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ANNUAL SURVEILLANCE REPORT

OCCUPATIONAL ALLERGIES

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Glossary

Allergens	A substance capable of triggering a response that starts in the human immune system and results in sensitisation or an allergic reaction
Allergic contact dermatitis (ACD)	An immune response on a localized region of the skin, due to contact with an allergen to which an individual is sensitized
Atopic patients	Patients that tested positive to three or more tests in the aeroallergens panel
Contact dermatitis	A reactive eczematous inflammation of the skin, which occurs after direct contact with a substance (chemical, biological or physical agent/s). Symptoms include itching, erythema, blisters, exudation, papules and flaking.
ESS	European Standard Series
IgE	Immunoglobulin E
Industry	The industry where the patients worked at the time of exposure were grouped into categories according to the Standard Industrial Classification of all economic activities (7th Edition)
Irritant contact dermatitis (ICD)	Contact dermatitis occurs when an irritant substance has caused damage to the skin (tissue)
Job	The activity that the patient does/did while on duty
NIOH	National Institute for Occupational Health
Occupational allergy	A condition resulting from exposure to allergens or chemicals while “on the job” such as contact dermatitis, urticaria, asthma, rhinitis, conjunctivitis
ORA	Occupational respiratory allergy
N-O	Non-occupational
OAU	Occupational Allergy Unit
OSDC	Occupational Skin Disease Clinic
Panel	A set of allergens used to test for skin allergies depending on the exposure. The European standard series is a set of the most common allergens that are associated with allergic contact dermatitis. Other exposure-specific series include: hairdressing, cosmetic, metalworking oil series, shoe, rubber, epoxy resin, dental series
Patient	All workers or persons referred (internal or external) to the NIOH for respiratory allergy or skin allergy testing
SPT	A skin prick test, also called a scratch test, checks for immediate allergic reactions to allergens and is usually done on the forearm
Type of sample	Blood, serum or bulk sample (samples from the workplace that is suspected as the causative agent)

Executive Summary

In 2020, 150 patients from various industries visited the occupational allergy clinic at the NIOH. A total of 150 patients attended the occupational allergy clinic at the NIOH in 2020. Data were obtained from patient records and entered into Microsoft Excel and Access, respectively. The data was imported into STATA SE version 16 for analyses, post-cleaning and removal of duplicates. Summary measures have been presented in this report.

Patch tests were used to test for possible contact allergies. Testing was conducted using a battery of commercial allergens (patch test series), as well as substances from the patient's workplace. Of the 43 patients who visited the occupational skin allergy clinic at the NIOH, 39 patients were tested for skin allergies. Of these patients, 42% were diagnosed with allergic contact dermatitis, 5% were diagnosed with both allergic and irritant contact dermatitis, and 37% were diagnosed with irritant contact dermatitis. The remainder was a mix of other diagnoses, such as contact urticarial (2%) and endogenous (or atopic) (4%) reactions.

The most common test series performed was for the European Standard Series (ESS), with 81% of all patients tested, followed by the cosmetic series (14%). Among both groups, the top allergens identified were nickel, methylisothiazolinone, fragrance, and cobalt chloride. Half (51%) of patients reported atopy.

Skin prick tests (SPT) were used to test for possible respiratory allergies. The mean age of patients attending the respiratory clinic was 42 years. Approximately 71.0% of patients were male. The patients were predominantly Black African (83%), followed by White patients (15%). The main industry that referred patients was research and experimental development (79%), followed by mining and quarrying (4%) as well as human health and social work activities (2%). The highest proportion of tests requested was platinum and nickel (43%), followed by platinum only (41%) and aeroallergens (13.1%). The atopic individuals predominantly non-occupational (N-O) (77%) were pensioners (18%), followed by healthcare workers (18%) and housewives/husbands (14%).

Although there are limitations to the data, such as the lack of generalisability, it should be noted that even for the N-O, the manufacturing industry, followed by the health sector, had

the highest proportion of patients with symptoms and positive allergy tests. Further investigation is required to assess the working environment and provide appropriate preventive controls.

Background

Industrialisation, in general, has caused a significant increase in occupational allergies. Occupational allergies can lead to serious health problems and hence are compensable under the South African Compensation for Occupational Injuries and Disease Act, of 1993 (Act 130, 1993). In certain industries where allergens are prominent, pre-employment screening is essential in preventing allergies resulting from workplace exposure. This pre-employment screening is particularly important for atopic individuals with a genetic predisposition to developing allergies. Numerous studies have described the strong association between atopic individuals and their likelihood to develop allergies due to exposure at work.

Occupational allergens are substances used or handled in the work environment that can trigger an immune response, which subsequently results in sensitisation or an allergic reaction. These agents are diverse and, in many instances, are complex and as such, proving the causation of disease can be challenging. In addition, only a few occupational allergens are commercially available; and biological allergens may differ by species and region and may not be relevant to South Africa or specific provinces.

The Occupational Allergy Unit (OAU) of the Immunology & Microbiology Section at the National Institute for Occupational Health (NIOH) conducts occupational allergy testing on both respiratory [Immunoglobulin E (IgE) mediated or Type I hypersensitivity] and skin (Type IV hypersensitivity reactions or delayed reactions) allergies in occupational settings.

The OAU also specialises in testing non-commercial allergens. This function is valuable since some allergens are specific to certain occupational sectors, which are found in a few countries or regions (e.g. certain metal allergies such as potassium dichromate). Laboratory preparation of allergens ensures that the cause of rare or less common allergies can be

identified. The laboratory maintains an extensive occupational allergen bank, and a list of allergens can be made available upon request. The OAU has been maintaining a database of occupational allergies since 2005. The information in this database is paramount for our understanding of occupational allergy tests and surveillance of occupational allergies in South Africa. Through the database-specific allergens and industries are identified, which can inform preventative measures to reduce exposure in the workplace. Furthermore, the data in the database is an important resource for research purposes.

Occupational respiratory allergy includes occupational rhinitis (OR) and occupational asthma (OA). Causative agents are divided into high-molecular-weight (HMW) and low-molecular-weight (LMW) agents. Common occupational HMW agents are proteins from grains and flour, seafood, moulds, animals, latex etc. LMW substances include isocyanates, metals such as platinum and nickel, cleaning products and disinfectants. Determination of IgE-mediated sensitisation using SPT and other tests is important in diagnosing occupational respiratory allergy.

Respiratory allergies reported in this report were tested using the skin prick test (SPT). SPT was used to test common inhalants (house dust mites, cockroach, mixed feathers, cat, dog, plane tree, Bermuda grass, mould and grass mix and corn pollen) and occupational allergens. The common inhalant allergens assist in identifying atopy among patients.

Occupational skin diseases (OSD) are among the most common type of occupational diseases which occur in the workplace. Worldwide it is recognised that these conditions are under-recognised, under-diagnosed, under-reported and under-compensated. Early diagnosis of OSD is crucial, as prolonged exposure is more likely to lead to intractable dermatitis, which persists after removal from exposure. Therefore, a need for an OSD diagnostic service in South Africa was identified and an occupational skin disease clinic was initiated at the Immunology & Microbiology Section, NIOH.

As approximately 80-90% of OSD patients present with contact dermatitis (CD), which can be either irritant (ICD) or allergic (ACD) in nature, patch testing is done to differentiate between

the two forms. This is important since ICD & ACD have different management requirements. Patch tests with commercially available allergen series, either the European standard series (known most common allergens that cause allergic contact dermatitis) or different exposure-specific series (e.g. cosmetic, dental, hairdressing, nail series etc.) enhance the detection of sensitisation to specific allergens. From the clinic, permission is obtained from the patients to capture their information into a comprehensive database in order to look at trends in OSD in the 'referral area', which includes Johannesburg and the surrounding areas as well as Mpumalanga, Limpopo, Free State and Northwest. This is an important process since little is known about the extent and type of OSD in South Africa and the industries in which these occur. The OSD clinic database which was donated by the British Contact Dermatitis group was started in 2005 and there are 898 patient records captured in the data base. The database was created in Access and has many linked tables which record the patients' demographics, the occupation and industry in which they work; their atopic status; the part of the body which is affected and the type of skin disease. Tables for the various patch test series allow for the comprehensive recording of the patch test results. The data can be exported into several statistical programs for analysis.

The data presented in this report summarises the data obtained in 2020, of patients presenting with suspected occupational skin allergies at the occupational skin clinic, as well as patients who have been tested for possible immediate type of allergic reactions to workplace allergens by skin prick testing. This report can be accessed at: <http://niohweb.nhls.ac.za/>

Methods

The data presented here were obtained from patients referred to the occupational allergy clinic at the NIOH and patients tested for possible immediate type of allergic reactions. Patients are referred by occupational health practitioners, dermatologists, company health and safety representatives & wellness programs, and public hospital clinics. The 2020 prevalence data are presented in this report. Patients referred to the NIOH came for consultation, follow-up, for further testing or for, requests from insurance, or completion of documents for the Compensation Commission.

Patch test

Although contact dermatitis can occasionally be classified as allergic or irritant by a physical examination, this is not always the case; often, irritant dermatitis is identified by negative patch testing. Patch testing is important as identification of a causative allergen will necessitate avoidance of that substance without resulting in work loss. Referrals from companies were seen by the consultant dermatologist and patch tests were conducted by staff of the Immunology & microbiology section that are deemed competent to perform the test.

A patch test is conducted by placing the allergens along with a negative control on a sticky strip and this is then placed on the patients back for two days when they return to the clinic for reading of the results and a report to be completed and recorded. The most common patch test series tested in 2020 at the OSD clinic was the European standard series. This is a good starting point as it includes the most common allergens which cause contact dermatitis. However, several other series were also applied to more specifically test for allergens associated with different occupational exposures. The cosmetic series is important not only for testing for reactions to self-care products but also for testing beauticians that work with cosmetics all the time. The rubber series is critical for healthcare workers who commonly wear rubber gloves but also for factory workers or miners who wear rubber gloves as well as other rubber items (e.g. gloves) at times.

Respiratory allergies

Skin prick tests (SPT) were used to test for respiratory allergies. The SPT involves applying allergen solutions onto the patient's skin and introducing them into the skin by pricking the patient's skin. The SPT is desirable since results are available within 15 minutes. In patients with potentially life-threatening anaphylactic shock reactions and those on medication that cannot be stopped, SPT is not recommended. For such cases, the ImmunoCAP specific IgE test is considered to identify the specific IgE against the suspected allergen. IgE tests results are not presented in this surveillance report.

The OAU specialises in testing non-commercial allergens. This function is valuable since some allergens are specific to certain occupational sectors, found in a few countries or regions (e.g. certain metal allergies such as potassium dichromate). Laboratory preparation of allergens ensures that the cause of rare or less common allergies can be identified. The laboratory maintains an extensive occupational allergen bank, and a list of allergens can be made available upon request.

Data from clinic files were entered into a database, then imported into STATA SE version 15 for data analysis. Summary measures consisting of means, medians and interquartile ranges for all continuous or discrete study variables were documented. Frequencies (numbers and percentages) were produced for categorical data. Atopic patients were defined as those who had a history of childhood eczema &/or had a family history of atopy.

Results

1. Respiratory Allergens

1.1 Sociodemographic characteristics

In total, 107 patients attended the respiratory allergy clinic at the NIOH in 2020. The mean age of patients attending the respiratory clinic was 42 years, ranging from 23 to 63 years. There was a larger proportion of patients (38), in the age group 40-49 years, presenting for respiratory allergy testing. Approximately 71.0% of patients were male. The patients were predominantly Black African (83%) followed by White patients (15%). The main industry that referred patients was research and experimental development (79%), followed by mining and quarrying (4%) as well as human health and social work activities (2%). Most workers screened were from the mining and quarrying industry. Other categories consisted of the following: unemployed patients, private security, scientific research and development, cleaning sector, water treatment, air transportation service and sound recording (Figure 1). Approximately 71% of the patients were male. The majority of clinic attendees were Black (83%), followed by White (15%). A large proportion (84%) came from the research and development industry.

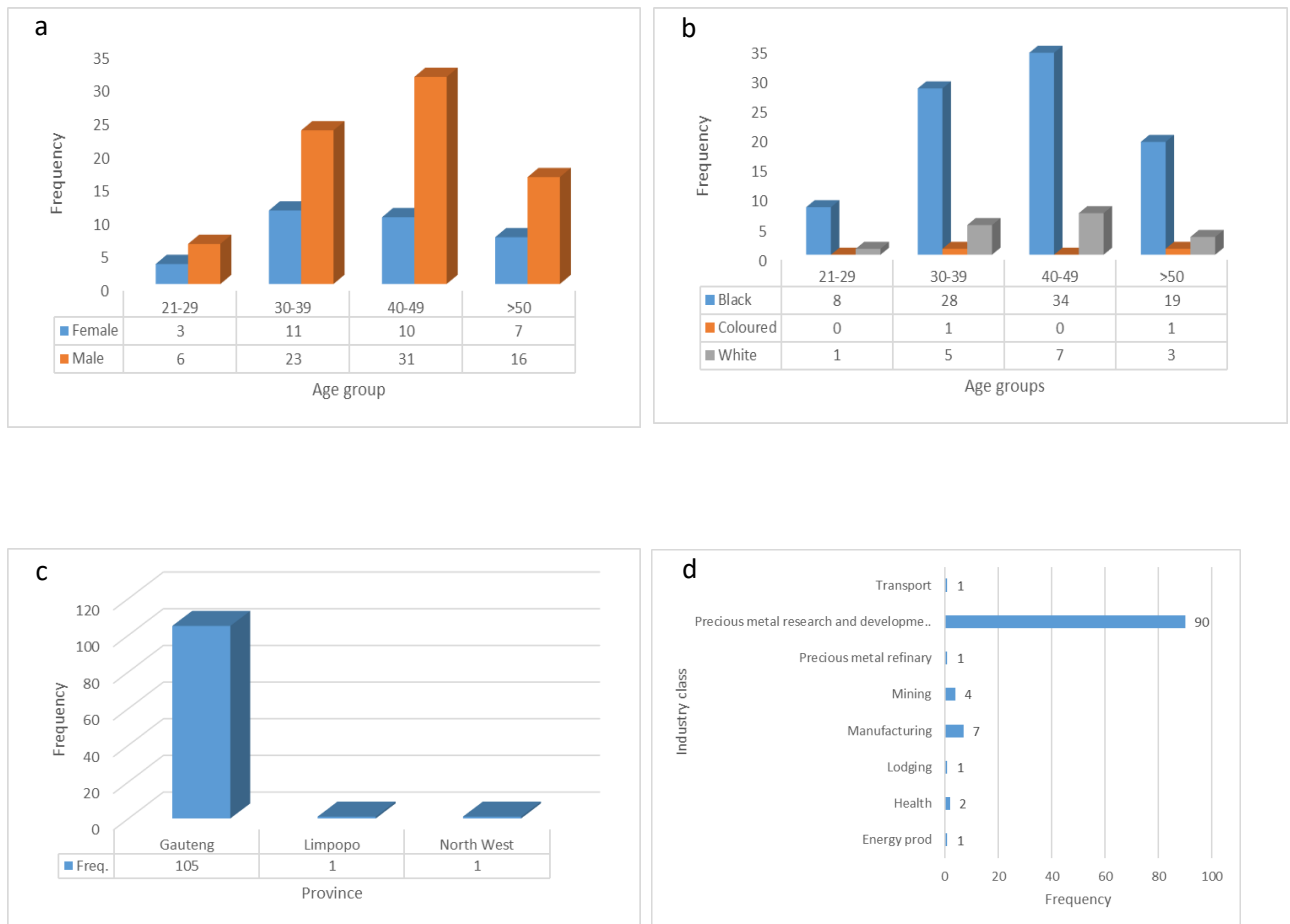


Figure 1 (a-d): Sociodemographic characteristics of patients seen at the Occupational Allergy clinic at NIOH

1.2. Respiratory allergy tests requested

The highest proportion of tests requested was platinum and nickel (43%), followed by platinum only (41%) and aeroallergens (13.1%) (Figure 2).

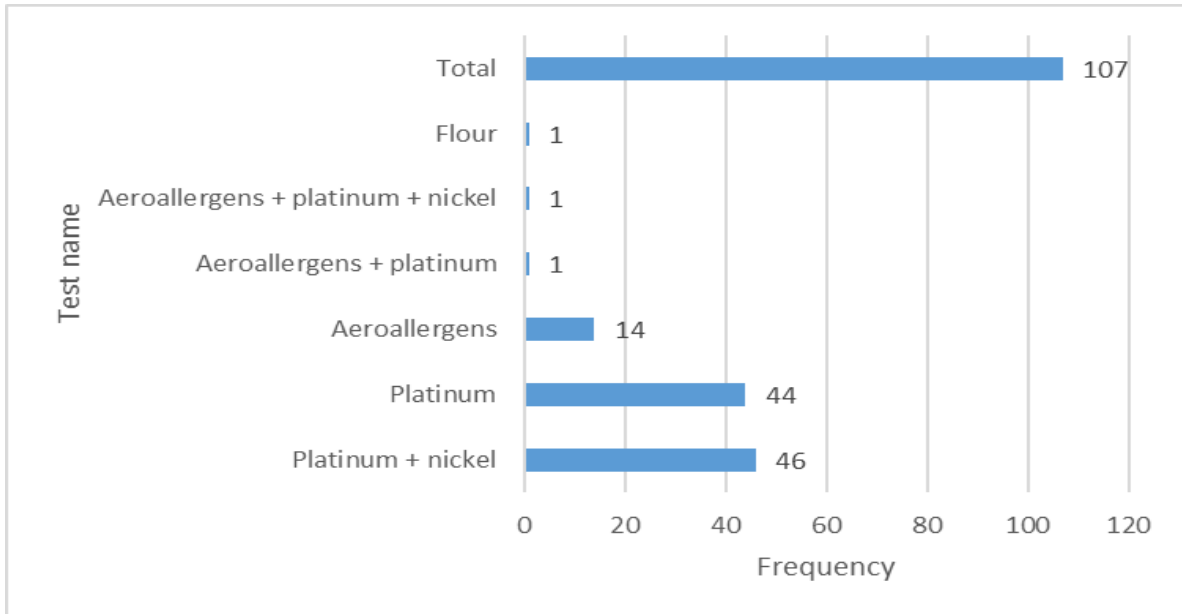


Figure 2: Frequency of positive respiratory allergy tests requested

Among the aeroallergens, approximately 37.5% tested positive for cockroaches and *D. pteronyssinus* (house dust mite), 31.2% for London plane tree, 25% for Bermuda grass, 19% for zeamaize and grass, respectively. The cat and dog contributed 12.5% and 6.25% respectively, while no-one tested positive for the feather mix (Figure 3).

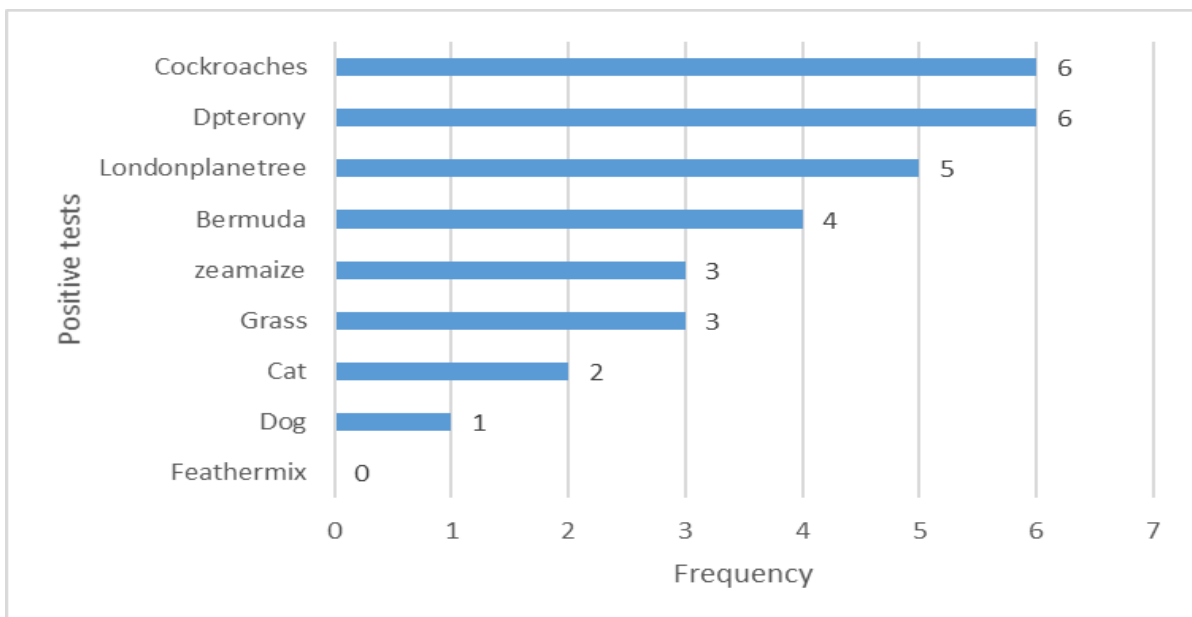


Figure 3: Frequency of positives for the various aeroallergens tests

2. Skin allergens

Of the 43 patients that presented at the OSDC, just over half were referred as occupational cases. The total patient group ranged in age from 9 -76 years.

2.1 Sociodemographic characteristics

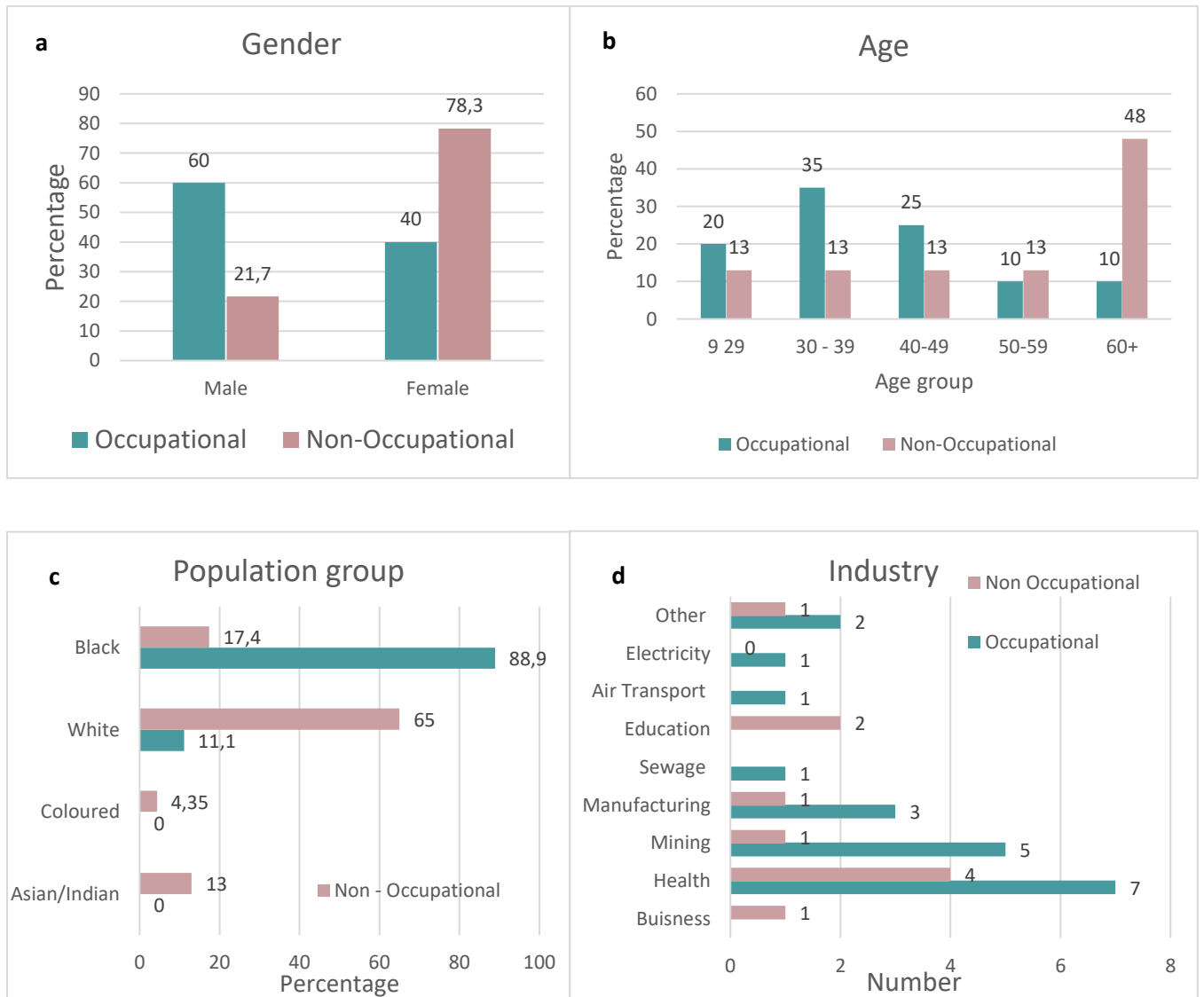


Figure 4a-d.Socio Demographic information

The mean age of patients, attending the OSDC was 47 years; while all of the occupational referrals were of working age, the N-O ranged from 9 to 76 years of age. Approximately 60% of the occupational patients were male, while 78% of the N-O were female. The majority of patients referred from workplaces were Black, while most of those referred by dermatologists (N-O) were White (Figure 4c).

2.2 Occupational profile of referrals

The main industry that referred patients was the health industry (35%), followed by mining (25%) and manufacturing (15%). The N-O patients came from Health, business, or were students (Figure 4d).

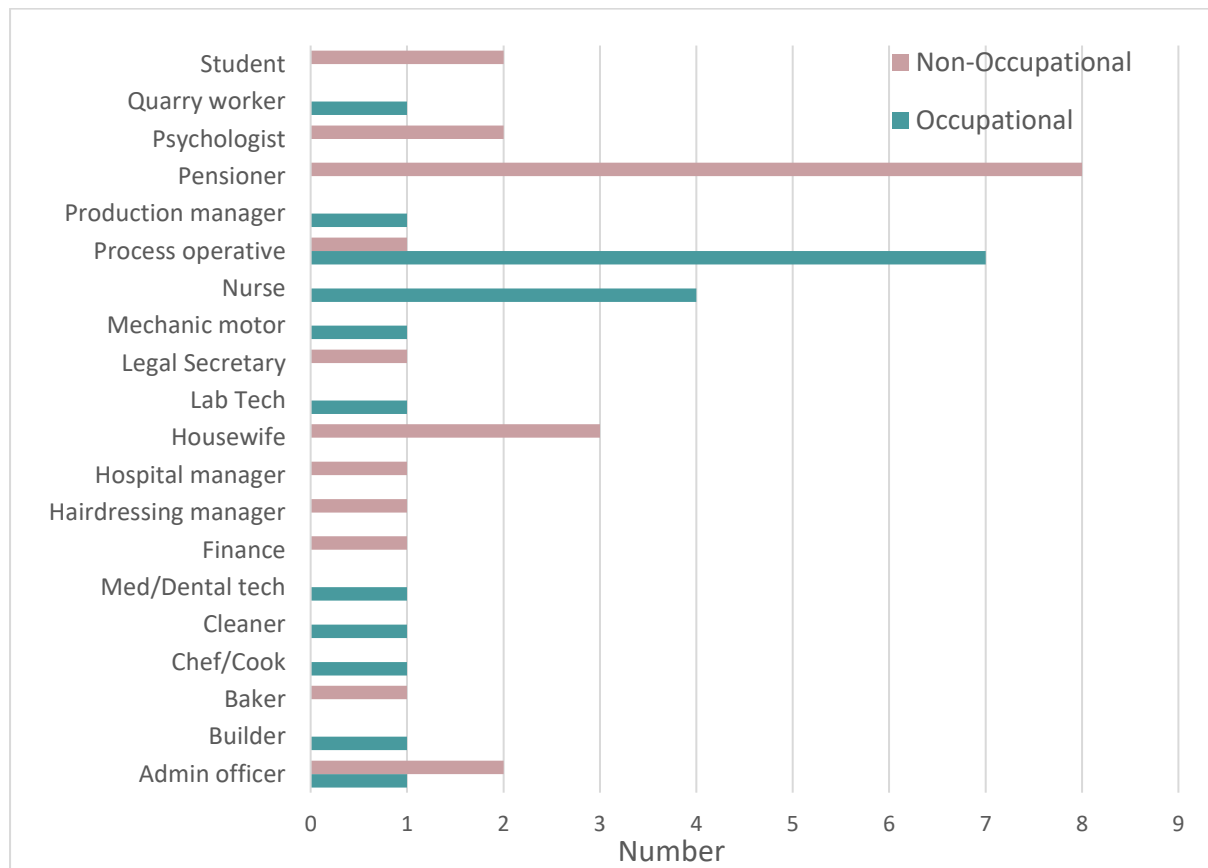


Figure 5. Occupations by referral type

Mining process operator was the most common occupational category of all the occupational referrals to the clinic, followed by nurses & a variety of occupations, including production manager, lab technician, and builder, among others (Figure 5).

2.3 Diagnosis of all referred patients

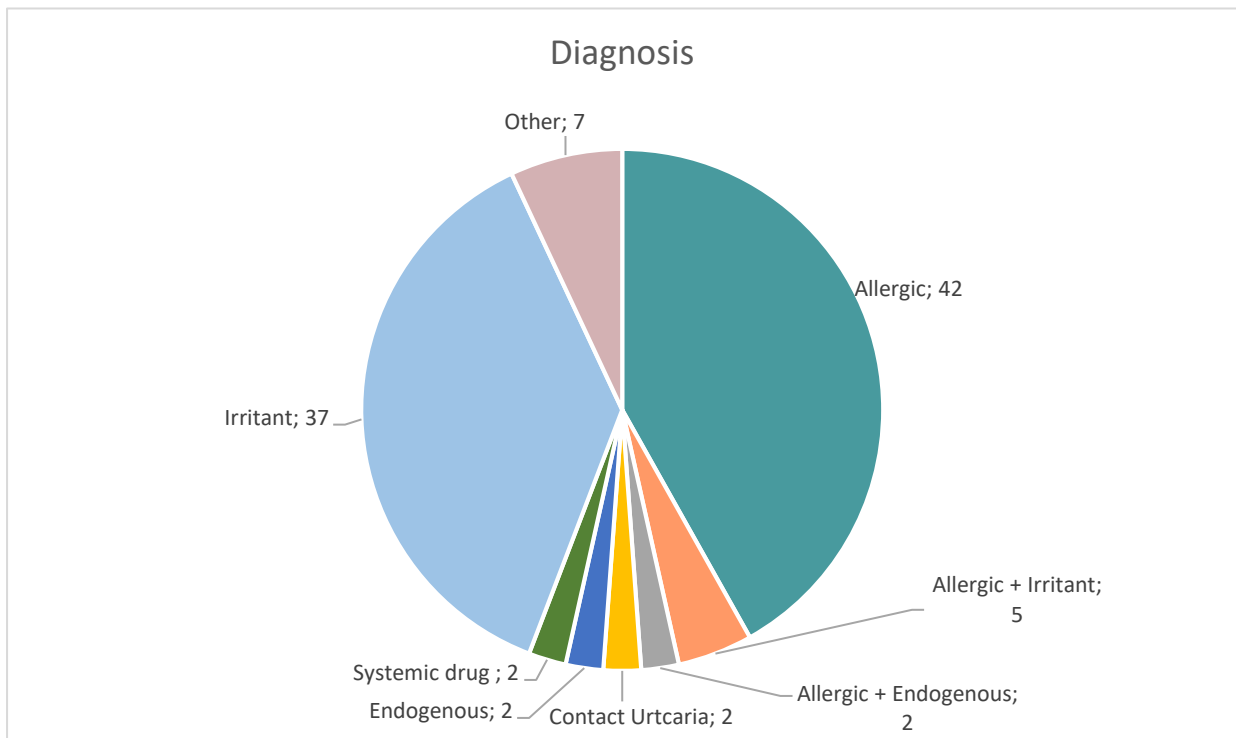


Figure 6. Percentage of all patients' main diagnosis.

Contact dermatitis (including allergic, irritant and a combination of both reactions) was diagnosed in the largest group of referrals (86%) (Figure 6). Followed by 'other' (7%), which included multiple chemical sensitivity, among others (Figure 6).

2.4 Allergy screening diagnosis

The patients that attend the OSDC are seen by a dermatologist who diagnoses the type of OSD and if they are considered to have contact dermatitis, they are screened for possible allergic reactions by patch testing.

2.4.1. Atopy

Atopy was more prevalent among the N-O patients (74%) than the occupational patients (25%) in Figure 7. The atopic individuals were predominantly pensioners (18%), followed by healthcare workers (18%) and housewife/husbands (14%).

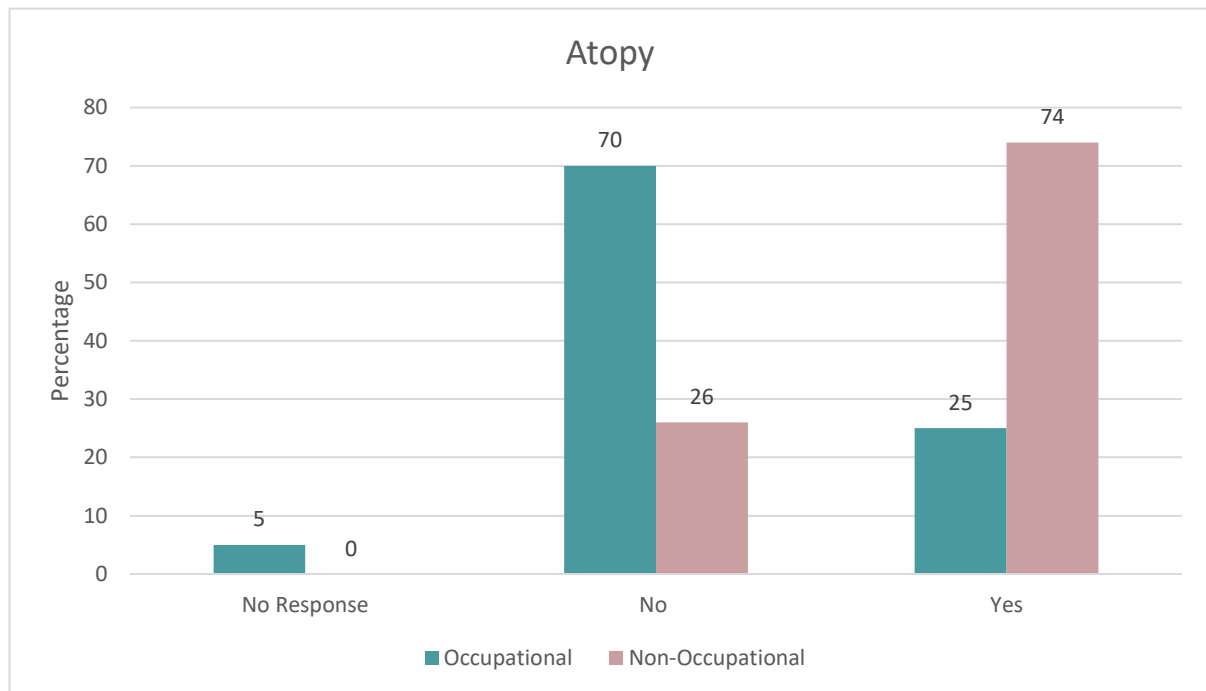
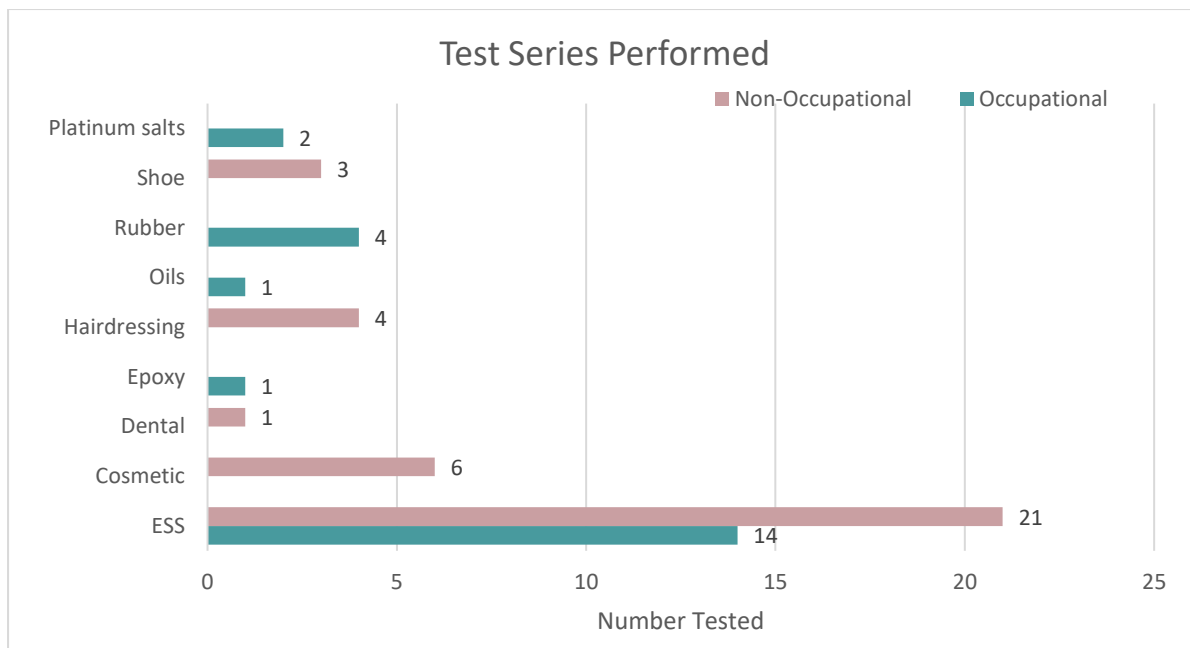


Figure 7 Percentage of patients reporting atopy.

2.4.2 Allergy test series performed

The most common series tested in the occupational referrals (other than the ESS) was the rubber series, while in the N-O the cosmetic series was most commonly tested. Various other substances were tested in both groups (figure 8).



**Miscellaneous consisted of specific tests such as metals or other allergens which do not form a series*

Figure 8 Number of allergy test series requested by patient group

2.4.2.1 Patch test results of common series tested

European standard series

The test series each consist of several allergens, 49% of those patients tested with the ESS were positive to at least one allergen in the test series.

Table 1 Number and percentage of patients testing positive for allergens in the ESS

Allergen Tested	OC (n* positive)	OC%* *	N-O (n positive)	N-O%**
Potassium dichromate	1	8.3	1	6.7
Thiuram	0	0	1	5.9
Paraphenylene diamine	0	0	2	10.5
Cobalt chloride	2	14.3	1	5.9
Formaldehyde	1	7.1	1	5.3
Colophonium	1	7.1	1	5.9
Balsam of Peru	0	0	2	11.1
Neomycin 20%	0	0	1	6.3
Quaternium	0	0	1	5.3
Mercapto mix	1	7.1	0	0.0
Paraben mix	0	0	1	5.9
PTBP formaldehyde	0	0.0	1	5.9
Fragrance	2	14.3	2	12.5
Nickel sulphate	3	21.4	5	23.8
Methylchloroisothiazolinone/ Methylisothiazolinone (MCI/MI)	6	35.3	1	5.3
mercaptobenzothiazole	1	7.1	1	5.3

**n is the number of people with a positive reaction ** percentage is calculated by dividing the number of positives by the total number tested with each substance, the number tested varies depending on exposures; thus the percentages vary.*

Cosmetic Series

Six patients were tested with the cosmetic series three tested positive and the positive reactions were:

Table 2 Positive reactions detected to allergens in the cosmetic series.

Positive reactions to allergens in Cosmetic series	No of positives
Cocamidopropyl betaine	1
Hydroabietyl alcohol	1
Benzyl salicylate	1
Dodecyl gallate	1
Lauryl Polyglucose	1

Of all patients tested with the ESS - nickel, methylisothiazolinone/ Methylchloroisothiazolinone, and fragrance were common allergens detected among both groups, whereas cobalt chloride is common among the OC group and paraphenylene diamine and balsam of Peru were more common among the non-occupational group. (Table 1)

A total of 50% of patients tested (all N-O) reacted to at least one allergen from the cosmetic series and two of the patients tested positive for two allergens (Table 2). Although these allergens were detected in N-O cases, they can also be of importance in an occupational setting. Cocamidopropyl betaine is a synthetic detergent that has been increasingly used in cosmetics and personal hygiene product eg, shampoos, skincare products, cleansers, liquid soaps, antiseptics, and gynaecologic and anal hygiene products); Benzyl salicylate is most often used as a fragrance and UV light absorber to stabilize perfumes; hydroabietyl alcohol is used in adhesives, mascara, inks, sealants and as a plasticizer in plastics. Dodecyl gallate is a preservative used in oil-based foods toothpaste, cosmetics, pharmaceutical creams, emulsion and waxes; Decyl glucoside is a non-ionic surfactant widely used in cleansers and detergents as it is obtained from natural sources it is commonly found in products for babies and those with sensitive skin. Lauryl Polyglucose is a surfactant found in personal care and cleaning products.

Rubber Series

A total of 4 OC patients were tested with the 25 allergens forming the rubber series and one patient was positive for Tetramethylthiuram monosulphide, which is used as an accelerator and activator in the processing of rubber. It is found in shoes and adhesives, condoms, gloves, personal care products and tires and tubes.

Hairdressing Series

Only three private patients were tested with the hairdressing series and one patient tested positive to 2-Nitrodiphenylamine found in hair dye, and one for Toluene-2,5-diamine. Toluene-2,5-diamine is used in commercial hair dyes as a substitute for the more toxic phenylenediamine. It is also used in the production of textiles, leather, stains and pigments.

Shoe Series

Three patients were tested for the shoe series and one non-occupational patient tested positive to Dodecyl mercaptan, which is used in the manufacturing of polymers for shoes, or as a lubricant found in oils and metalworking fluids.

2.5 Primary site affected by allergy

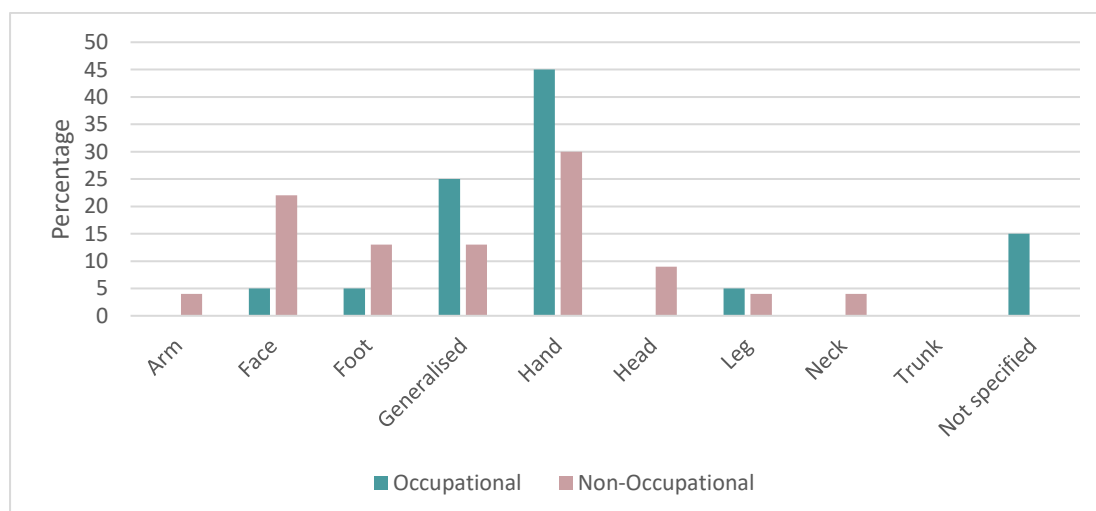


Figure 9 Percentage of patients and primary site of allergy.

The most common primary affected site in both occupational and N-O cases is the hands which are a common site for contact dermatitis. , The N-O also commonly presents with facial allergies and thus being tested for cosmetic products (Figure 9).

2.6 Workplace relatedness

The skin diseases were considered to be work-related if they occurred while at work, with an improvement when away from work and a recurrence when returning to work. Also, if there are exposures to possible causative agents in the workplace. Ninety-two percent of the occupational referrals were diagnosed as having an occupational or work-related skin disease. In comparison, none of the N-O referrals had occupational allergies (Figure 10).

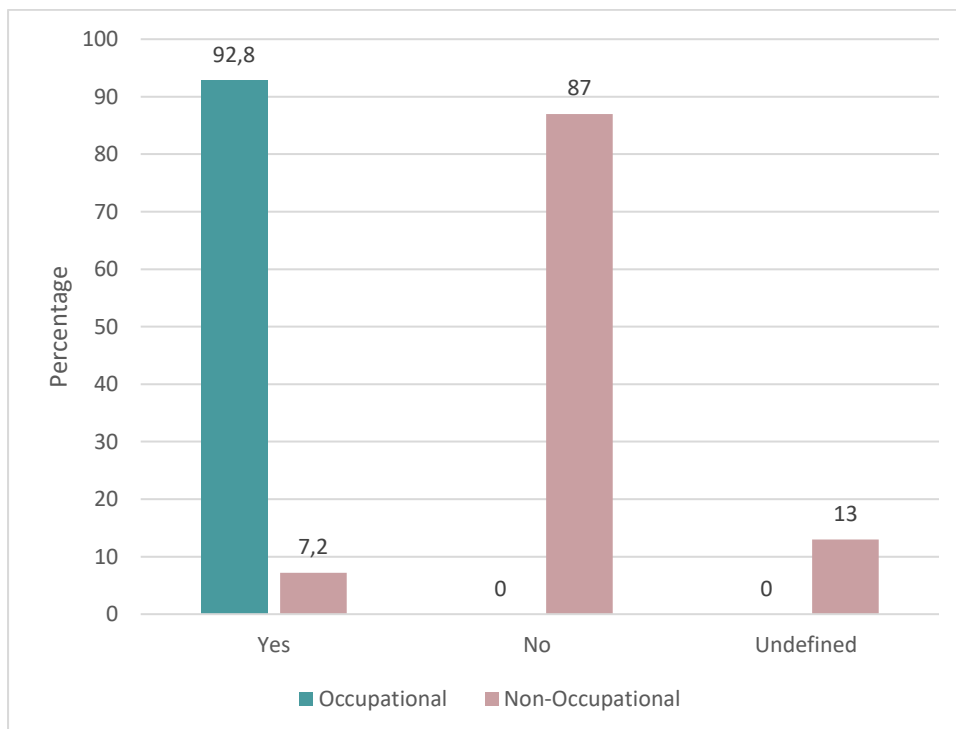


Figure 10 Percentage of work related skin diseases by patient type

Conclusions

Occupational skin allergies and irritant reactions form an important part of Occupational Health. Surveillance of these diseases is an essential component of an occupational health surveillance programme, which helps with control and planning. Awareness is needed amongst workers and management of the risk of developing workplace allergies.

In 2020, the majority of patients were from the manufacturing, mining and health industries, highlighting the need for more research and implementation of control measures in these industries. Strengthening the allergy surveillance programme in these industries and in South Africa could provide a comprehensive picture; additional data is needed from other allergy treatment centres throughout the country.

Testing was conducted for a battery of common aeroallergens as well as non-commercial allergens. The majority of patients were in the 31-40 and 40-49 year age group. However, there were a higher proportion of > 51-year-old patients in the referral group compared to the worker group. The sex distribution was similar among workers and referrals- 60% males and 40% female in the total sample. The majority of patients were from the mining and quarrying sector. Referral patients included 49% from mining and quarrying and 25% from manufacturing. The highest proportion of tests requested was the platinum and nickel test (37%), followed by aeroallergens (25%) and platinum (21%). Approximately 63% of patients tested positive for aeroallergens, 22% for chrome, 4% for platinum and 2% for nickel. The top three aeroallergens were house dust mites (48% positive of all tested), Cockroaches (41%) and zea maize (31%).

In 2020, due to the COVID-19 pandemic, a reduced number of occupational and non-occupational patients were seen. A significant percentage of workers had work-related allergies and the majority of patients were from the mining, business and health sectors, highlighting the need for more research and implementation of control measures in these industries. Strengthening the skin surveillance programme in these industries and in South Africa could provide a more comprehensive picture, but for this to occur, additional data is needed from other allergy treatment centres throughout the country.

Limitations

The majority of the patients are from Gauteng due to the clinic's location in Johannesburg, Gauteng. Thus these results cannot be generalised. Other centres assessing skin allergies (public and private) need to provide data to develop a comprehensive occupational skin surveillance system.

There is missing data/ information in the current data collection tool. The exact nature of the job within an industry is unknown, and the province of employment is unavailable. These and other relevant information will be added to the minimum data set for future surveillance.