also the skin condition that has aroused most attention in discussions about VDU work and skin problems. The study gives a prevalence (10%) for the disease in this adult indoor-working population. It has previously been assumed that women consult physicians more frequently for facial skin afflictions (Marks, 1976; Rebora, 1987), and that rosacea should be as common in men. The present study shows, however, that rosacea really is more common in women than in men (Figure V).

The connection between rosacea and migraine has previously been reported by Tan & Cunliffe (1976), 44% of an out-patient population of 137 rosacea patients having migraine compared to 13% in the control population of 161 hospital personnel without rosacea ($p < 0.001$). Migraine, like rosacea, is thought to be linked to a lability in the regulatory mechanisms of the blood vessels (Adams, 1983). The referred patients (I), like the rosacea group of the examined employees (IV), had an increased incidence of migraine. However, the referred patients without rosacea (I) had migraine

working at VDUs have been influenced by all the information about VDU work and skin problems. As mentioned earlier, skin problems attributed to work with VDUs are a common problem only in Sweden, a fact which was confirmed in discussions at two international scientific conferences on "Work with display units" (Stockholm 1986 and Montreal 1989). Many articles have appeared in the Swedish popular press about the possible skin effects from VDU work since the first case (Lagerholm, 1985) was recognized by the National Insurance Board as an occupational damage. In this context it should be mentioned that the Swedish law of compensation for occupational damage is rather liberal towards the employee. It states that unless there is overwhelming evidence against the work being a provoking factor of the damage, it is to be accepted. Thus valid scientific evidence is not required.

It should, however, be mentioned that even if skin complaints said to be associated with work at VDUs are a particular problem only in Sweden, these types of non-specific subjective symptoms without visible signs are not unique for this country. There are several reports of patients with similar subjective symptoms not working at VDUs, when e.g. low indoor-humidity, psycho-somatic mechanisms or the office environment as a whole have been thought to cause the symptoms (e.g. Anderson, 1986; Cotterill, 1981; Maibach & Engasser, 1986; Stewart & Raskin, 1985; White & Rycroft, 1982).

CONCLUSIONS

Most patients referred for dermatological examination suspected of having skin disease related to work with VDUs had ordinary facial skin disorders, and half of them had rosacea. Two thirds of them improved without pharmacological therapy in spite of continued work with VDUs.

VDU-exposed subjects had subjective skin symptoms with few or no skin lesions significantly more often than a nonexposed control population, but had no more visible skin signs. Unilateral facial skin signs and tumours with a malignant potential were seen in the same frequencies in the two groups.

The self-reported questionnaire used showed a reasonably good correlation to more clear-cut skin symptoms, but not to the presence of skin signs, and less marked changes might not be picked up particularly well if questionnaires alone are used.

Rosacea was found in 10% of the randomly selected indoor-working population, and it was as common in nonexposed as in exposed subjects. There was a strong association between rosacea and migraine, but no relation between impairment of the disease and exposure to sunlight.

Patients with skin complaints which they attributed to working with VDUs had no characteristic histological changes in facial skin. Histological changes of varying degrees were also common in the nonexposed control population without skin complaints,

The occurrence of skin disease in VDU-exposed people is entirely coincidental from an epidemiological point of view. An increase in subjective sensations in the skin in people with such work is registered, but is not further analyzed in the present study.

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