

# Side-effects Associated with Gel Nail Polish: A Self-questionnaire Study of 2,118 Respondents

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**Gel nail polish is commonly used in manicures; however, research into the side-effects of gel nail polish is scarce and focusses mainly on allergic contact dermatitis. The aim of this study was to assess the frequency and characteristics of side-effects associated with use of gel nail polish. A self-questionnaire survey was conducted on a representative sample of individuals ( $n = 2,118$ , all female). Of these, 48.3% reported side-effects while applying gel nail polish, approximately 20% during wearing it, and more than 75% after removing the polish. Frequency of changes in the nail plates was significantly higher after removing the gel nail polish than when applying or wearing it ( $p < 0.0001$ ). Frequency of changes in the nail plates was associated with whether the procedure was performed by professionals or non-professionals. Education about the risk of side-effects and sensitization is crucial for people using gel nail polish.**

*Key words:* gel nail polish; side-effects; nail plate.

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Gel nail polish ("long-lasting nail polish") is widely used in manicures due to its attractive cosmetic properties. It is a type of nail polish that consists of oligomers and ultraviolet (UV) catalysts. After application of the polish, it is hardened using a UV lamp, which causes oligomers in the polish to change their structure, resulting in polymerization (1). The majority of beauty salons offer gel nail polish manicures, and gel nail polish kits for domestic use are widely available. However, research into the side-effects of this cosmetic procedure is scarce and focusses mainly on allergic contact dermatitis caused by methylacrylates, which are the main compound in the gel (1, 2). The aim of the current study was to assess the frequency and characteristics of side-effects associated with the use of gel nail polish in a representative group of female subjects.

## METHODS

This was a self-questionnaire online survey, conducted on a representative sample of individuals from Poland ( $n = 2,118$ ). All

## SIGNIFICANCE

This study shows that use of gel nail polish has many side-effects. Scarce literature and a lack of education among clients and beauticians lead to the uncontrolled use of gel nail polish. Both home and professionally performed application of gel nail polish have many side-effects; almost one-fifth of female subjects surveyed reported side-effects affecting the nail plate, which is a long-lasting and slowly reversible process. Surprisingly almost 80% of respondents who reported side-effects associated with gel nail polish wanted to continue using gel polish. Dermatologists should be aware of this situation, which they may encounter in everyday practice.

participants were female, age range 12–60 years (mean  $\pm$  standard deviation (SD) age  $25 \pm 6.4$  years). The survey was conducted using a self-created questionnaire comprising 12 questions. The questionnaire survey was constructed based on interviews with 10 female respondents using gel nail polish (authors TP, JP). The questionnaire was assessed by 2 independent experts, who provided comments on the proper understanding of each question (WB, ABB) (Appendix S1<sup>1</sup>).

The self-administered questionnaire (SAQ) was posted on Facebook groups for females interested in applying manicures using gel nail polish. Respondents who had reported side-effects associated with using gel nail polish were further asked when those side-effects occurred: while applying the gel nail polish; while wearing the polish; or after removing it. To identify factors that could influence the occurrence of side-effects, the survey included questions about the duration of wearing the gel nail polish manicure, the frequency of applying such a manicure in the last 12 months, and the duration of intervals between conducting gel polish manicures. Respondents were asked whether their manicure was performed by professionals or they performed the manicure themselves. They were further asked about the method of learning how to perform the manicure, if any. Finally, the respondents were asked if they would be willing to have gel nail polish manicures in the future.

Statistical analysis was performed using the software Statistica version 13.1 (StatSoft, Tulsa, OK, USA) and GraphPad Prism version 5.0 (La Jolla, CA, USA). The mean and SD were calculated. The Shapiro–Wilk test and Kolmogorov–Smirnov normality test were used to assess the distribution of values. Differences between groups were determined using the  $\chi^2$  Pearson test, Fisher's exact test, Mann–Whitney  $U$  test or Student's  $t$ -test. Statistical significance was set at  $p < 0.05$ . The study was conducted according to the principles of the Declaration of Helsinki and approved by the local ethics committee.

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## RESULTS

The survey was completed by 2,118 female respondent, mean age  $25 \pm 6.4$  years. The majority of respondents ( $n=1,790$ , 84.5%) reported side-effects associated with using gel nail polish. The mean age of this group was  $24 \pm 6.4$  years, which was not statistically significantly different from the group that did not report any side-effects ( $26 \pm 6.7$  years). Of respondents, 8.3% ( $n=1,024$ ) reported side-effects while applying the gel nail polish manicure. Among them, 46.9% reported subjective side-effects, such as pain and burning sensation (50.4%) and itch (0.4%) (**Table I**). Of respondents, 0.6% reported some changes in the nail folds, such as swelling (0.2%), vesicles (0.2%), redness (0.04%), scaling (0.04%) and dryness of the skin (0.04%). One respondent reported changes in the nail plate (0.04%) and one reported disseminated skin lesions on the hands, face and neck (0.04%) (Table I). A total of 1,094 (48.6%) respondents did not notice any side-effects while applying the manicure.

Approximately 20% ( $n=449$ ) of subjects reported some side-effects during wearing the manicure. Among them 15.5 % reported subjective symptoms, such as itch (9.6 %) and pain or burning sensation (9.6%). Of the respondents, 0.3% reported some changes in the nail plate, such as onycholysis (0.2%), and subungual hyperkeratosis (0.1%). Changes in the nail folds were reported by 16.1% of respondents (e.g. redness (9.6%), vesicles (8.4%), scaling (0.2%), dryness of skin (0.2%), swelling of nail fold (0.2%), skin fissure (0.2%) and paronychia (0.1%)). Interestingly, 0.6% of respondents reported disseminated skin lesions, such as rash on the hands (0.2%), rash on the body (0.2%), eczema of the hands (0.04%) and lip oedema (0.04%). A total of 1,669 respondents (78.8%) did not notice any kind of side-effects (**Table II**).

More than 75% ( $n=1,592$ ) of respondents reported side-effects after removing the manicure. Of these, 7% reported some subjective symptoms, such as itch (2.2%) and pain or burning sensation (2.2%). Changes in the nail plate were reported by 74.1% of respondents (e.g. decreased toughness of nails (30.3%), splitting of nails

**Table I. Side-effects during application of gel nail polish manicure**

Side-effects	Responses $n=2,252$ $n$ (%)
No symptoms	1,094 (48.5)
Subjective	
Pain and burning sensation	1,135 (50.4)
Itch	8 (0.3)
Objective	
Changes in the nail plate	1 (0.04)
Changes in the nail fold <sup>a</sup>	13 (0.6)
Disseminated skin lesions on palms/face/neck	1 (0.04)

<sup>a</sup>swelling, vesicles, redness, scaling, dryness of skin.

**Table II. Side-effects during wearing the gel nail polish manicure**

Side-effects	Responses $n=2,727$ $n$ (%)
No symptoms	1,669 (61.2)
Subjective	
Itch	263 (9.6)
Pain and burning sensation	261 (9.6)
Objective	
Changes in the nail plate <sup>a</sup>	12 (0.4)
Changes in the nail fold <sup>b</sup>	510 (18.7)
Disseminated skin lesions <sup>c</sup>	12 (0.4)

<sup>a</sup>onycholysis, paronychia, subungual hyperkeratosis. <sup>b</sup>redness, vesicles, scaling, dryness of skin, swelling of nail fold, skin fissure. <sup>c</sup>eczema of palms, rash on palms/neck/face, lip oedema.

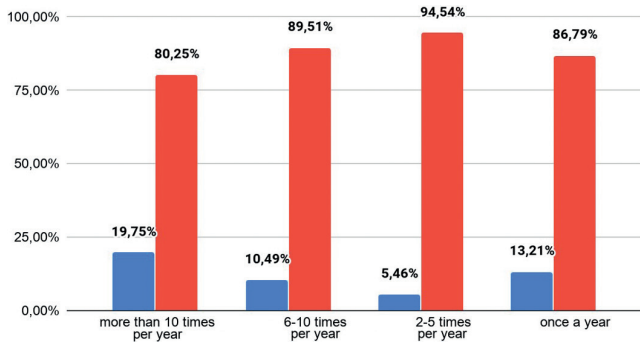
**Table III. Side-effects after removal of the gel nail polish manicure**

Side-effects	Responses $n=3,972$ $n$ (%)
No symptoms	526 (13.2)
Subjective	
Itch	87 (2.2)
Pain and burning sensation	87 (2.2)
Objective	
Changes in the nail plate (overall)	3,007 (75.7)
Decreased toughness	1,202 (30.3)
Split of nails	983 (24.8)
White spots	339 (8.5)
Grooves	260 (6.6)
Change in colour	201 (5.1)
Onycholysis, subungual hyperkeratosis, deformation, matte nails, subungual haematoma	22 (0.6)
Changes in the nail fold (overall)	213 (5.4)
Scaling	138 (3.5)
Redness	75 (1.9)
Rash on the hands	29 (0.7)
Disseminated skin lesions	23 (0.6)

**Table IV. Comparison of side-effects of gel nail polish**

	Application	Wearing	Removal	$p$ -value*	$p$ -value**	$p$ -value***
Side-effects all	51.5 %	38.8%	86.8 %	0.11	<b>&lt; 0.0001</b>	<b>&lt; 0.0001</b>
Pain and burning sensation	50.4 %	9.6%	2.2%	<b>&lt; 0.0001</b>	<b>&lt; 0.0001</b>	<b>0.03</b>
Itch	0.3%	9.6%	2.2%	<b>&lt; 0.001</b>	0.49	<b>0.03</b>
Changes in the nail plate	0.04%	0.4%	75.7%	> 0.9	<b>&lt; 0.0001</b>	<b>&lt; 0.0001</b>
Changes in the nail fold	0.6%	18.7%	5.4%	<b>&lt; 0.0001</b>	0.05	<b>0.003</b>
Disseminated skin lesions on palms/face/neck	0.04%	0.4%	0.6%	> 0.9	> 0.9	> 0.9

\*Application vs wearing; \*\*application vs removal; \*\*\*wearing vs removal. Bold values denote statistical significance at the  $p < 0.05$  level.

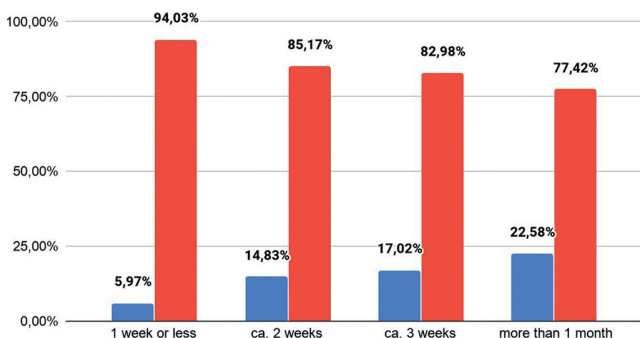


**Fig. 1. Incidence of side-effects according to frequency of application of gel polish nail manicure during the last year** (blue: no symptoms, red: some symptoms).

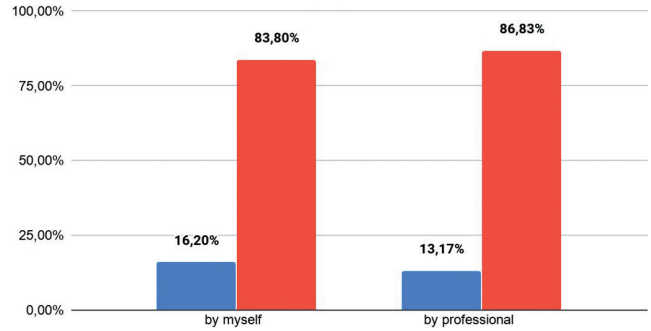
(24.7%), white spots on the nail plates (8.5%), grooves on the nail plates (6.5%), change in the colour of the nail plates (5.1%), onycholysis (0.35%), subungual hyperkeratosis (0.08%), deformation of the nails (0.05%), tarnishing of the nails (0.05%) and subungual haematoma (0.03%). Changes in the nail folds, such as scaling (3.5%) and redness (1.9%), were reported by 8.4% of respondents. Skin lesions of the hands (0.7%) and on the body (0.6%) were also reported (Table III). A total of 526 respondents (24.8%) did not notice any side-effects.

Comparison of the frequency of side-effects revealed that pain and burning sensation were reported mainly during application of the polish, while itch and changes in the nail fold were reported mainly during wearing the polish. The frequency of changes in the nail plates was significantly higher after removing the polish than during application or wearing ( $p < 0.0001$ ). The frequency of side-effects was significantly higher after removing the polish than during application or wearing ( $p < 0.0001$ ) (Table IV).

In the last 12 months, 60.9% ( $n = 1,291$ ) of respondents performed a gel nail polish manicure more than 10 times, 21.1% ( $n = 448$ ) 6–10 times, 14.7% ( $n = 311$ ) 2–5 times, and 3.2% ( $n = 68$ ) once. No significant impact of frequency of application of gel nail polish manicure on frequency of side-effects was observed (Fig. 1). Respondents mostly wore the gel nail polish for 2 weeks (49.3%,  $n = 1,045$ ) or for 3 weeks (40.0%,

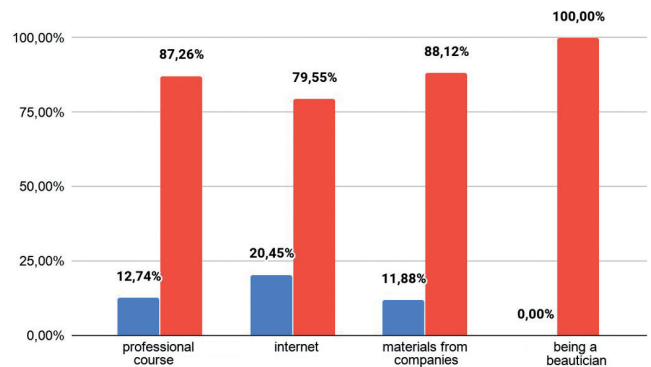


**Fig. 2. Incidence of side-effects according to duration of wearing the manicure** (blue: no symptoms, red: some symptoms).



**Fig. 3. Incidence of side-effects according to method of application of gel nail polish** (blue: no symptoms, red: some symptoms).

$n = 846$ ). No impact on frequency of side-effects was observed regarding the duration of wearing the polish (Fig. 2). Most respondents (62.1%,  $n = 1,316$ ) reported no break between gel nail polish manicures, while 17.3% ( $n = 366$ ) had a one-week break, 5.6% ( $n = 119$ ) a 2-week break, and 15.0% ( $n = 274$ ) a one-month or more break. There was no association between the duration of the break and the incidence of side-effects. The majority of respondents (76.3%,  $n = 1,616$ ) performed the nail gel polish manicure themselves. They learned the procedure during professional courses (39.7%,  $n = 642$ ), by using the internet (37.0%,  $n = 599$ ), from films and leaflets released by the companies producing accessories for gel polish manicure (18.4%,  $n = 297$ ), from a friend (1.3%,  $n = 21$ ), they were a beautician (0.7%,  $n = 11$ ), or through other means (2.9%,  $n = 46$ ). Surprisingly, there was no association between the method of application of the gel nail polish and the overall frequency of side-effects (Fig. 3). Also, in the group applying the manicure themselves, the method of learning had no impact on the occurrence of side-effects (Fig. 4). However, there was a significant difference in frequency of changes in the nail plate between groups applying gel polish themselves and having it applied by professionals. Changes in the nail plates after removing the manicure were reported by 18.13% of respondents who had gel nail polish applied by professionals and 55.95% of respondents who applied the polish themselves. These changes included decreased



**Fig. 4. Incidence of side-effects according to method of learning the gel nail polish manicure application procedure** (blue: no symptoms, red: some symptoms).

toughness, splitting of nails, white spots or grooves on the nails ( $p < 0.0001$ ). The majority of respondents (80.4%,  $n = 1,702$ ) reported that they would perform the gel nail polish manicure themselves in the future, 11.52% ( $n = 244$ ) planned to take longer breaks between gel nail polish manicure procedures, and 8.1% ( $n = 172$ ) stated that they would not perform such a manicure in the future. Of respondents, 77.4% ( $n = 1,386$ ) of those who had reported side-effects still wanted to perform gel nail polish manicures in the future.

## DISCUSSION

In the last decade, gel nail polish has gained widespread popularity in the cosmetic industry. Nowadays, the majority of beauty salons offer gel nail polish manicures. Furthermore, gel nail polish kits for domestic use are widely available. Sensitization from (meth)acrylates caused by using gel nail polish has been described. Gatica-Ortega et al. (2) reported cases of allergic contact dermatitis caused by (meth)acrylates in gel nail polish manicures. Periungual eczema and eczema on other body sites, as well as pain in the fingers and paraesthesia, have been described (2). Recurrent cheilitis and lip oedema caused by (meth)acrylates were reported by Scheers et al. (3). The incidence of sensitization and allergic contact dermatitis caused by (meth)acrylates, both in occupational and non-occupational settings, has increased in the last decade, which may result from wider use of gel nail polish among women in all age groups (2). Furthermore, acrylates are present in a wide range of products, including medical materials. There is therefore a danger that increasing sensitization from (meth)acrylates may jeopardize access to some medical procedures (2).

This survey shows that the majority of respondents experienced some side-effects associated with using gel nail polish: 21.2% during wearing the manicure and 75.2% after removing it. Overall 3.1% respondents reported skin lesions on the hands, lip oedema or disseminated skin lesions, which may indicate allergic contact dermatitis. Overall, 52.9% of respondents reported some subjective symptoms, such as itching, burning sensation and pain; 15.53% during wearing the gel nail polish, and 6.99% after removing it. Furthermore, 16.10% observed changes in the nail fold, such as redness, swelling, and scaling, during wearing the gel nail polish, and 8.45% after removing it. These symptoms may indicate allergic contact dermatitis or irritant contact dermatitis. Further studies are required to determine whether individuals experiencing such symptoms have already developed, or are at higher risk of developing, sensitization from (meth)acrylates, e.g. prospective observation, patch testing (with regard to the possibility of sensitization due to this procedure). Therefore, it is important to provide information to the individuals using gel nail polish about potential side-

effects associated with this type of manicure. Education regarding the possibility of sensitization caused by gel nail polish containing acrylates is especially important for patients with an existing history of allergic contact dermatitis or atopy. Gel polish also damages the nail plates, which can result in nail weakness, brittleness and thinning (4). Two patients with severe onycholysis and subungual hyperkeratosis from acrylic nails were described (5). One of them was misdiagnosed and was treated for nail psoriasis with acitretin and cyclosporine with no improvement (5). The current study shows that, after removal of the gel nail polish, 74.1% observed changes in the nail plate and 0.2% during wearing it. Decreased toughness of the nails (30.3%), splitting of the nails (24.7%) and white spots on the nail plates (8.5%) were mostly observed.

Nail damage from gel polish manicure via instrumentation, the gel polish itself, or nail polish removers were also reported by Chen et al. (4). In the current study, 55.9% of respondents who applied gel polish manicure themselves and 18.1% of respondents whose manicure was performed by a professional, noticed changes in the nail plate after removing the manicure. Deterioration of the nails can be caused by decreased trans-epidermal water loss in the nail plate following application of gel polish hybrid, which indicates a reduced loss of water from the surface of the nail to the environment (6). Furthermore, the increased pH level after removal of the gel polish might have a negative impact on the nail plate (6).

In the group of responders applying gel nail polish 2–5 times per year, 94.5% experienced side-effects, whereas in the group applying gel nail polish more than 10 times per year 80.2% reported side-effects. In the group wearing the manicure for one week or less 94.0% reported side-effects, whereas 77.4% of respondents wearing their manicure for one month or more reported side-effects. Thus, respondents reporting any side-effect tend to prolong the time interval before the next manicure or to shorten the duration of wearing the gel polish manicure.

Some authors have suggested that the technique of applying gel nail polish manicure may impact the incidence of side-effects. It was postulated that having the gel nail polish manicure performed by non-professionals at home may increase the risk of side-effects and sensitization from (meth)acrylates. Therefore, some authors suggested banning the use of gel nail polish kits for domestic use (2). The current study did not find any association between the method of application of the gel nail polish and the overall frequency of side-effects. However, the survey showed that the frequency of changes in the nail plate after removal of the gel nail polish (e.g. decreased toughness, splitting of the nails, or white spots on the nails) was associated with whether the procedure was performed by professionals or non-professionals (18.1% vs 55.9%). It may be concluded that the application

technique may have a significant impact on the frequency of these side-effects. However, almost one-fifth of respondents reported side-effects of the nail plate, even if their manicure was performed by a professional. The self-administered questionnaire was posted among groups interested in using gel nail polish. Therefore, the knowledge of respondents on proper technique of application of such a manicure may be higher than in the general population.

Education about the risk of side-effects and sensitization from acrylates is crucial for women using gel nail polish. Surprisingly, 77.4% of respondents who reported side-effects associated with gel nail polish wanted to continue the use of gel polish. It is likely that they regard the cosmetic benefits as more important than the risk of side-effects.

#### *Study limitations*

The current survey used a self-created questionnaire to assess the incidence of side-effects reported by individuals applying gel nail polish. The survey was a self-administered questionnaire, completed by respondents on-line. A definite limitation is the lack of clinical dermatological assessment by a physician.

#### *Conclusion*

Education about the risk of side-effects and sensitization from acrylates is crucial for individuals using gel nail polish and physicians.

*The authors have no conflicts of interest to declare.*

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