

Evaluating awareness of health risks and self-reported symptoms among nail technicians in Johannesburg, South Africa – a pilot study

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ABSTRACT

Background: The professional nailcare industry is expanding rapidly in South Africa. Nail treatment involves the use of solvents and acrylates. Exposure to these chemicals is associated with skin, eye, and respiratory tract irritation, and neurological and reproductive health effects.

Objective: To test the feasibility of conducting a study on formal and informal nail technicians, which included testing a self-developed questionnaire, and to collect preliminary data about their knowledge and awareness of health risks associated with exposure to chemicals in nail products, and associated symptoms.

Methods: A self-developed questionnaire was administered to 10 formal and 10 informal nail technicians working in conveniently selected nail salons in Johannesburg. Work practices and exposure control measures were observed. Demographic characteristics, working conditions, awareness of health risks, and self-reported symptoms in the two groups are presented as frequency distributions.

Results: Poor phrasing was identified in some of the questions. Participants provided the correct terminology to describe nail services. The revised questionnaire comprised 39 questions. Seven of the informal nail technicians were male while all the formal nail technicians were female. Informal nail technicians worked longer hours per week than formal nail technicians (median of 61.5 and 46.5 hours, respectively) and reported more symptoms. Informal nail technicians used a wider range of nail products than formal nail technicians and used some unknown brands. Although all participants indicated that they were aware of health risks associated with nail products, only four of the formal nail technicians and one informal nail technician reported receiving training (although not specific to health and safety). Informal nail technicians reported using personal protective equipment (PPE); however, this practice was inconsistent, and they used the incorrect PPE.

Conclusions: We showed that conducting a larger study in nail technicians is feasible. The questionnaire was revised to include more information about the chemical content of nail products, a wider range of symptoms, the frequency of their occurrence, and the work-relatedness nature of the self-reported symptoms. A knowledge gap was identified among nail technicians relating to risks associated with exposure to chemicals in nail products. The questionnaire was refined to assess more accurately nail technicians' understanding of exposure and awareness of health risks associated with chemicals in nail products.

INTRODUCTION

Professional nailcare is a rapidly expanding industry which has seen tremendous growth globally.¹⁻⁶ South Africa has also experienced growth in the nailcare industry, in both the formal and informal sectors.⁷ While some research has been conducted in the formal sector,⁸ little is known about nail salons in the informal sector.

The 15th International Conference of Labour Statistics (ICLS) defined the informal sector as “non-registration of the enterprise in terms of national legislation such as taxation or other commercial legislation; non-registration of employees of the enterprise in terms of labour laws; or small size of the enterprise in terms of the numbers of people employed”.⁹ Statistics South Africa defines informal work as “economic activity which takes place without a registered value-added tax (VAT) number”, and the informal sector as “those businesses that are non-registered”.¹⁰

Nailcare establishments, including those in South Africa, offer nailcare services only, or as part of a comprehensive cosmetics business.¹¹ The treatment of nails ranges from simple buffing, to basic manicures, to the application of sculptured artificial nails.^{12,13} The chemicals in

all treatments of natural nails and the application of artificial nails are associated with potential adverse health effects. These include solvents, such as acetone, ethyl acetate, and n-butyl acetate. Additionally, artificial nail applications use acrylic polymers and monomers,¹⁴ which may pose risks to the health of both the nail technicians applying the products and their clients.

One of the main chemical monomers found in acrylic nail products is methyl methacrylate (MMA), a chemical that was banned by the United States Food and Drug Administration (US-FDA) in 1974 due to its skin sensitisation properties, which are associated with allergic contact dermatitis.^{15,16} Exposure to MMA causes eye, skin, and respiratory tract irritation, and is associated with asthma.¹⁷ Methyl methacrylate has been replaced with a similar chemical, ethyl methacrylate (EMA), which is considered, in the United States of America (USA) and several other countries, to have lower toxicity.¹⁴ However, some countries, such as South Africa, and certain states in the USA continue to use nail products that contain MMA as they are cheaper than those containing EMA.¹⁸ Consequently, there are pockets of unregulated workers and small

industries where nail products containing MMA are still used.^{17,19,20}

Acetone and butyl acetate (contained in nail polish removers) may lead to headaches, dizziness and eye, skin and throat irritation.^{2,21} Some nail polishes contain toluene, formaldehyde, and dibutyl phthalate (DBP) – a combination referred to as the 'toxic trio'.^{22,23} Toluene can affect the central nervous system (CNS) and cause reproductive harm.²⁴ The CNS effects include headache, light-headedness, dizziness, confusion, nausea, impaired judgment, and blurred vision.^{19,25,26} The reproductive effects, such as risk for pregnancy complications, as well as developmental delays and neurobehavioral difficulties, have been reported to be higher in the offspring of women who have been exposed to high concentrations of toluene during pregnancy.²⁷ Formaldehyde has been classified as a Group 1 carcinogen by the International Agency for Research on Cancer (IARC), based on the findings of nasopharyngeal cancer and leukaemia studies.²⁸ Exposure to DBP has been linked to reproductive problems such as birth defects and negative developmental and reproductive system effects.^{19,22,29,30} There are many other harmful chemicals used in nailcare products. Park, et al. (2014), in a study on the comparison between nail technicians and office workers, showed that a significantly higher proportion of nail technicians were exposed to airborne acetone, toluene, butyl acetate, and MMA reported respiratory, neurologic, eye, skin, and musculoskeletal complaints.¹⁷ Symptoms such as headaches and light-headedness have been reported to worsen after starting work in the nail salon industry.³

Internationally, several studies have investigated the characteristics, work conditions, and self-reported symptoms in nail technicians, and knowledge of health and safety regulations and products used.^{21,31,32} Studies in Korea, the United Kingdom (UK), Vietnam, and the USA have reported musculoskeletal disorders, respiratory symptoms, skin problems, and headaches.^{17,21,31} Only one study has been conducted in South Africa, on the respiratory and dermal exposures to volatile organic compounds (VOCs) from products used in nail salons.⁸ The authors reported that nail technicians were exposed to VOCs at levels below the recommended occupational exposure limits specified by the Regulations for Hazardous Chemical Agents framed under the South

African Occupational Health and Safety Act (Act No. 83 of 1995).³³ The study assessed only VOC exposures, in the formal sector. Worker characteristics and health effects associated with exposure were not included.

The aim of this pilot study was to test the feasibility of conducting a study on nail technicians in Johannesburg, South Africa in the formal and informal sectors. The study included testing a self-developed questionnaire, and collecting preliminary data about the nail technicians' knowledge and awareness of health risks associated with exposure to chemicals in nail products, and associated symptoms.

METHODS

Formal nail salons were defined as those that are licensed and registered as part of a franchise. Informal nail salons comprised those not licensed or registered with any formal enterprise or establishment.

Ten nail technicians, working in six conveniently selected nail salons from the three largest nail salon franchise companies in Johannesburg, and 10 working in conveniently selected informal nail salons in Braamfontein, near the Johannesburg central business district (CBD), were invited to participate.

Data were collected, using a self-developed questionnaire, designed to gather information on sociodemographic characteristics, perceptions of working with nail products, knowledge of associated health effects, and self-reported symptoms. The questions were adapted from questionnaires used in other studies on nail technicians.^{17,21,31} Those studies incorporated standardised and validated questions on respiratory health from the American Thoracic Society questionnaire and the Protocol for the European Community Respiratory Health Survey,³⁴ while the skin-related questions were based on the Nordic Occupational Skin Questionnaire – NOSQ 2002.³⁵ Questions adopted from these studies addressed careers, average number of clients seen per day, type and duration of nail services, knowledge of health and safety issues in the workplace, self-reported health problems, and measures taken to protect their health. Open-ended questions were added to elicit responses about their experiences and their work environments.

Table 1. Characteristics of formal and informal nail technicians

| Characteristic | Category | Formal sector (n = 10) | | Informal sector (n = 10) | |
|---------------------------|----------|---------------------------|-------|-----------------------------|------|
| | | n | % | n | % |
| Sex | Male | 0 | - | 7 | 70.0 |
| | Female | 10 | 100.0 | 3 | 30.0 |
| Age (years) | < 30 | 4 | 40.0 | 8 | 80.0 |
| | 30–40 | 4 | 40.0 | 2 | 20.0 |
| | > 40 | 2 | 20.0 | 0 | - |
| Work history (years) | < 1 | 0 | - | 1 | 10.0 |
| | 1–5 | 5 | 50.0 | 7 | 70.0 |
| | 6–9 | 3 | 30.0 | 2 | 20.0 |
| | ≥ 10 | 2 | 20.0 | 0 | - |
| Working hours per day | 8–9 | 7 | 70.0 | 6 | 60.0 |
| | 10–11 | 3 | 30.0 | 1 | 10.0 |
| | ≥ 11 | 0 | - | 3 | 30.0 |
| Number of clients per day | 4–6 | 3 | 30.0 | 4 | 40.0 |
| | 7–9 | 5 | 50.0 | 3 | 30.0 |
| | ≥ 10 | 2 | 20.0 | 3 | 30.0 |
| Smoking | Yes | 1 | 10.0 | 2 | 20.0 |
| | No | 9 | 90.0 | 8 | 80.0 |

The first draft questionnaire, comprising 35 questions, was assessed by experienced researchers to address face validity. Feedback highlighted issues such as redundant questions, and clarity and phrasing of some questions. The questionnaire was modified for the pilot study.

The questionnaire was paper-based and was administered in English by the researcher before the start of the work day, or between clients at the salon where the nail technicians worked. The participants' responses were audio-recorded to assess their initial reactions to the questions and the need for clarification. The questionnaire was timed and, at the end of administering it, the participants were asked how they perceived both the study and the questionnaire. Work practices and exposure control measures during nail treatments were observed and documented; photographs were taken.

The study was approved by the University of the Witwatersrand Human Research Ethics Committee (Medical), certificate number M151194.

Data analysis

All data from the questionnaires were captured in Microsoft Excel, checked for missing data, and cleaned for any data entry errors. Data analysis was performed using STATA iC15.0. Sociodemographic characteristics, awareness of health effects, and self-reported symptoms were described using frequencies and proportions for categorical variables. Means and standard deviations, and medians and ranges, were used to describe continuous variables. The self-reported symptoms were categorised into four categories: respiratory effects, neurological effects, skin irritation, and eye irritation. Since the sample size was small (< 30), Cronbach's alpha could not be calculated to determine the internal consistency of the tool.³⁶

RESULTS

Characteristics of study participants

Most of the informal nail technicians in the study were men ($n = 7, 70.0\%$), while all those in the formal sector were women (Table 1). Nail technicians in the formal nail salons were older and had worked for longer in the nail industry than those in the informal nail salons.

Informal nail technicians worked for more hours per week (median 61.5 (56–72)) than formal nail technicians (median 46.5 (45–54)). The mean number of clients serviced per day, however, was similar for both groups, viz. 7.4 ± 2.2 and 7.4 ± 2.1 , respectively.

Face validity of the questionnaire

The piloted questionnaire initially comprised 35 questions. The researchers who assessed the content found the questions to be inclusive and able to capture the purpose of the pilot study; however, they recommended rewording some of the questions for clarity. Seven questions

were thus modified. The question about the perception of how harmful the nail products are was preceded by two questions asking the participant's knowledge about health effects related to the chemicals found in nail products ("Do you know if the chemicals in nail products may cause any health effects?"; and "If yes, please list the health effects"). Two questions were deemed very similar and were merged: "Do the symptoms experienced when working with nail products improve or worsen while at work?" and "Do the symptoms experienced when working with nail products improve while away from work?" The resultant question was "Do the symptoms experienced while working with nail products get better when away from work?"

The pilot study participants expressed that they were comfortable with the questions asked and felt that the study was important to address health- and safety-related issues in the nailcare industry. In some instances, they corrected the terminology used to describe the services they offer. For example, the phrase 'nail treatment', used to describe the services offered, was replaced with 'nail application'. The question, "Do you know the chemical content of the nail products that you use?" was often confused with knowledge about the nail products themselves. This question was therefore preceded by two additional questions: "What type of nail products do you use?" and "Have you ever read the label of these nail products?", to give clarity to the question on chemical content. Three nail technicians asked for clarity about the question, "How harmful do you think these nail products are?" as they assumed that it referred to the potential harm caused to the client and not themselves. After modifying seven questions, merging two, and adding four new ones, the questionnaire – to be used in a larger study – comprised 39 questions (see [Supplementary Appendix 1](#)). The estimated time taken to complete the questionnaire was 45 minutes; the actual time was around 35 minutes, including the time taken to explain the study and for participants to sign the consent form.

Health risk awareness, working conditions and self-reported symptoms

The formal nail salons were part of the three big franchises in South Africa and operated under a franchise model, with several nail salons employing more than one nail technician per salon. The informal nail technicians worked independently, often as freelancers, leasing a space in a hair salon. This influenced the work practices, procurement procedures, and the types of products they used. The formal nail salons purchased their products from common suppliers, following the company's procurement procedures, while procurement of products in the informal nail salons was at the discretion of the individual nail technicians.

All the study participants knew the names of the products and their intended use, but none were familiar with the chemical contents (Table 2). Information related to the use and handling of nail products

Table 2. Knowledge and awareness about nail products among formal and informal nail technicians

| Item | Formal sector (n = 10) | | Informal sector (n = 10) | |
|----------------------------------------------|---------------------------|-------|-----------------------------|-------|
| | n | % | n | % |
| Knowledge about products | 10 | 100.0 | 10 | 100.0 |
| Knowledge about chemical content of products | 0 | - | 0 | - |
| Health and safety information | 4 | 40.0 | 1 | 10.0 |
| Awareness of health risks | 7 | 70.0 | 10 | 100.0 |
| Use of PPE | 5 | 50.0 | 10 | 100.0 |

PPE: personal protective equipment

was reportedly provided to four (40.0%) of the formal nail technicians during their training, while only one (10.0%) of the informal nail technicians indicated they had received training. Some participants reported that the training did not incorporate health and safety aspects of their work, but focused on nail application methods, and the use and disposal of nail products. Seven (70.0%) nail technicians in the formal and all those in the informal (n = 10, 100.0%) nail salons said that they were aware of the health risks associated with working with nail products. This was informed mainly by their experiences of working with nail products every day and the ill-health symptoms that they experienced.

Although the participants reported using masks as personal protective equipment (PPE), this was at their discretion. The masks were dust masks and did not provide protection against the chemical compounds to which they were exposed. Dust masks protect only against exposure to particulates, whereas nail technicians are exposed to VOCs. They wore the dust masks when using nail products that they perceived to emit toxic chemicals, e.g. when applying acrylic nail products or using acetone. These tasks involve the use of nail products that have a distinct odour.

Figure 1 shows the acute health-related symptoms reported by nail technicians since they started working in the nail industry. These included sneezing, coughing, flu-like symptoms, sinusitis, dizziness, headache, red/itchy skin, and red eyes. Informal nail technicians reported more health-related symptoms than formal nail technicians.

The nail technicians reported many similar symptoms – most were related to sinuses and the upper respiratory tract. The symptoms most frequently reported by the informal nail technicians were respiratory effects (n = 6), neurological effects (n = 5), and skin and eye irritation (n = 2). The formal nail technicians reported respiratory effects (n = 3), neurological effects (n = 1), and skin irritation (n = 1).

Some of these symptoms were perceived to be caused by specific nail products or related to specific nail treatments:

“It (runny nose) only occurs during the day when using the product (monomer). It starts as I am busy with a client and when I am done it stops.” (formal nail technician)

The symptoms were also perceived to be related to dust generated when performing a specific task during a nail application:

“Around the chest, there is (are) always complications there, even now you can hear my voice is not coming out clearly. I think there is a congestion of dust. Especially when we file the nails it brings out dust.” (informal nail technician)

DISCUSSION

The primary objective of this study was to test the feasibility of conducting a study on formal and informal nail technicians, which included testing a self-developed questionnaire, and collecting preliminary data about their knowledge and awareness of health risks associated with exposure to chemicals in nail products, and associated symptoms. We demonstrated that such a study is feasible with respect to accessing participants and administering the questionnaire in a clear and understandable manner. The initial questionnaire needed to be revised as the phrasing of some questions was unclear, especially those related to awareness of potential health risks associated with working with nail products. After conducting the pilot study, the tool was further refined to include knowledge and awareness about the specific chemical contents of the nail products and the related potential health effects, and a wider range of symptoms and their work-relatedness.

Information about room size, ventilation, and confounding factors such as chemicals emitted from other activities in the

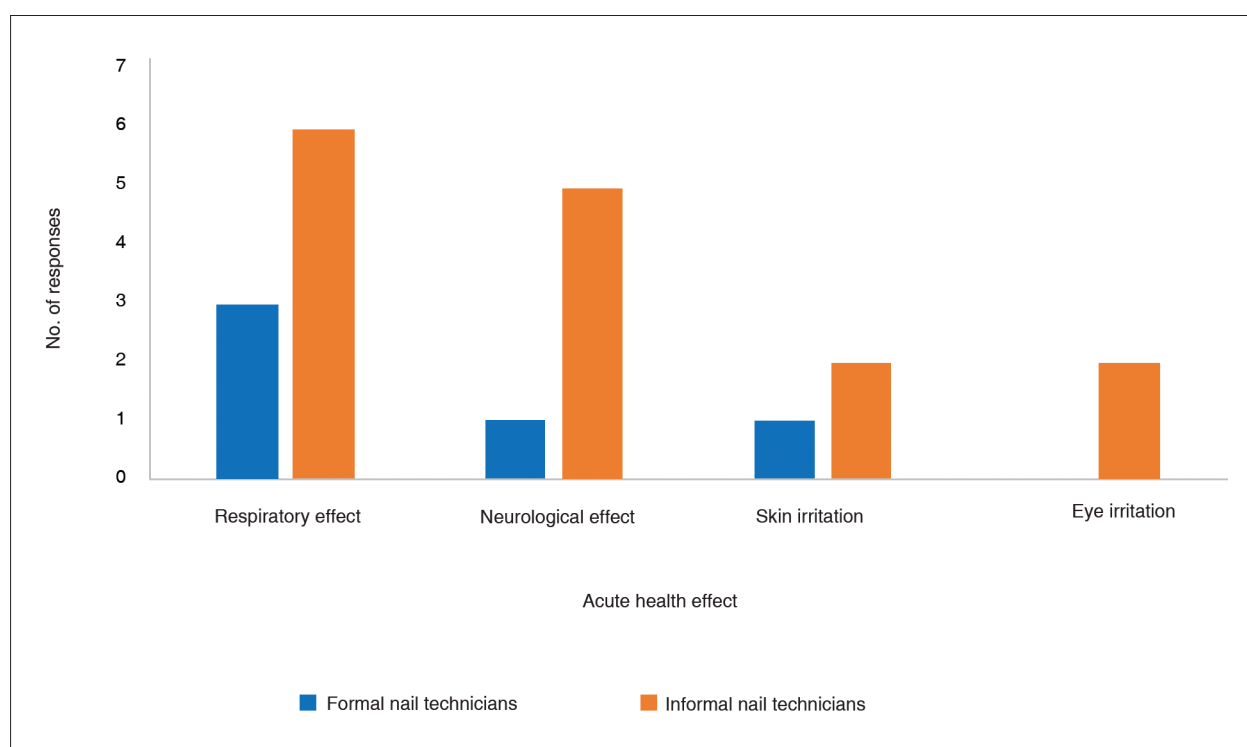


Figure 1. Self-reported ill-health symptoms among formal and informal nail technicians

nail salon (e.g. hairdressing) will be included in a larger study, where exposures to specific chemicals used in nail treatments will be assessed.

Although this was a pilot study, with very few participants, there were some interesting findings, the validity of which will need to be tested in a larger study. The informal nail technicians worked for more hours and reported more symptoms than the formal nail technicians. This might be attributed to the flexible nature of their work as they do not have defined working hours, which is common in the formal sector.

In the pilot study, the informal nail technicians were predominantly male, which was unexpected. Formal nail technicians were older and had worked in the industry for longer periods. This may be due to the formalised structure of the sector and the security that the job provides in terms of regular working hours and set salaries.³⁷

The results from the pilot study also suggested that there are some similarities between the two groups. Nail technicians in both sectors could easily identify the nail products and their intended use but did not know their chemical contents or the related potential health effects of exposure to them. The formal nail technicians reported having received training; however, the training focused on nail treatment procedures, and how to handle and dispose of nail products, rather than the health and safety aspects of their work. The majority of the informal nail technicians relied on training while on the job, and their awareness of health risks was based on their individual experiences of working with nail products. Formal training and health and safety training is not a requirement in the informal industry due to the industry not being regulated. A study on nail technicians from a mixture of rural and urban areas in the UK, published in 2011, reported that the majority of the participating nail technicians (99%) had received training that included aspects of health and safety, and most were aware of the Control of Substances Hazardous to Health (COSHH) regulations and risk assessments.³¹ Nail salons in the UK are more formalised and most nail technicians undergo training by their employers or colleges in order to qualify as nail technicians.

Although awareness of health risks was high in both groups, differences were noted in the reporting of PPE use. All informal nail technicians reported using PPE, compared to 50% of the formal nail technicians. However, PPE use was at their discretion, and they wore masks only when performing tasks they perceived to be emitting toxic chemicals, based on the distinct odours. This was both reported and observed. This practice was misinformed as the nail technicians were not knowledgeable about the chemical contents of the nail products or their associated health effects. The choice of PPE was also inappropriate as they used dust masks that only protect against exposure to particulate matter and not VOCs. A study conducted on Vietnamese-American nail salon workers reported similar findings of inappropriate PPE usage, where disposable surgical masks were used.²¹ These types of masks are designed for infection control and do not reduce exposure to chemical vapours.

This was a pilot study on a small number of participants; thus, inferences and generalisations cannot be made. However, the preliminary findings suggest that there is a potential for identifying behaviours and practices that are unique to the industry, and differences between the formal and informal sectors.

CONCLUSION

Pilot studies are important for testing the feasibility of conducting large epidemiological studies and collecting preliminary data to support the justification for undertaking a larger study. They are also

useful for pre-testing data-collection tools, such as questionnaires and devices. This small pilot study drew attention to the nature of the work of nail technicians and levels of awareness of potential health risks. A comprehensive data-collection tool has been developed for use in the assessment of nail technicians' exposure to, and awareness of health risks associated with, chemicals in nail products, for use in a larger study.

Larger studies are needed to quantify the exposure to chemicals that are associated with adverse health symptoms, and to identify the long-term health effects of these exposures in both the formal and informal nail sectors. Such studies are imperative to ensure the health and safety of vulnerable groups, such as informal nail technicians, due to the nature of their work and the lack of regulation. The findings from such studies can influence policy development to ensure the protection of the health of both workers and patrons in this industry.

KEY MESSAGES

1. Pilot studies provide insight regarding the feasibility of conducting a study and provide preliminary data.
2. Nail technicians in the formal and informal sectors of the beauty industry differ with regard to working hours, number of clients, and types of products.
3. A larger study on nail technicians will determine chemical exposure assessment and the relationship with symptoms; and health risk awareness.

DECLARATION

The authors declare that this is their own work; all the sources used in this paper have been duly acknowledged and there are no conflicts of interest.

AUTHOR CONTRIBUTIONS

Conception and design of the study: GK, DB, GN

Data acquisition: GK

Data analysis: GK

Interpretation of the data: GK, GN, DB

Drafting of the paper: GK

Critical revision of the paper: DB, GN, GK

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