

Review

Allergic contact dermatitis: a significant environmental and occupational skin disease

Olufunmilayo A. Olusegun, BSc (Hons), MSc, PhD  and Bice S. Martincigh, BSc (Hons), PhD

School of Chemistry and Physics,
University of KwaZulu-Natal, Westville
Campus, Private Bag X54001, Durban,
4000, South Africa

Correspondence

Olufunmilayo A. Olusegun BSC (HONS), MSc,
PHD
School of Chemistry and Physics
University of KwaZulu-Natal
Westville Campus, Private Bag X54001
Durban 4000
South Africa
E-mail: folusegun1@gmail.com

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Abstract

This review article seeks to provide an overview of allergic contact dermatitis (ACD) as a significant environmental and occupational skin disease, the phases of ACD, its causes from the occupational and environmental perspectives, its detection, the effects of ACD with respect to the social, psychological, occupational, and financial perspectives, and its cure and/or prevention. Human skin is very sensitive and as the largest organ in the body, it is highly prone to direct and indirect contact with the substances from its environment. The skin reacts to these substances (xenobiotics) differently depending on the individual's tolerance level or threshold. Allergic contact dermatitis is a significant environmental and occupational skin disease that should not be ignored in our society because it can affect the quality of life of an affected individual. There are multiple causes of ACD, and these causes of ACD have been discussed from two perspectives: environmental and occupational. The effects of ACD can be psychological, social, financial, and occupational. There is need for more public enlightenment on the effects of ACD as well as a precise understanding that it is not a contagious disease so as to significantly reduce the psychological and social effects of ACD on these patients.

Introduction

Human skin can be very sensitive and as the largest organ in the body, it tends to come in contact with different substances (xenobiotics) and reacts to them differently depending on an individual's tolerance level or threshold.¹ Contact dermatitis is a skin condition that occurs when the skin encounters an irritant and/or an allergen. These substances can occur in the environment and/or in the workplace. Over the years, multiple studies have been conducted on the two types of contact dermatitis. These are irritant contact dermatitis (ICD) and allergic contact dermatitis (ACD). This review is focused on ACD as a significant environmental and occupational skin disease, the phases of ACD, its causes, its detection, the effects of ACD with respect to social, occupational, and health perspectives, and its cure and/or prevention.

Allergic contact dermatitis

Skin is very far from being an inert tissue, rather it undergoes many metabolic processes which can lead to the structural modification of xenobiotics that penetrate into it, thereby resulting in skin sensitization.² Skin sensitization (SS) is the immunological

response to previous exposure to xenobiotics (allergens) through skin contact, thereby resulting in ACD.^{3,4} As previously indicated, the skin is usually exposed to many xenobiotic compounds which can arise from both naturally occurring and synthetic sources in the environment and workplaces, and the exposure of the skin to xenobiotics may be accidental or intentional.⁵ Allergic contact dermatitis is the clinical manifestation of contact dermatitis which can be referred to as a complex immunopathological reaction which occurs in an individual who has been previously sensitized due to exposure to an allergen and is later re-sensitized due to further exposure to an allergen in a concentration exceeding the individual's tolerance level.^{6,7} ACD can also be referred to as a type IV immunological reaction (i.e., it is a cell-mediated reaction which does not involve the participation of antibodies but is due to the interaction of T cells with antigens) which manifests as eczema.⁸ Apart from diseases that occur as a result of repeated traumatic injury, contact dermatitis is the second most commonly reported occupational disease.⁹

Allergic contact dermatitis is an environmental disease because it can occur as a result of exposure of the skin to xenobiotics (allergens) in the surrounding environment, but it can also be an occupational disease because it may occur as a result of exposure to some reactive chemical substances in the

workplace.¹⁰ About 20% of the general population in Europe suffers from contact allergy due to a minimum of one contact allergen, and this contact dermatitis occurs twice as frequently in women as in men, and statistically this disease affects about 5% of men and 11% of women in industrialized countries.¹¹ This skin disease over the years has accounted for about 50% of all occupational dermatoses and about one-fifth of all reported workplace diseases in the world.¹²

Characteristics of ACD

The main characteristics of ACD are redness (erythema), rash/papules, severe itching (pruritus), dry/cracked scaly skin, crusting, swelling (edema), skin burning/tenderness, and blisters with associated weeping.⁴ Allergic contact dermatitis can be said to have chronic and acute (severe) forms. Chronic ACD is the most common, and it is associated with scaly papules, skin discoloration/pigmentation, dry and scaly skin, and severe itching.¹³ Acute ACD is characterized by edema, blisters, crusting, and erythema.¹⁴

Appearance of ACD

ACD can appear on any part of the body (face, scalp, neck, hand, leg, etc.) that might have been exposed to a causative allergen. Hands are the part of the body that mostly have the most contact with the environment and hence are more affected by ACD.⁶

Contact allergens

Contact allergens are small molecules with a low molecular weight (<1000 Da.) that can only elicit an immune response when attached to a large carrier such as protein. A nonprotein compound can be said to be a contact allergen if it is reactive enough to penetrate the epidermis of a skin.^{14,15} These reactive contact allergens can also be referred to as haptens or incomplete antigens.¹⁰ A complete antigen is a hapten–protein conjugate formed through the covalent bonding of a hapten and an epidermal protein. From a chemical perspective, skin can be described as a nucleophilic environment (protein), while most contact allergens are electrophilic in nature.⁶ Therefore, ACD can only occur on penetration of a contact allergen into the epidermis of the skin, hence causing skin sensitization.

Phases of ACD

For ACD to occur, there are two phases or stages involved: the induction phase (also known as the sensitization phase) and the elicitation phase.

Induction/sensitization phase

This is the first phase of ACD, and it occurs when skin is initially exposed to contact allergens that can penetrate into the skin and react with proteins. Based on experimental studies, the antigenic potency and the concentration of an antigen determine whether the exposure of skin to an antigen will lead to

skin sensitization.¹⁶ The complete antigen can be presented, by means of the epidermis, to inexperienced T lymphocytes. These lymphocytes differentiate into memory cells and effector cells and reproduce rapidly in the skin; therefore, the individual can now be said to be hypersensitive, which in turn will make him react to a subsequent attack by the same hapten.¹⁷

In other words, the induction phase can be said to be the phase in which an individual has a first contact with a potential chemical allergen. The person is then sensitized by chemical absorption of the allergen into the skin, which in turn involves protein haptenation, presentation of the antigen, and the development of T cells with specific antigens, thereby making the individual to give a positive ACD reaction.^{18,19}

Elicitation phase

This is the second phase of ACD in which the hapten that caused the sensitization of the individual at the induction phase comes again into contact with the individual's skin on re-exposure of the individual to the hapten. The effector cells formed during the induction phase that circulate in the blood will come in contact with the allergen, and this results in the production of lymphokines (proinflammatory cytokines and chemokines), chemical mediators that aim at different targets. These targets are the macrophages and the lymphocytes, thereby resulting in the pathological manifestation of ACD.¹⁷

According to Chittiboyina et al.,⁴ the elicitation phase is a phase of ACD in which a further contact with the same hapten can result in the production of a rapid immunoreaction which often leads to rash, redness, and skin lesions.

In addition, a sensitized individual may also come in contact with another allergen which is completely different from the previous allergen from which he/she was previously sensitized, thereby causing cross-sensitization. On the other hand, cross-sensitization can be defined as a phenomenon in which a sensitized individual is sensitized by a second allergen different from the first allergen that caused his/her sensitization at the induction phase. The cross-sensitization may occur because the second allergen has a similar chemical structure to the first allergen or if the first allergen has the ability to cross-react with the second allergen.^{3,17}

Furthermore, the factors that determine the two phases of ACD are the nature, extent, and duration of exposure of the skin to the allergen as well as the potency of the allergen. The other determining factor can be how susceptible (easily sensitive) an individual is to the allergen upon exposure.¹⁵ Figure 1 shows an image of the induction and the elicitation phases of ACD in human skin, while Figure 2 shows a simple schematic diagram or flowchart on the phases of ACD.

Causes of ACD

There are multiple causes of ACD, and these can be discussed from two perspectives, namely, environmental and occupational (Fig. 3).

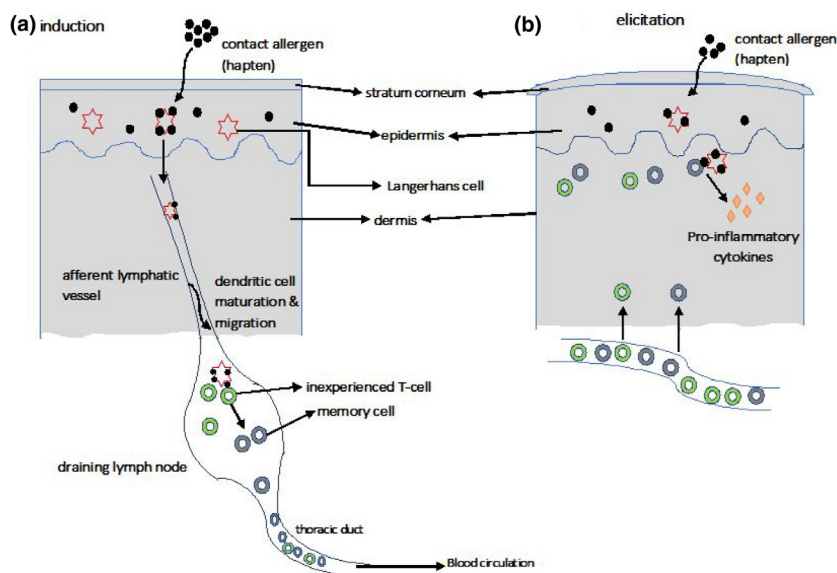


Figure 1 A typical diagram of the induction and elicitation phases of ACD in human skin (a) sensitization/induction phase: A hapten comes in contact with skin and penetrates into the epidermis; (b) elicitation phase: Re-exposure of the skin to the hapten causes an immunological reaction in the previously sensitized individual

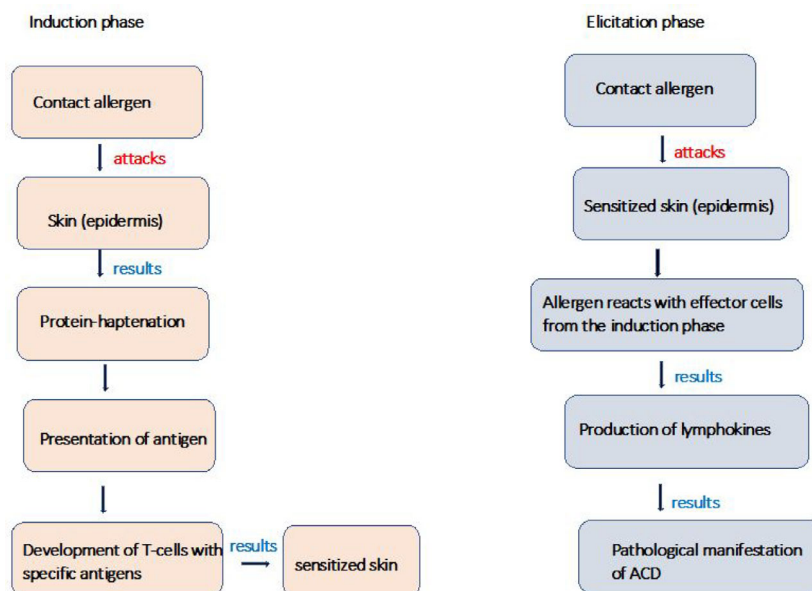


Figure 2 A simple schematic diagram of the induction and elicitation phases of ACD in human skin

Environmental perspectives

The causes of ACD based on environmental factors are due to exposure of the skin to contact allergens present in the environment. There are numerous sources of contact allergens in the environment, and some of these contact allergens will be discussed in relation to their likely sources with emphasis on sources such as plants, cosmetics/personal care products, and jewelry.

Plants

It is well known that in the environment, the skin can have direct or indirect contact with plants containing contact allergens. Lepoittevin and Benezra¹⁷ explained that ACD can be caused by contact allergens in plants in which quinones play a major role. They further stated that the occurrence of allergy-inducing quinones is not restricted to one or two plant families but is widely distributed among *Primulaceae*, *Bignoniaceae*,

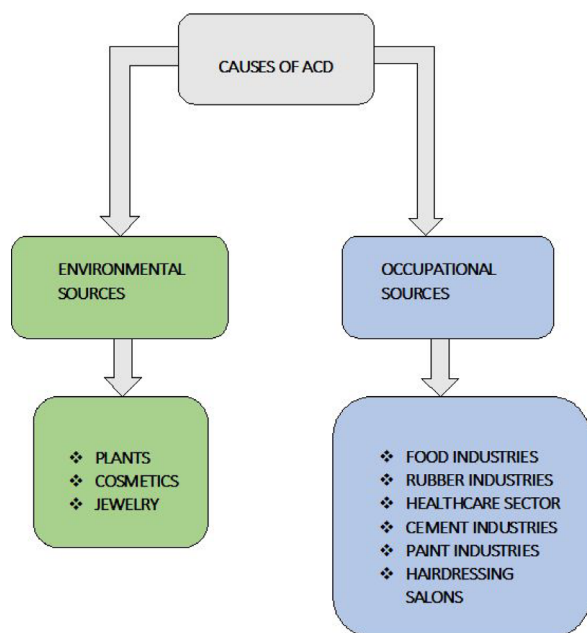


Figure 3 A schematic diagram of the causes of ACD

Ebenaceae, and *Leguminosae* among others. The main allergens present in these plants cause both ICD and ACD. Some of these allergens are benzoquinones or naphthoquinones, as well as simple phenolic compounds such as catechols and flavonoids which are presumably bioconverted into allergenic *o*-quinones or *p*-quinones. Benzoquinone is known as an extreme skin sensitizer, and it is known to be responsible for the pigmentation of most plants in the environment.²⁰ Apart from quinones, some other notable chemical sensitizers in plants are phenol derivatives, terpenes, isothiocyanates, and alpha-methylene-gamma-butyrolactones. Otang et al.²¹ explained that 24 plant species (distributed within 11 families) in the Eastern Cape province of South Africa are causative agents of ACD. According to their report, the most important allergenic plant family was *Asteraceae*, and the most cited cause of ACD was Mango (*Magnifera indica*) in the study area. Many allergens responsible for ACD are found in plants, for example, pentadecylcatechol is a highly potent allergen found in poison ivy in North America, and the members of *Rhus* genus such as poison ivy, poison oak, and poison sumac are responsible for most incidents of ACD in the United States.^{15,22}

Cosmetics/Personal care products

Some plants are used in the production of preservatives and fragrances for cosmetics purposes, and hence contact allergens present in these plants can be found in some of these cosmetic products, thereby resulting in ACD. Ortiz and Yiannias²³ explained that contact dermatitis has been reported due to the use of aloe in botanicals (additives used in cosmetics). Also,

there have been reports that lavender oil used for its perfume properties, peppermint, tea tree oil widely used in cosmetics, and cucumber and rosemary that are used for hair products are causative agents of contact dermatitis. According to Heisterberg et al.,²⁴ the most frequent cause of ACD is the ingredients in fragrances. They confirmed that the most frequent fragrance ingredient causing allergenicity is *Encoelia furfuracea*, while the most important fragrance allergens are *Evernia prunastri*, cinnamal, isoeugenol, eugenol, cinnamyl alcohol, benzyl alcohol, cinnamaldehyde, benzyl cinnamate, farnesol, hydroxycitronellal, and α -hexyl cinnamal. A fragrance mix that is a mixture of eight perfume ingredients has been identified as a major indicator of ACD reaction to perfumes.²⁵ Some of the common allergens in skin care products are parabens, imidazolidinyl urea, phenoxyethanol, quaternium-15, diazolidinyl urea, methylchloroisothiazolinone/methylisothiazolinone (MCI/MI), methylmethacrylate (MMA), and formaldehyde. Formaldehyde is known to be allergenic; therefore, manufacturers of cosmetics are rarely using it as a preservative. However, some of these manufacturers have replaced it with formaldehyde-releasing preservatives such as quaternium-15, diazolidinyl urea, methylchloroisothiazolinone/methylisothiazolinone (MCI/MI), imidazolidinyl urea, and parabens. Some of these formaldehyde releasers (these are substances or chemicals that were synthesized from formaldehyde and/or have the ability to slowly release formaldehyde due to decomposition) used as preservatives are among the top in the list of allergens that have tested positive to patch tests, and these preservatives are added to a large number of skin, hair, and make-up products because of their antimicrobial properties.¹⁶ The major allergens that are associated with facial ACD are hair dressing product-related allergens.¹⁸ It has been discovered that hair dyes are widely used by both men and women for beauty or fashion purposes irrespective of their adverse effects.^{19,26} Paraphenylenediamine (PPD) is an allergen present in most hair dyes. Benzophenone 4, an ultraviolet (UV) filter present in most toiletries and hair products, has been identified as an allergen responsible for face and neck dermatitis.^{19,26} In other words, ACD can be caused by different chemicals in cosmetics, inclusive of fragrances, botanicals, and preservatives.¹³

Jewelry

Jewelry is an important component of fashion for most women and men; therefore, it usually has direct contact with the skin (therefore, it is in the skin environment). It includes personal ornaments such as rings, necklaces, brooches, and bracelets made with precious metals and stones. Jewelry are of different quality depending on the percentage composition of the precious metals used for its production. Over the years, several studies have shown that allergic reactions to metals in jewelry exist. Most allergic reactions have been reported to be associated with nickel, palladium, and gold that are commonly used for jewelry. Cases of nickel allergy are higher in women than

men, especially among women associated with ear piercing, body piercing, and use of cheap jewelry. Nickel is the most common cause of metal dermatitis (allergic reaction to metals).^{27–29} Palladium is one of the major components of jewelry, especially white gold, in which it has a composition of 20%. Metal dermatitis due to palladium has been reported because of its increased use in dentistry, industries, and jewelry; however, palladium sensitivity has been reported to mainly occur in oral or dental diseases rather than skin.^{30–32} It is believed by some authors that the allergic reaction to palladium may be a cross-reaction because most of the people that are allergic to nickel are also allergic to palladium, and this is simply because both metals are transition metals which belong to the same group in the periodic table. Despite the increased use of palladium in jewelry, it is rarely found in the worldwide patch series, which may be due to the type of methodology, concentration of appropriate screening agent, serial dilution, and time course for patch testing. In addition, some authors have reported that patients that tested positive to sensitivity to palladium chloride have also tested positive to nickel but mostly tested negative to palladium when pure palladium metal is used for patch testing. It is believed that this possibility may be because there are traces of nickel in palladium chloride patch testing material.³³ There have also been incidences of allergic reactions to gold in jewelry especially at the sites of contact such as earlobes, fingers, and necks, though it was previously believed that metallic gold is relatively inert and would not cause allergic reactions.^{29,34} Gold can occur in different ionic states, but it is nonreactive in its natural state. There have been controversies on gold as a contact allergen, gold has been considered by some authors as a late reactor, thereby recommending patch test reading at 3 weeks to prevent missing any positive reactions. Gold allergy prevalence may be limited by different factors such as testing conditions, inappropriate screening agents, concentration of salt solution used, dilution factors, and time course for patch testing.³⁵ Some authors believed that the metals present in gold alloy, such as copper, cobalt, and nickel, may be the actual culprits responsible for the sensitivity in gold allergy patients; therefore, lower karat gold may cause severe dermatitis compared to higher karat gold and pure gold.³⁶

Occupational perspectives

The causes of ACD from an occupational perspective are based on exposure of the skin to chemical allergens or to materials that contain contact allergens within the workplace. Allergic contact dermatitis may be caused by different chemicals due to prolonged or continuous contact with the skin.⁶ Different occupations have unique exposures, thereby resulting in high rates of occupational contact dermatitis. The main affected occupational groups are mechanics, housekeepers, metalworkers, cleaners, health care workers, construction workers, hairdressers, beauticians, bakers, and cooks; what is common to these professions is extensive exposure to water, solvents, and/

or caustic materials.^{9,37} A few of these workplaces and the associated causes of ACD in them will be discussed.

Food processing industries

ACD may be caused by exposure of workers to high molecular weight proteins such as animal and vegetable proteins from the food processing industry, thereby causing protein contact dermatitis which is a type of ACD.⁸ Protein contact dermatitis mainly occurs when the epidermis of a skin is damaged, and this damage may be a result of urticaria, atopic dermatitis, ICD, or another type of dermatitis, thereby increasing the possibility of high molecular weight proteins to pass through it.^{38–40} Otang et al.²¹ explained that out of the 24-plant species that were mentioned in their survey as causing ACD, 67% are principally used as food, which means that workers within food industries (such as bakers, caterers, cooks, chefs, etc.) have a high risk of contracting plant-induced ACD. Wet processes are usually part of the processes in the food industries; hence, workers make continuous or repeated use of hand gloves, which results in allergic reactions because of the presence of some allergens such as thiurams in gloves. Apprentices in food processing professions are at a very high risk of developing hand dermatitis.⁴¹ Flour, flour additives, flavoring agents, food mites, and shellfish are also known to cause dermatitis in bakers and food handlers.⁴²

Rubber industries

Otang et al.²¹ reported that allergies do occur after contact with rubber latex gloves, resulting in blisters, scaling, and erythema. Latex is known as the milky sap of the *Hevea brasiliensis* tree, which is usually processed to manufacture multiple products such as gloves, condoms, and balloons; therefore, workers who are occupationally exposed to rubber gloves and other rubber products have a high risk of allergy to natural rubber as the protein content of natural rubber triggers a type IV immunological reaction. Over the years, some manufacturers have greatly decreased the concentration of latex protein in gloves, but some cases of high concentrations of rubber latex allergens in some gloves have been reported in Africa.⁴³ Alternative gloves such as nitrile gloves, which are latex free, are being manufactured globally for use by individuals that are allergic to rubber latex. Rubber sensitization has increased because people come into contact with different rubber products everyday including rubber gloves especially in industrial settings. The significant increase in rubber allergies in women can be associated with an increase in the use of rubber gloves by health care workers, especially nursing staff, who are mainly women.⁴⁴ The likely causes of ACD among rubber workers are exposure to some potent allergens such as para-phenylenediamine (PPD)-mix, isopropylaminodiphenylamine, phenylcyclohexyl-*p*-phenylenediamine, 1,3-diphenylguanidine, tetramethylthiuramdisulphide, nickel, black rubber, mercapto-mix, and epoxy resin, among others.⁴⁵ When workers are exposed to epoxy products, there is a high risk of

them developing ACD.⁴⁶ Also, high incidences of PPD-derivative sensitization have been reported among men in industries because of the use of heavy-duty industrial rubber gloves.

Health care sector

Health care workers have a tendency of being exposed to different agents that can result in several diseases including ACD. Health care workers are most likely to have occupational-related reactions to chemicals such as formaldehyde, quaternium-15, 2-bromo-2-nitropane-1,3-diol, thiuram mix, carba mix, glutaraldehyde, and bacitracin, among others. Based on statistics, health care workers also have a high rate of ACD to glutaraldehyde since glutaraldehyde is used as a cold-sterilizing solution for medical and dental equipment. Individuals working in the dental profession are most likely to experience reactions to glutaraldehyde.^{47,48} Nurses are majorly affected by hand dermatitis because of wet work exposure and prolonged use of gloves and biocides (disinfectants), while physicians and dentists are mainly affected by thiomersal and thiuram. Thiomersal sensitization is more common among health care employees because of its use in vaccines.^{49–51}

Cement/Construction industries

The presence of chromium in cement tends to expose factory workers in the cement industry to reactions of ACD.^{15,17,52} Cement dermatitis is a significant problem among construction workers, and it is one of the most common types of occupational dermatitis in the world.^{53,54} It has been reported that the reduction in the concentration of water soluble hexavalent chromium content in Danish and Scandinavia cement to 2 ppm by the addition of ferrous sulfate has resulted in a significant decrease in the prevalence of cement dermatitis and hand dermatitis among construction and cement industrial workers.^{54–56}

Paint industries

There have been incidences of contact dermatitis among factory workers in paint industries. Allergic contact dermatitis can arise from contact with a biocidal agent named 2-n-octyl-4-isothiazolin-3-one (trade name: skane M-8), which is used as a mildewicide (a chemical used to prevent or retard the growth of mildew) in paint.⁵⁷ Allergic reactions can arise from methylmethacrylates which are used in surface coatings especially in latex paints; however, paint additives containing biocides such as formaldehyde, methylisothiazolinone (MI), methylchloroisothiazolinone, and/or benzisothiazolinone have been reported to cause allergic reactions in factory workers in paint industries.⁵⁸ From the findings of Jolanki, Kanerva,⁵⁹ occupational ACD can also arise from epoxy diacrylate in ultraviolet light-cured paint.

Hairdressing salons

Hairdressers are very prone to ACD, especially hand dermatitis, because of the continuous exposure of their hands to some allergens in hair dyes and other hair products.⁶⁰ Statistics have

shown over the years that hair dressers have one of the highest incidences of skin sensitization because of continuous wet exposure and exposure to chemical allergens in hairdressing products.^{56,61} Young, inexperienced hairdressers tend to be more affected by skin sensitization in salons due to lack of adequate knowledge that chemicals in hairdressing products could cause allergy. The major allergic reactions that have been recorded among hairdressers have occurred from exposure to PPD from hair dyes, ammonium persulfate (APS) from bleach, and glyceryl monoethioglycolate (GMTG) present in permanent wave solutions.^{56,62}

Detection and Prevention of ACD

Early detection of ACD is of high importance so as to treat the symptoms, and this will help in assisting the affected individual to prevent further exposure to the allergen.

Detection of ACD

Despite various studies conducted over the years, the detection of ACD in affected patients remains the same. The most reliable and important method for the detection of ACD is a proper patch test.^{6,7,10,14,63} Patch testing is mainly conducted by applying a standard tray of the most frequent contact allergens on the back of the patient (an individual suspected with ACD); the allergens are diluted in water or petrolatum prior to application. The patches are allowed to remain on the patient's skin for 48 hours after which the patches are removed for proper evaluation of the patient's skin for possible reactions; the final readings are taken 5 to 7 days after placement of the patches. A positive eczematous reaction at the test site confirms that the patient is allergic to the actual compound applied to the site.^{6,64,65}

Prevention / cure of ACD

According to Karlberg et al.,⁶ there is no present cure for ACD other than prevention through avoidance of the contact allergens. It is important to know that acquired contact allergy is chronic and for an individual to prevent himself/herself from the elicitation of ACD, he/she must avoid the offending agent because contact allergy can result in prolonged dermatitis, and the treatment for the symptoms of ACD is the use of anti-inflammatory corticosteroids, topical nonsteroidal anti-inflammatory drugs, and systemic immunosuppressive medication such as azathioprine, methotrexate and dupilumab (immune modifier).^{66,67} Saary et al.⁶⁸ indicated that there is good evidence that a top skin protectant and quaternium-18-bentonite can prevent rhus dermatitis, while diethylenetriamine pentaacetic acid can prevent nickel, chrome, and copper dermatitis. They also stated that there is good- and fair-quality evidence that potent or moderately potent steroids can treat ACD. Some authors have indicated that severe ACD (especially when its caused by poison ivy or airborne allergens) can be treated using

immunosuppressive medication such as azathioprine,⁶⁹ while some authors are of the opinion that the use of dupimulab may be an effective treatment for ACD.⁷⁰ Other ways of preventing ACD are the willingness of industries to limit allergen exposure to consumers and workers.⁵⁶ Contact allergen avoidance programs have been initiated in the United States and UK, few of which are Contact Allergen Management Program (available to members of the American Contact Dermatitis Society, www.contactderm.org) and SkinSAFE (available to patients and consumers, developed in association with Mayo Clinic, www.SkinSafeProducts.com), and these programs promote the avoidance of contact allergen and introduce products that are free of known contact allergens; therefore, they are safe.^{71,72} Based on the creation of the contact allergen replacement database (CARD),⁷³ some authors believed that evidence has shown that there is a significant increase in the rate of patients' compliance to the avoidance of contact allergens especially because the CARD's guide provides the opportunity to shop for the right products thereby resulting in patients being empowered and not confused.⁷⁴ There is need for education of adult patients as there is poor knowledge regarding contagiousness among couples; therefore, this education is an important component of treatment for adult patients and their families.⁷⁵ It is very important to ensure that products (cosmetics and personal care) and their ingredients do not cause ACD in workers or consumers.¹⁵ Karlberg et al.⁶ emphasized the importance of stopping the epidemics of ACD as well as to hinder its commencement by preventing strong allergens from entering the market.

Effects of ACD

Different studies have shown that there are several effects of ACD.^{76,77} ACD can develop in any part of the body depending on exposure. There have been cases of facial dermatitis, hand dermatitis, foot dermatitis, and neck dermatitis, but the most common is hand dermatitis because the hands are most exposed to allergens in the environment and the workplace, thereby significantly affecting the quality of life of the affected individual.^{6,77} According to Jowett and Ryan,⁷⁸ social and personal relationships as well as the employment of an individual with skin conditions may be affected, thereby generating negative emotions in him/her. The effects of ACD on the affected patients or individuals can tend to impact them socially, psychologically, financially, and occupationally.

Social effects

The manifestation of ACD on an individual's skin can have a negative social effect due to the way he/she is being treated because of his/her skin conditions. When the dermatitis is on the face or hand, the social effect can be greater especially for the female gender. Affected individuals may withdraw from public settings due to the fear of being neglected or not related with appropriately, which in turn can affect their confidence level,

thereby causing a significant shift in their interpersonal relationships. It has been very difficult for most patients to convince the people around them that contact dermatitis is a skin condition that is not contagious. Most patients are hurt by some people's views that contact dermatitis is something dirty.⁷⁸ Some patients have mentioned that there is a misconception among their personal contacts that their skin condition is contagious.^{76,79,80}

Psychological effects

One of the negative effects of ACD is the psychological effect, as the quality of life of the patient is affected. The perception of the patient about himself/herself changes due to his/her skin condition. Patients can also be affected with fears of rejection within their social spheres because of their skin conditions thereby causing them to have mood disorders or to feel helpless, embarrassed, frustrated, and angry.⁸⁰ Based on the findings of Maroti et al.,⁷⁹ skin problems have tremendous influence on the patients, thereby impacting the way they view themselves in public because they feel ugly, which in turn affects their sexual relationships. Cvetkovski et al.⁸¹ established the fact that there is strong association between the degree of severity of contact dermatitis and the quality of life of the affected patients.

Occupational effects

Occupational ACD is a disease that becomes chronic and persistent, thereby resulting in prolonged sick leave taken by affected workers and which may later result in loss of employment if the situation is not properly managed.⁷⁶ Work may be affected as workers with ACD may spend less time on assigned tasks or may be limited in the scope of work they can perform; therefore, this may result in redeployment in the workplace and may have financial consequences on the employer because re-skilling may be required. Some workers may also voluntarily resign from their workplaces because of their skin conditions, thereby resulting in the need for recruitment of new workers.^{76,80}

Financial effects

Allergic contact dermatitis-affected individuals will experience financial effects because of their skin conditions based on direct or indirect expenses required for their treatment.⁸⁰ For ACD to be detected in a suspected patient, there must be a clinical diagnosis, which will incur costs. Most workers that are affected by ACD in their workplaces are usually on medical aid, which will cover expenses for medical treatment, while some may need to use their personal money to embark on the required treatment. Therefore, a patient that requires using personal funds to treat their skin condition may be financially stressed if he/she is a low-income earner or unemployed.⁷⁵ In a situation whereby a worker that is affected with ACD in his/her workplace is not adequately compensated, there is enormous financial stress involved. According to

Cvetkovski et al.,⁸¹ contact dermatitis patients with low socioeconomic status and those with loss of income have low quality of life compared to patients with high/medium socioeconomic status. In other words, according to Thyssen et al.,⁷⁰ contact dermatitis can be severe and incur significant health care expenses.

Conclusions

It is imperative to know and understand that ACD is a significant environmental and occupational skin disease that should not be ignored in our society because it is a disease of public concern that has no cure. There is need to continuously investigate and identify potential allergens in our environment and workplaces in order for rapid measures to be taken by members of the public, including employers, to avoid the allergens causing this disease.

Author contribution

OAo designed the search strategy and carried out the literature searches and screening. OAo carried out the data extraction. OAo wrote the first draft of the review with input from BSM. BSM edited and OAo finalized the review article.

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