

Original article

doi:10.5633/amm.2025.0205

RESULTS OF THE COMPARATIVE STUDY ON THE REASONS AND FREQUENCY OF OCCUPATIONAL ALLERGIC CONTACT DERMATITIS IN WORKERS IN THE RUBBER AND CONSTRUCTION INDUSTRY

Mirjana Paravina¹, Marija Nedeva^{1,2}

¹University of Niš, Faculty of Medicine, Niš, Serbia

²University of Niš, Faculty of Medicine, doctoral studies, Niš, Serbia

Contact: Mirjana Paravina

Borova 44, 18000 Niš, Serbia

Email: mrijanaparavina@gmail.com

Occupational skin diseases are changes in the skin and its adnexa which occur under the influence of various exogenic and endogenic factors. They can be caused by irritants or allergens (irritant or allergic contact dermatitis). With the intention of examining the impact of the work environment and occupational hazards regarding the occurrence of Occupational Allergic Contact Dermatitis, a study on workers in the rubber and construction industry who had changes in the skin of the CD type was conducted. The structure of the workers is 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 is emphasized, as well 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 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.

Keywords: occupational dermatitis, allergic contact dermatitis, allergens

Originalni rad

doi:10.5633/amm.2025.0205

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

Mirjana Paravina¹, Marija Nedeva^{1,2}

¹Univerzitet u Nišu, Medicinski fakultet, Niš, Srbija

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

Kontakt: Mirjana Paravina

Borova 44, 18000 Niš, Srbija

Email: mrijanaparavina@gmail.com

Profesionalne bolesti kože su promene na koži i njenim adneksima, koje nastaju pri obavljanju profesije, a pod uticajem raznih egzogenih i endogenih faktora. Mogu ih izazvati iritansi ili alergeni (iritativni ili alergijski kontaktni dermatitis). U cilju sagledavanja uticaja radne sredine i profesionalnih noksi na kožu u smislu nastajanja profesionalni alergijski kontaktni dermatitisa (PAKD) izvršena su ispitivanja gumarskih i građevinskih radnika koji su imali promene na koži tipa KD. Prikazana je struktura radnika prema polu mestu stanovanja godinama zivota, kvalifikacijama, dužina radnog staža, vrsti alergena i radnom mestu. Naglašen je značaj medicinske, profesionalne i socijalne rehabilitacije, kao i mera prevencije profesionalna orijentacija, edukacija i zdravstveno prosvetavanje radnika. Zaključeno je da u građevinstvu obolevaju muškarci, postoji veći rizik za nastanka PAKD, mada je potrebna duža ekspozicija. Uzročni alergeni su raznoliki. Vazno je registrovati obolele i preduzeti odgovarajuće mere lečenja i prevencije.

Ključne reči: profesionalne dermatoze, alergijski kontaktni dermatitis, alergeni

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 exogenic (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. The list of occupational diseases in Serbia is comprised of 56 occupational diseases (3), while for instance the one in Austria includes 52, in Italy 58, in Germany 67, in England 70, in France 98 (4).

Occupational contact dermatitis (OCD) which occurs as a consequence of contact with chemicals is the most frequent amongst occupational skin diseases (5), (as much as 90-95% of these diseases with irritant contact dermatitis (ICD) in 80% and allergic contact dermatitis (ACD) in 20% of cases (3,7). It is estimated that more than 85000 chemicals in human surroundings can act as an irritant or allergen and cause Irritant or Allergic ICD. (8).

ACD occurs after repetitive contact of the sensitized person with the sensitizer after a IV late type allergic reaction, which plays out in two stages – induction stage (primary response) and elicitation stage (secondary response) (10,11,12). Contact sensitization occurs in 20% of the population (13). The frequency of CD in the USA is 13,6% per 1000 residents (14). 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 (15).

Occupational Allergic Contact Dermatitis (OACD) occurs within the work environment and has the same characteristics (16), 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 on the skin of are of the contact dermatitis type, 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. Workers from the construction industry were tested with a series accordant to the substances they come in contact with while performing their jobs. Further action was dependent on the results of the testing.

AIM OF THE STUDY

A group of workers in the rubber and construction industry who had skin changes of the CD type were tested with the aim of examining the effect of the working environment and occupational hazards in regard to the occurrence of OACD. It is after the causes of the disease are determined that 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, even possibly change of job or work conditions.

MATERIAL AND METHODS

At the Rubber Products Factory in Nish 1032 workers were examined. Signs of CD were registered in 90 (8,72%) of workers. Epicutaneous testing of rubber chemicals was conducted on 80 workers.

In the period of 10 years, the Clinic for Skin and Venereal Diseases in Nish tested 1237 subjects. 494 workers tested positive. Amongst the tested workers there were 160 (12,93%) construction workers. It was proved that 51 person (75%) who has OACD, has hypersensitivity to one or more allergens that they come into contact while working. This amounts to 86,44% of all workers with ACD and 4,84% of all examined workers.

The examinations and the 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 is 5,71% of the total number of examined workers. Eight (8) out of these 59 workers had no contact with chemicals in rubber, therefore it was proved that 51 (75%) have hypersensitivity to one or more allergens with which they come into contact at the workplace and have ACD. This amounts to 86,44% of all workers with ACD and 4,84% of all examined workers.

91 construction workers (56,87%) tested positive, i.e., they represent 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. OCAD was proved in 61 workers, 38,12% of all construction workers, while 67,03% of construction workers who tested positive, were diagnosed with ACD.

TABLE 1. STRUCTURE OF WORKERS WITH OACD IN THE RUBBER AND CONSTRUCTION INDUSTRY ACCORDING TO SEX AND PLACE OF RESIDENCE

Sex	Male (No %)	Female (No %)	Total (No %)
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)

OACD was registered in 52,94% men and 47,05% 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% 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 are 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 is slightly higher (56,87%).

TABLE 2. AGE STRUCTURE AND YEARS OF SERVICE OF WORKERS WITH OACD IN THE RUBBER AND CONSTRUCTION INDUSTRIES

Age	Rubber		Construction		
	No.	%	No.	%	
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)

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

In the rubber industry, OACD is most frequently registered among workers who have between 21 and 30 years of service, then among those with 11-20 years, followed by those with 6 to 10 years and those with up to 5 years of service. It is least common among those with over 30 years of service. OACD is registered among workers in the first 10 years of service in as much as 33,32%.

The situation is similar in the construction industry, with most common occurrence in those with over 30 years of service, less frequent in those with between 6 and 10 years of service and least common in those with up to 5 years of service. OACD is 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. NUMBER AND PERCENTAGE OF POSITIVE TESTS AND ORDER OF ALLERGENS IN WORKERS WITH OACD IN THE RUBBER AND CONSTRUCTION INDUSTRIES

Rubber industry	Number %	Construction	Number %
Type of Allergen		Type of Allergen	
Antioxidants	50 (40,98)	Potassium dichromate	60 (66,67)
Organic solvents	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 solvents 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 registers, which is an average of 2,19 reactions per worker.

In the construction industry, in 61 workers 90 positive reactions were registered, 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 is Potassium dichromate, which makes up 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 dye 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 (20). Metals Cr, Co and Ni have been labeled as a high-risk factor for the occurrence of ACD (21,22,23). As for cobalt, the metal itself as well as its salts can be factors of sensibilization. It is used in the chemical and pharmaceutical industry, it 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 (24).

TABLE 4. NUMBER AND PERCENTAGE OF POSITIVE TESTS AND ORDER OF ALLERGENS OF THE RUBBER SERIES IN WORKERS WITH OACD

Allergen Order	Men Number %	Women Number %	Allergen Order	Men Number %	Women Number %
1. 4010 Na (antioxidant)	13 (48)	17 (71)	13. MBT (accel.)	2 (7)	2 (8)
2. PAN (antioxidant)	6 (27)	4 (17)	14. Masticit VII (mastic)	4 (15)	2 (8)
3. Acetone (ogr. dissolv.)	6 (22)	3 (12)	15. Smoke	3 (11)	1 (4)
4. Hemosil 20 (glue)	2 (7)	6 (25)	16. Toluot (org dissolv)	1 (4)	2 (8)
5. Vulk. D (acceler.)	1 (4)	6 (25)	17. Vulc. DM (acceler.)	2 (7)	0 (0)

6. Perbunan (synth. 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 dissolv)	1 (4)	4 (17)	20. White glue	0 (0)	1 (4)
9. Gasoline (org dissolv)	3 (11)	2 (8)	21. TMT (acceler)	0 (0)	1 (4)
10. SMR 10 (nat rubber)	3 (11)	1 (4)	22. Vulk. CZ (acceler)	1 (4)	0 (0)
11.DOD (antioxidant)	2 (7)	2 (8)	23. Vulk. ZDBC (acceler)	0 (0)	1 (4)
12. Hemosil 21 1(glue)	2 (7)	2 (8)	24. Vulc. H30 (acceler)	0 (0)	1 (4)
			25. Colophonium All	0 (0) M	1 (4) F
				61 (50)	61 (50)
			Total	122 (100,00)	

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 (25). It frequently causes crossed sensibilization (aniline and azo dyes, sulphonamides, local anesthetics and other aromatic amines found in hair dye, food, cosmetic products (26).

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 sensibilization to antioxidants usually occurs in workers with longer years of service (27).

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), toluol 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. 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)	Terazzo 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)

In regards to the work positions of workers with OACD in the rubber industry, there is a great variety: 6 workers come from the laboratory and from manufacture of rubber footwear, 3 people work on lining sewing, 2 of each work 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), facade 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 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.

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

The next step would be occupational rehabilitation – referral of the patient to the Disability Board where 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 (30).

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 (31, 32). 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 her or his personal features.

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

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, is 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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