Original article

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RESULTS OF THE COMPARATIVE STUDY ON THE ONSET AND FREQUENCY OF OCCUPATIONAL ALLERGIC CONTACT DERMATITIS AMONG WORKERS IN THE RUBBER AND CONSTRUCTION INDUSTRIES

Mirjana Paravina[1], Marija Nedeva[2]

Occupational skin diseases are changes in the skin and its adnexa which occur under the influence of various exogenous and endogenous factors. They can be caused by irritants or allergens (irritant or allergic contact dermatitis). To examine the impact of the work environment and occupational hazards concerning the occurrence of Occupational Allergic Contact Dermatitis (OACD), a study on workers in the rubber and construction industries diagnosed with contact dermatitis (CD) was conducted. The structure of the workers was presented according to sex, place of residence, age, qualifications, years of service, type of allergen and work position. The importance of medical, occupational, and social rehabilitation was emphasized, as well as prevention measures (professional orientation, education and health education of the workers). The following conclusion was reached—in the construction industry, men are more frequently affected and there is a higher risk of OACD, although a longer time of exposure is required. The causing allergens are varied. It is imperative to register those affected by the disease and to undertake the corresponding measures of treatment and prevention.

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Key words: *occupational dermatitis, allergic contact dermatitis, allergens*

[1]University of Niš, Faculty of Medicine, Niš, Serbia
[2]University of Niš, Faculty of Medicine, doctoral studies, Niš, Serbia

Contact: Mirjana Paravina
44 Borova St., 18000 Niš, Serbia
E-mail: mirjanaparavina@gmail.com

Introduction

Occupational diseases of the skin are changes in the skin and its adnexa, which occur while performing the profession under the influence of varied exogenous (physical, biological, or chemical) or endogenic (sex, age, race, genetic diseases, atopic) factors. They are among the top five registered occupational diseases in the EU, making up between 10% and 40% (1) or even 40–50% (2) of the total number of registered cases and represent a significant health issue in Europe, while for instance, the one in Austria includes 52, in Italy 58, in Germany 67, in England 70, in France 98 (3).

Occupational contact dermatitis (OCD), which occurs as a consequence of contact with chemicals, is the most frequent amongst occupational skin diseases (4), (as much as 90–95% of these diseases with irritant contact dermatitis (ICD) in 80% and allergic contact dermatitis (ACD) in 20% of cases (5). It is estimated that more than 85,000 chemicals in human surroundings can act as irritants or allergens and cause irritant or allergic CD (6).

ACD occurs after repetitive contact of the sensitized person with the sensitizer after a IV type allergic reaction (7), which plays out in two stages—induction stage (primary response) and elicitation stage (secondary response) (8–10). Contact sensibilization occurs in 20% of the population (11). The frequency of CD in the USA is 13.6% per 1,000 residents. Clinical signs vary depending on the stage of the disease and the containment of the changes. In the acute stage, the place of contact is affected by erythema, papulae, vesicles, pustules, possibly blisters with continuous oozing, creation of scabs and flaking of the skin. In the case of chronic disease, the skin is rough, thick, with dark reddish color, lichenified, with rare papulae, flakes and sometimes cracks (12).

Occupational allergic contact dermatitis occurs within the work environment and has the same characteristics (13), as well as many differences depending on the environment and the occupation. We performed examinations on workers from the rubber industry and construction, two very different work environments, and we received specific results. After the examination, extensive clinical history was written out, and a finding was made that the

changes in the skin are of the contact dermatitis typem (14). Epicutaneous (patch) testing was performed, using suitable allergens. For the workers in the rubber industry, it was a "rubber series" of 30 allergens, with the addition of standard and domestic series as needed (15). Workers from the construction industry were tested with a series according to the substances they come in contact with while performing their jobs. Further action was dependent on the results of the testing (16).

Aim

A group of workers in the rubber and construction industries who had skin changes of the CD type were tested to examine the effect of the working environment and occupational hazards with regard to the occurrence of OACD. It is only after the causes of the disease are determined that the appropriate treatment measures and appropriate therapy can be applied to the diseased person, as well as prevention and protection at the workplace, including leave of absence, possibly even a change of job or work conditions.

Materials and Methods

At the Rubber Products Factory in Niš, 1,032 workers were examined. Signs of CD were registered in 90 (8.72%) workers. Epicutaneous testing of rubber chemicals was conducted on 80 workers.

In the period of 10 years, the Dermatovenerology Clinic in Niš tested 1,237 subjects. Four hundred and ninety-four workers tested positive. Amongst the tested workers, there were 160 (12.93%) construction workers. It was proved that 51 (75%) people who have OACD, have hypersensitivity to one or more allergens that they come into contact with while working. This amounts to 86.44% of all workers with ACD and 4.84% of all examined workers.

Examinations and epicutaneous testing were accompanied by certain parameters (sex, place of residence, age, years of service, qualification structure, work position, etc.), and they were presented in a chart.

Results and Discussion

Out of the 80 workers tested for chemicals found in rubber in the Rubber Products Factory, 59 tested positive—73.75% workers with CD, which was 5.71% of the total number of examined workers. Eight out of these 59 workers had no contact with chemicals in rubber; therefore, it was proved that 51 (75%) had hypersensitivity to one or more allergens with which they came into contact at the workplace and had ACD. This summed up to 86.44% of all workers with ACD and 4.84% of all examined workers.

Ninety-one construction workers (56.87%) tested positive, i.e., they represented 19.42% of the total number of workers who tested positive. A number of construction workers reacted to allergens that were not related to the profession. OACD was found in 61 workers, 38.12% of all construction workers, while 67.03% of construction workers who tested positive were diagnosed with ACD.

Table 1 shows structure of workers with OACD in the rubber and construction industries according to sex and place of residence

OACD was registered in 52.94% of men and 47.05% of women in the rubber industry workers. If we take into consideration the fact that out of the total number of tested workers, 74% were men and 26% were women, and 57% men had ACD, whereas 43% of women had ACD, it is clear that women are more sensitive to chemicals in the workplace and beyond.

There were no women with ACD or OACD among the construction workers.

Workers in the rubber industry were more frequently residents of the town (60.78%) rather than a village (39.20%), while the number of workers in the construction industry with OACD who reside in a village was slightly higher (56.87%).

Table 2 shows age structure and Years of Service of workers with OACD in the rubber and construction industries

In the rubber industry, OACD was the most frequent among workers in their fifth decade of life, followed by those in their fourth and then in their third decade of life. In the construction industry, it was the most frequent among workers in their fifties, then in their sixties and forties.

In the rubber industry, OACD was most frequently reported by workers with 21 to 30 years of service, followed by those with 11 to 20 years, then those with 6 to 10 years, and finally those with up to 5 years of service. It was the least common among those with over 30 years of service. OACD was recorded among workers with the first 10 years of service, at approximately 33.32%.

The situation was similar in the construction industry, with the most common occurrence in those with over 30 years of service, less frequent in those with between 6 and 10 years of service and the least common in those with up to 5 years of service. OACD was registered in 14.75% of workers in the first 10 years of service. This means that in the construction industry, OACD occurs after prolonged exposure.

Table 3 shows number and percentage of positive tests and order of allergens of workers with OACD in the rubber and construction industries

Table 1. Structure of Workers with OACD in the Rubber and Construction Industries according to Sex and Place of Residence

Sex	Male (Number %)	Female (Number %)	Total (Number %)
Rubber industry	27 (52.94)	24 (47.05)	51 (99.99)
Construction	61 (100.00)	-	61 (100.00)
Place of residence	Village (No %)	Town (No %)	Total (No %)
Rubber industry	20 (39.20)	31 (60.78)	51 (99.98)
Construction	35 (56.87)	26 (43.13)	61 (100.00)

Table 2. Age Structure and Years of Service of Workers with OACD in the Rubber and Construction Industries

Age	Rubber	Construction	Years of service	Rubber	Construction
	Number %	Number %		Number %	Number %
Up to 20	-	-	Up to 5	6 (11.76)	4 (6.55)
21–30	11 (21.58)	3 (4.92)	6–10	11 (21.56)	5 (8.20)
31–40	16 (31.37)	10 (16.39)	11–20	13 (25.49)	17 (27.86)
41–50	20 (39.21)	25 (40.98)	21–30	16 (31.36)	26 (42.62)
51–60	4 (7.84)	23 (37.70)	Over 30	5 (9.80)	61 (99.98)
Total	51 (100.00)	61 (99.99)	Total	51 (99.97)	61 (99.98)

Table 3. Number and Percentage of Positive Tests and Order of Allergens of Workers with OACD in the Rubber and Construction Industries

Rubber industry Type of Allergen	Number %	Construction Type of Allergen	Number %
Antioxidants	50 (40.98)	Potassium dichromate	60 (66.67)
Organic dissolvents	22 (18.03)	TMT (accelerator)	8 (8.89)
Vulcanising accelerants	17 (13.93)	Cobalt chloride	4 (4.44)
Glues	13 (10.66)	Phenergan	3 (3.34)
Synthetic rubber	6 (4.92)	Nickel sulfate	3 (3.34)
Natural rubber	5 (4.07)	Aniline	2 (2.22)
Mastication agent	4 (3.28)	Formaldehyde	2 (2.22)
Smoke	4 (3.28)	Other	x 1 (11.11) 8 (8.88)
Colophonium	1 (0.28)	(IPPD (antioxidant), Ursol, synopen, lanoline, glue, cement, white cement, grout mortar)	
Total	122 (100.00)	Total	90 (100.00)

In each group of chemicals in the rubber series with which the workers were tested, several allergens were present: 5 antioxidants with 50 positive tests, 4 organic dissolvents with 22 positive tests, 7 vulcanizing accelerators with 17 positive tests, 3 glues with 13 positive tests, 4 synthetic rubbers with 6 positive tests, 2 natural rubbers with 5 positive tests, Masticit VII and smoke with 4 positive tests each and colophonium with 1 positive test. In 51 workers with OACD, 122 positive reactions to 27 allergens were registered, which is an average of 2.19 reactions per worker.

In the construction industry, 90 positive reactions were registered in 61 workers, an average of 1.47 positive tests per worker.

Therefore, the conclusion is that polysensitization is somewhat more common among rubber workers than it is among construction workers.

The leading allergen among construction workers was potassium dichromate, which made up to 66.67% of all positive tests. A positive test was registered in 60 of the 61 workers with OACD (98.36%). Potassium dichromate is a hexavalent chromium salt which easily penetrates the skin. This is in fact a ubiquitous allergen found in cement and construction material, in products for protection against corrosion, in explosives, wood ash, in dyes and pigments, in synthetic perfumes, photographic and lab chemicals, glue, leather and textile (16). It is the cement that acts as the irritant at first, allowing penetration and sensitization. Metals: Cr, Co, and Ni have been labeled as a high-risk factor for the occurrence of ACD (17–19). As for cobalt, the metal itself and its salts can be factors of sensitization. It is used in the chemical and pharmaceutical industries and is found in dyes, cement, resin, glass, ceramics, etc. A simultaneous hypersensitivity to Cr, Co and Ni can occur due to the bonding of hapten to the same place of protein carrier (20).

Table 4 shows number and percentage of positive tests and order of allergens of the rubber series among workers with OACD

As for the order of allergens according to the number of positive tests, the Antioxidant 4010 Na or IPPD (N-isopropyl-N-phenyl-p-phenylene diamine) holds the first place with 13 + 17 (m + f) positive tests. It is a derivative of para-phenylene-diamine, a sensitizer from the group of aromatic amines (21). It frequently causes crossed-sensibilization (aniline and azo dyes, sulphonamides, local anesthetics and other aromatic amines found in hair dye, food, cosmetic products (22).

From the list of antioxidants, we can list PAN (phenyl alpha naphthylamine) with 6 + 4 (m + f) positive tests, PBN (phenyl-beta-naphthylamine) with 4 + 1 (m + f) and DOD (4,4-dihydroxydiphenyl) with 2 + 2 (m + f) positive tests. The sensitization to antioxidants usually occurs in workers with longer years of service (23).

There were 17 reactions to vulcanizing accelerators: Vulkacid D 1 + 6 (m + f), to MBT 2 + 2 (m + f), to Vulkacid DM 2 + 0 (m + f), to TMT 0 + 1 (m + f), to Vulkacid CZ 1 + 0 (m + f), to Vulkacid ZDBC 0 + 1 (m + f) and to Vulkacid H30 0 + 1 (m + f).

The reactions to organic dissolvents were as follows: to acetone 6 + 3 (m + f), xilol 1 + 4 (m + f), gasoline 3 + 2 (m + f), Toluene 1 + 2 (m + f).

Reactions to glues: Hemosil 20 2 + 6 (m + f), Hemosil 21 2 + 3 (m + f), white glue 0 + 1 (m + f).

Reactions to natural rubber: SMR 10 3 + 1 (m + f), SMR 20 1 + 0 (m + f).

Reactions to synthetic rubber: Perbunan 4 + 2 (m + f)

Reactions to Masticit VII 4 + 3 (m + f), to smoke 3 + 1 (m + f), to colophonium 0 + 1 (m + f).

Table 5 shows work positions of workers with OACD in the rubber and construction industries

Work positions of workers with OACD in the rubber industry, showed a great variety: 6 workers come from the laboratory and manufacture of rubber footwear, 3 people worked on lining sewing, 2 of each worked on pressing boots, packing boots, pressing rubber, separating foil from rubber, coating metal parts, phosphatization, packing finished products and production of conveyor belts (a total of 16 workers) and 20 more workers in various other work positions.

In the construction industry, OACD is mostly registered among bricklayers (27 workers), followed by tile installers (19 workers), concrete mixers (6), façade makers (4), carpenters (3) and terrazzo masons (2).

In respect to the qualification structure, workers with OACD in the rubber industry are most frequently qualified (40 workers), semi-qualified (4 workers), unqualified (1 worker) and people with a high-school or university diploma (3 of each category).

In the construction industry, these are mostly qualified and semi-qualified workers.

After making the diagnosis of contact, and in particular, allergic and occupational allergic dermatitis, symptomatic treatment needs to be administered depending on the stage of the disease, the intensity of the clinical signs and containment of the changes (24).

This would include medical rehabilitation by applying protective measures and/or taking sick leave, making attempts to influence the behavior of the affected person and work conditions (25).

The next step would be occupational rehabilitation—referral of the patient to the Disability Board, where the assessment of his/her work abilities is to be conducted (lowered work ability – III category disability or loss of work ability), and the Board is to give an opinion in regards to vocational retraining (26).

Social rehabilitation depends on the characteristics of the affected person, as well as the financial situation and his or her social standing in the family and society in general.

Prevention measures are imperative (27, 28). The process of manufacture with specific technology is very important (machinery, automation, closed base system of transport), different working conditions and exposure to various aggressive chemicals, with assessment of the possibility of replacing them with less aggressive substances.

However, we must not forget the individual with his or her characteristics.

Professional orientation is very important, education of the workers as well as health education, use of personal protection means, and health control in terms of conducting general medical examinations or periodical examinations of the workers in risky work positions.

Table 4. Number and Percentage of Positive Tests and Order of Allergens of the Rubber Series among Workers with OACD

Allergen	Men	Women	Allergen	Men	Women
Order	Number %	Number %	Order	Number %	Number %
1. 4010 Na (antioxidant)	13 (48)	17 (71)	13. MBT (accelerator)	2 (7)	2 (8)
2. PAN (antioxidant)	6 (27)	4 (17)	14. Masticit VII (mastic)	4 (15)	2 (8)
3. Acetone (org.dissolvent)	6 (22)	3 (12)	15. Smoke	3 (11)	1 (4)
4. Hemosil 20 (glue)	2 (7)	6 (25)	16. Toluene (org. dissolvent)	1 (4)	2 (8)
5. Vulkacid D (accelerator)	1 (4)	6 (25)	17. Vulkacid DM (accelerator)	2 (7)	0 (0)
6. Perbunan (synthetic rubber)	4 (15)	2 (8)	18. SMR 20 (nat. rubber)	1 (4)	0 (0)
7. PNB (antioxidant)	4 (15)	1 (4)	19. MBI (antioxidant)	0 (0)	1 (4)
8. Xylol (org. dissolvent)	1 (4)	4 (17)	20. White glue	0 (0)	1 (4)
9. Gasoline (org.dissolvent)	3 (11)	2 (8)	21. TMT (accelerator)	0 (0)	1 (4)
10. SMR 10 (nat. rubber)	3 (11)	1 (4)	22. Vulkacid CZ (accelerator)	1 (4)	0 (0)
11.DOD (antioxidant)	2 (7)	2 (8)	23. Vulkacid ZDBC (accelerator)	0 (0)	1 (4)
12. Hemosil 21 1 (glue)	2 (7)	2 (8)	24. Vulkacid H30 (accelerator)	0 (0)	1 (4)
			25.Colophonium	0 (0)	1 (4)
			All	M	F
				61 (50)	61 (50)
			Total	122 (100.00)	

Table 5. Work Positions of Workers with OACD in the Rubber and Construction Industries

Rubber industry		Construction	
Work position	Number %	Work position	Number %
Laboratory	6 (11.76)	Bricklayer	27 (44.26)
Production of rubber footwear	6 (11.76)	Tile installer	19 (26.23)
Lining sewing	3 (5.88)	Concrete mixer	6 (9.84)
Pressing boots	2 (3.92)	Façade maker	4 (6.56)
Packing boots	2 (3.92)	Carpenter	3 (4.92)
Pressing	2 (3.92)	Terrazzo mason	2 (3.28)
Separating foil from rubber	2 (3.92)	Total	61 (99.99)
Coating of metal parts	2 (3.92)	/	/
Phosphatisation	2 (3.92)	/	/
Final product packing	2 (3.92)	/	/
Production of conveyor belts	2 (3.92)	/	/
All	20 (39.33)		
Total	51 (99.98)	Total	61 (99.99)

Conclusion

In the construction industry, there is a high risk of the occurrence of OACD, although longer exposure is required, while the rubber industry is an environment of medium risk.

In the construction industry, it is more frequent for men to get the disease, while in the rubber industry, it is more frequent among women.

The causing allergens are varied and depend on the production technology.

The rubber and construction industries are two very different industry branches. In the rubber industry, many employees are placed in the same position; production is quite complicated; a large number of various chemicals, many of which have allergenic potential, are used; both men and women are employed, and they come from towns and villages.

In the construction industry, jobs are mostly performed by men. It is a matter of a number of specific jobs that are not very different among each other; fewer types of materials are used and contact dermatitis occurs more frequently, but after prolonged exposure.

Be as it may, it is of great importance to register the affected individuals and administer appropriate treatment and prevention measures.

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REZULTATI UPOREDNOG ISPITIVANJA NASTANKA I UČESTALOSTI PROFESIONALNOG KONTAKTNOG ALERGIJSKOG DERMATITISA KOD GUMARSKIH I GRAĐEVINSKIH RADNIKA

Mirjana Paravina[1], Marija Nedeva[2]

[1]Univerzitet u Nišu, Medicinski fakultet, Niš, Srbija
[2]Univerzitet u Nišu, Medicinski fakultet, student doktorskih studija, Niš, Srbija

Kontakt: Mirjana Paravina
Borova 44, 18000 Niš, Srbija
E-mail: mirjanaparavina@gmail.com

Profesionalne bolesti kože predstavljaju promene na koži i njenim adneksima, koje nastaju prilikom obavljanja određenog posla, i to pod uticajem različitih egzogenih i endogenih faktora. Mogu ih izazvati iritansi ili alergeni (iritativni ili alergijski kontaktni dermatitis). Kako bi se sagledao uticaj radne sredine i profesionalnih noksi na kožu u pogledu nastanka profesionalnog alergijskog kontaktnog dermatitisa (PAKD), ispitani su gumarski i građevinski radnici na čijoj su koži uočene promene koje izaziva kontaktni dermatitis (KD). Radnici su klasifikovani prema polu, mestu stanovanja, starosti, kvalifikacijama, dužini radnog staža, vrsti alergena i radnom mestu. Istaknut je značaj medicinske, profesionalne i socijalne rehabilitacije, kao i mera prevencije (profesionalna orijentacija, edukacija i zdravstvena osvešćenost radnika). Utvrđeno je da u građevinarstvu obolevaju muškarci i da postoji veći rizik za nastanak PAKD-a, s tim što do toga dolazi tek nakon duže izloženosti alergenima. Uzročni alergeni su raznoliki. Važno je registrovati obolele i preduzeti odgovarajuće mere lečenja i prevencije.

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***Ključne reči**: profesionalne dermatoze, alergijski kontaktni dermatitis, alergeni*