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Knowledge about ultraviolet radiation (UVR) and attitudes and behaviour regarding gel manicure according to the age of women

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Abstract

Introduction and purpose. Nowadays, artificial gel nails, which require Ultraviolet Radiation (UVR) for polymerization, steadily gain popularity. Gel manicure dried with UV lamps has become a regular part of many women's beauty routines. However, its safety remains controversial. The aim of the study was to assess the knowledge, attitudes and behaviour of women towards UV radiation generated by manicure devices.

Material and methods. The study was carried out from January to March 2020 with the use of PAPI and CAWI method. The study population consisted of 188 women living in the Silesian Voivodeship in Poland. The mean age was 31.7 ± 12.4 . The majority of women were familiar with UV nail polish drying devices (74%). Most of the respondents were regularly using UV lamps (51.1%).

Results. 62% of women aged 18-25 regularly got UV manicure, whereas only 29% of women older than 40 years ($p < 0.001$). Most of the respondents got UV manicure at beauty salon. However, 37% of women got it also at home. Self-manicure was mostly popular among women at age 18-25 ($p < 0.001$). Only 18.7% put sunscreen on hands and 10.8% wore fingerless gloves. Simultaneous antibiotic therapy or artificial sunbathing was not a contraindication for 15% and 8% of women, respectively. The knowledge of respondents about UV radiation was poor. The rate of correct responses was 54.7%.

Conclusions. While existing research suggests a low risk of carcinogenesis resulting from UV nail lamp use, ways to minimize any risk should be kept in mind. Dermatologists should educate patients, especially those with photosensitivity disorders, tanning bed history or with family history of skin cancer and raise their awareness about the potential health risk of UV manicure. Photoprotection and fingerless gloves should be accessible in beauty salons and recommended to use during UV manicure. Safety regulations concerning UV lamps are needed because they are very often self-operated by many women at home.

Key words: ultraviolet radiation (UV); nails; UV nail lamp; carcinogenic risk; knowledge

Introduction

Ultraviolet radiation (UVR) is a non-ionizing electromagnetic radiation with the wavelength from 10 nanometers (nm) to the border of the visible light (400 nm) [1]. The depth of penetration of the UVR into the human skin depends on its wavelength: the longer the wave, the deeper its penetration. Shorter waves (UV-C and UV-B) are absorbed by the epidermis, while the UV-A, characterized by a longer wavelength, reaches the dermis.

UV-B radiation is more cytotoxic and mutagenic than UV-A [2]. While UV-B is absorbed directly by DNA and induces structural DNA damage, UV-A is mainly responsible for indirect DNA damage by the generation of reactive oxygen species (ROS). The final biological effect depends, however, not only on the wavelength but also on personal characteristics such as the skin phototype or genetic load. The amount of absorbed radiation by a tissue depends also on the optics of the skin and its transmittance [3].

Ultraviolet radiation is regarded as the major cause of melanoma (MSC) and non-melanoma skin cancer (NMSC, keratinocyte carcinomas). The most common keratinocyte carcinomas are basal cell carcinoma (BCC) and squamous cell carcinoma (SCC), 70% and 25% of NMSC, respectively [4]. The risk depends on the dose of effective ultraviolet radiation accumulated during the lifetime, so the risk is higher among elderly people [5].

Carcinogenic character of UVR generated by tanning beds has been proved in many studies [4, 6]. In the European Union, to reduce the risk of skin burns and cancer caused by tanning beds, the European standard EN 60335-2-27, harmonized with the LVD 2006/95/EC directive, was introduced [7].

Nowadays, there has been an increased trend in the use of artificial gel nails, which require UVR for polymerization. Gel manicure dried with special UV lamps has become a regular part of many women's beauty routines. Gel polish has been gaining popularity because it is long-lasting, resistant to chipping and scratching, and easy to apply [8]. It contains photoinitiators that are photocured with a UV nail lamp [9]. UV nail devices have similar properties to UV tanning beds, with most of the light emitted from UV-A radiation. They consist of either fluorescent bulbs or light-emitting diode (LED) lamps. The emission spectrum of fluorescent lamps ranges from 300 to 410 nm, with a peak emission at 375 nm. LED lamps have narrower UV spectrum, from 375 to 425 nm, with a peak at 385 nm [9]. Because led lamps have more intense irradiance, they require a shorter time of exposure to achieve proper polymerization in comparison to fluorescent lamps [10]. Curing a nail usually lasts 2 minutes with the use of fluorescent lamps and 45 seconds using LED lamps [9]. However, depending on the wattage of the bulb, the number of bulbs in the lamp, and the distance between the lamp and fingernails, the exposure time of the hands and nails to UV lamp can range from 3 to 5 minutes so it is very important to use nail polishes which are dedicated to selected UV nail devices. The difference is also in the price. UV lamps are less expensive than LED lamps and they are more routinely used in the photocuring process [10].

Similar properties of UV manicure devices and tanning beds led to the formulation of the question if UV nail lamp can contribute to the increased incidence of keratinocyte carcinomas. This question is still without a solid answer. Relationship between skin cancer and UV nail light exposure has not been established yet. In many papers, skin cancer risk resulting from UV driers is suggested to be negligible [9, 11, 12]. According to Dowdy and Sayre even in the case of the worst lamp measured — 30 minutes of daily exposure to this device was below the occupational exposure limits for UV radiation [13]. However, these results apply only to healthy people who are not sensitive to UV radiation. In other papers, extensive UV nail exposure is thought to couple with UV-A exposure from tanning beds [14]. In some papers it is claimed that UV produced by a nail dryer in repeated doses could act in the same way as artificial tanning beds [15]. According to the latest reports, radiation emitted by UV-nail polish dryers can both damage DNA and permanently engrave mutations on the genomes of primary mouse embryonic fibroblasts, human foreskin fibroblasts, and human epidermal keratinocytes [16]. The public appears to be confused about the carcinogenic potential of UV nail lamps which varies between nail lamps. Moreover, skin cancer risk can increase when the nail dryers are used by patients with photosensitivity disorders, tanning bed history or with family history of skin cancer.

There is a huge diversity of UV nail devices. According to Shipp et al., UV nail lamps demonstrate a wide range of light source brands, the number of bulbs per device and UV-A irradiance emitted, which correlates with bulb wattages [12]. Moreover, the irradiance values are not equally distributed over the entire area of potential exposure. According to the type of UV nail lamp, multiple visits (from 8 to 208) would be required to reach the threshold for potential DNA damage.

Although the risk of carcinogenesis from UV nail lamp is considered low, ways to minimize any risk should be applied during UV manicure. Skin protection is recommended in many papers. It is also suggested to use nail polish which is properly selected for the type of the device. Women knowledge concerning UVR is not without significance. UV manicure steadily gains popularity. In response, there has been an increase in the sale of UV devices supporting the drying of gel polish [15]. Nowadays, gel polishes are not only available in professional nail salons. They are also easily accessible for purchase for home use. Gel polish kits using UV light for home use pose a significant health threat especially for women who are fair-skinned, undergo antibiotic therapy or regularly use sunbeds. Nail lamps for domestic use are unregulated and their safety depends on UV knowledge of users [17]. For this reason, assessing the knowledge of potential UV lamp users is of key importance.

Purpose

The aim of the study was to assess the knowledge, attitudes and behaviour of women towards UV radiation generated by manicure devices.

Material and methods

The study was carried out from January to March 2020 with the use of PAPI and CAWI method. The only inclusion criterion for the study was female gender. According to the sampling calculator 300 women were planned to be included in the study. Finally, the study population consisted of 188 women living in Silesian Voivodeship in Poland. The mean age was 31.7 ± 12.4 . The oldest woman was 66 years old. 120 questionnaires were completed with paper-and-pencil technique among women in the shopping centre in the city of Silesian Voivodeship. 68 questionnaires were completed by CAWI technique. All questionnaires were fully completed. Data collection was interrupted with the lockdown in Poland in March 2020. The study group could not be enlarged because lockdown could have had an impact on women behaviours concerning gel manicure, especially using professional beauty salons.

An original questionnaire was used to evaluate UV-related knowledge, attitudes towards UV exposure and its impact on human health. It consisted of 35 questions, including 3 on basic sociodemographic data to describe the study group (age, place of residence, level of education), 10 questions to check general UV knowledge (for example, what traits are taken into consideration when determining skin phototype, what are the negative effects of UV exposure, and what SPF means) and 22 related to performing a manicure with the use of UV lamps (including the frequency and place where the treatment is performed; time and frequency of irradiation of each hand; preparation for the treatment; personal protective equipment used; contraindications to the treatment; etc.). The questionnaire mostly contained closed-ended type questions, both those that require the selection of one of several proposed answers (26 questions) and those that allow the selection of more than one answer from a set (8 questions). Only 1 question (regarding age) was open-ended.

The respondents' level of knowledge about UV radiation was evaluated based on the answers to the 10 questions on general knowledge about UV radiation. Each correct answer equalled one point. The degree of knowledge was estimated depending on the number of correct answers, namely: poor (0-5 points), moderate (6-7 points), good (8-10 points).

General information about the purpose of the study and informed consent was placed on the first page of the paper questionnaire. Only respondents who read the consent and signed it could go to further questions. Online questionnaires also started with consent which should be ticked to get permission to complete the survey. All data were collected and stored anonymously.

Statistical analyses were performed with the use of Statistica 13.3 (Statsoft, Poland). Normally distributed data are presented as mean (\bar{X}) and standard deviation (SD). Whereas non-normally distributed data as median (Me) and quartiles (Q1-Q3). Differences of knowledge between subgroups are tested for significance with one-way ANOVA for normally distributed variables. Chi-squared was used for testing relationships between categorical variables. A statistical significance was defined as $p \leq 0.05$.

Results

Attitudes and behaviour regarding UV manicure

UV manicure is very popular among the surveyed women. 139 women (74%) were familiar with UV lamps. Most of the respondents regularly got UV manicure (51.1 %). 22.3% of women got gels even twice a month. In the group of women familiar with UV manicure, there were 20 (10.6%) women who only got gel manicure dried with UV lamps.

Table 1. General population characteristics (N=188).

Variable		n	%
Place of living	City	93	49.5
	Countryside	95	50.5
Level of education	Primary	14	7.5
	Secondary	104	55.3
	Higher	70	37.2
UV manicure	Yes, regularly	96	51.1
	Yes, in the past	43	22.9
	No, never	49	26.0

The percentage of respondents using UV lamps decreased with age. 62% of women aged 18-25 regularly got UV manicure, whereas only 29% of women older than 40 years. The differences presented here were statistically significant ($p < 0.001$). Most of the respondents got UV manicure at beauty salon. However, 37% of women got it also at home. Self-manicure was mostly popular among women at age 18-25 ($p < 0.001$).

Some negative behaviours concerning UV manicure were very common. Almost 40% of women did not pay attention if the lamp was properly selected for the type of manicure performed. 25% did not know what

kind of lamp (UV/LED) was used during UV manicure. Taking antibiotics was not a contraindication for 15% of women and they got UV manicure and antibiotic therapy simultaneously. Some women (N=15; 8.0%) also admitted that they got UV manicure at the same day as artificial sunbathing. Detailed data according to the age group is presented in the Table 2.

Table 2. Behaviour and attitudes towards UV manicure according to the age group (N=188).

Variable (%)		Age group			Chi squared	p-value
		<25	25-40	>40		
UV manicure	Yes, regularly	62.2	53.4	29.2	25.79	<0.001
	Yes, in the past	25.6	22.4	18.7		
	No, never	12.2	24.2	52.1		
Type of manicure	Hybrid	45.8	50.0	43.5	11.37	0.0226
	Gel	8.4	13.6	34.8		
	Both	45.8	36.4	21.7		
Place	Beauty salon	30.5	63.6	87.0	27.83	<0.001
	Home	51.4	31.8	8.7		
	Both	18.1	4.6	4.3		
UV manicure and antibiotics at the same day	Yes	25.0	20.5	4.3	19.99	<0.001
	No	52.8	31.8	26.1		
	Don't remember	22.2	47.7	69.6		
UV manicure and artificial sunbathing at the same day	Yes	11.1	9.1	13.0	7.06	0.1326
	No	75.0	56.8	69.6		
	Don't remember	13.9	34.1	17.4		
Covering birthmarks	Yes, always	6,1	24,1	13,1	23.47	<0.001
	Yes, sometimes	26,8	46,6	41,3		
	No, I haven't any	52,5	24,1	30,4		
	No, it is useless	14,6	5,2	15,2		

More than half of the respondents (54%) got UV manicure at least once a month. The biggest number of UV exposure for one hand was 10. The total time of UV exposure for one hand during a single treatment was 2.5 minutes (Q1-Q3: 2.0-4.0). However, some admitted that nail photocuring of one hand lasted even 18 minutes. The surveyed women were asked about the activities performed before the manicure treatment. 45.3% of respondents usually covered skin birthmarks before UV exposure. Only 18.7% put sunscreen on hands and 10.8 % wore fingerless gloves (Figure 1).

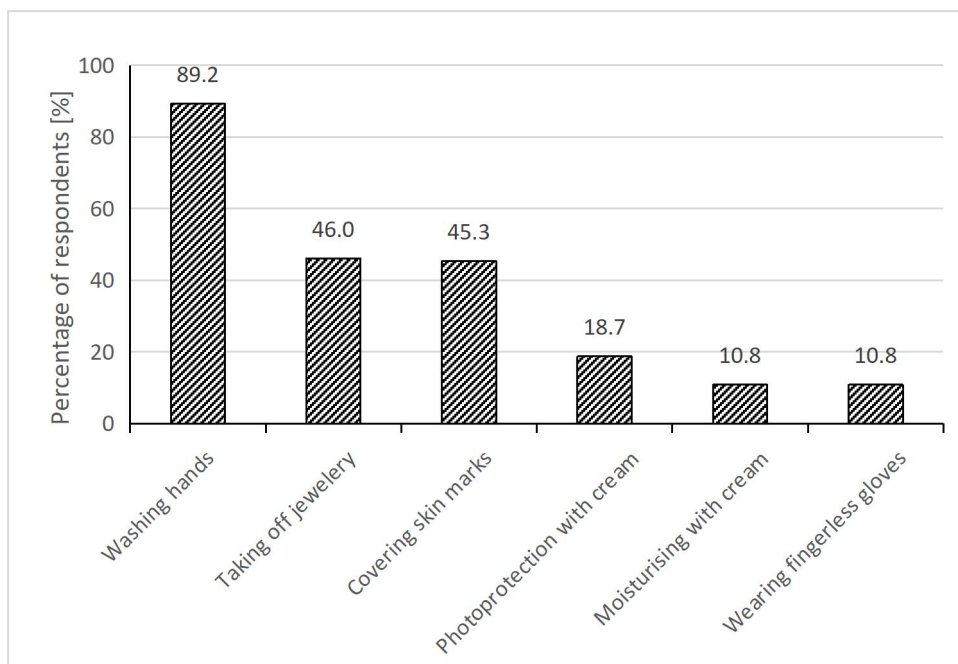


Figure 1. Activities performed before and during the manicure treatment (N=139).

The knowledge of respondents about UV radiation

In the questionnaire, there were 10 questions assessing UV-related knowledge. The easiest question for the study group was the meaning of SPF – 92% knew the correct answer. The question concerning the name of the radiation produced by UV nail device was the most difficult one (23%). Mean score was 5.47 ± 1.77 in the study group. Most of respondents had poor knowledge about UVR (Figure 2). Knowledge did not depend on that the person got UV manicure ($p=0.942$).

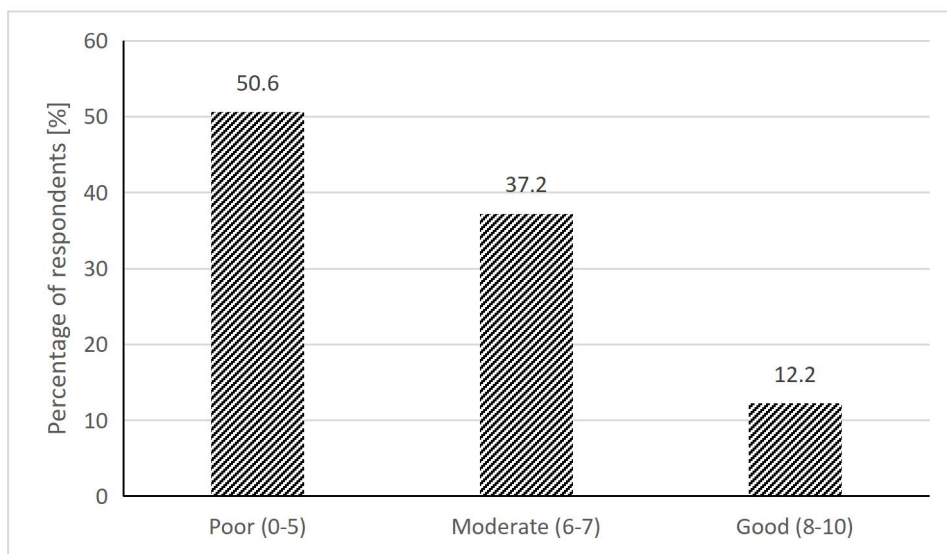


Figure 2. Knowledge of respondents concerning UVR (N=188).

The knowledge depended on women’s age and level of education (Table 3). The best knowledge had women at age 25-40 (6.12 ± 1.42). Mean score for younger women was 4.87 ± 1.73 . Differences presented here were statistically significant ($p < 0.001$).

Table 3. Knowledge (in scores) according to the age and level of education of respondents (N=188)

		Mean value	SD	F	p
Age	<25	4.87	1.73	9.99	<0.001
	25-40	6.12	1.42		
	>40	5.70	1.91		
Level of education	Primary	3.79	1.76	19.46	<0.001
	Secondary	5.13	1.57		
	Higher	6.31	1.66		
total		5.47	1.77		

It is worth to add that 68.6% of women believed there was a cancer risk associated with UV manicure. 52.6% of women knew how to determine the skin type. However, more than half of the respondents did not know their skin phototype (Figure 3).

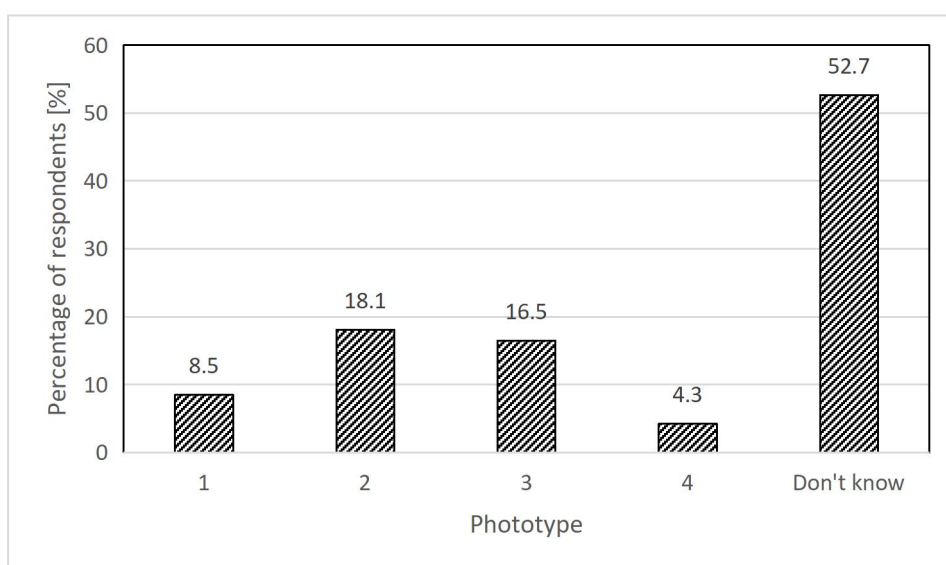


Figure 3. Skin phototype of respondents (N=188)

Most women learnt about UVR from Internet (N=132;70.2%). Not every woman who got manicure at home read the manual of the curing lamp (N=29; 42.02%). Only 12 people admitted that they asked the technician at beauty salon or dermatologist about the safety of UVR generated by nail devices.

Discussion

The risk calculation based on measurement of total effective irradiance of the nail lamps suggests that even the most intense lamps present only a moderate UV risk – a far lower than that measured at UV tanning devices [18].

Curtis et al. suggested that in less than 10 minutes the hands could receive an energy dose equivalent to the recommended limit for an entire day for outdoor workers [19]. The UV lamps emitted 4.2 times more energy between 355 nm and 385 nm than the sun. This study faced controversy from Dowdy and Sayre who claimed it used inappropriate measurement techniques [20]. The computed analysis of keratinocyte carcinomas risk from nail lamps was 11 to 46 times less than overhead sunlight and 3 to 12 times less than mid-angle sunlight for equivalent exposure duration. The risk from UV nail lamps was defined as only moderate with approximately 30 to 130 minutes of permissible daily occupational exposure. The dorsum of the hand, due to its regular exposure to sunlight, is the most photoadapted and UVR-resistant part of the body [9]. As a consequence, the cancer risk from nail lamps could be even lower than calculated in that paper. However, in the light of the latest research the risk of cancer cannot be negligible [16].

According to Dowdy and Sayre [13] daily permissible times of exposure ranged from 36 min to 4.6 h. In this study, the mean total time of UV exposure for one hand was 3.8 min. However, UV lamps differ in properties. They consist of either fluorescent bulbs or LEDs, which have safer light emissions [21]. The time of exposure can range according to the type of device, wattage of the bulb, the number of bulbs in the lamp and the distance between the lamp and fingernails.

UV manicure is very popular among women studied. More than half (51.1%) got UV manicure regularly once a month. Younger women, aged <25, more often got UV manicure than older ones. Another study realised among Polish women confirms the growing popularity of UV manicure [22]. 57% of nurses had hybrid varnish. It is worth to notice that because of the effectiveness of washing and disinfection, short and natural nails are recommended for this professional group. In another study, 68% of women previously had a gel manicure and 13% repeated it more than once a month [23]. It needs to be highlighted that young women mostly make manicure themselves.

Even with the fact that there is no strong correlation between skin cancer and UV exposure during manicure and the cancer risk is rather small, skin protection is recommended in many papers. People who choose nail treatment with UV devices should apply a broad-spectrum sunscreen with an SPF of 30 or higher to the hands before their appointment [4]. Because sunscreen should be put 20 minutes before manicure and accidentally could contaminate nails, fingerless gloves are recommended instead of sunscreen. In this study, only 18.7% of women applied sunscreen prior to receiving the manicure. Only 1 out of 10 used fingerless gloves. This number is very low. A 2018 survey found that only 3% of the respondents applied sunscreen prior to manicures and only 2 respondents (0.5%) were told at nail salons to use sunscreen prior to UV treatment [23]. This suggests that those performing nail treatment are also unaware of the radiation potential. According to Polish law, a person who wants to become a manicurist does not need to have any special education or certificates confirming their skills.

Only 12 people admitted that they asked the technician at a beauty salon or a dermatologist about the safety of UVR produced by nail devices. Dermatologists should educate patients about the potential health risks of gels and UV nail lamps. They should caution until more evidence concerning the safety of UV manicure becomes available [21]. Dermatologists and manicurists need to be aware of the potential use of fingerless gloves and sunscreens and should advise patients or clients about such measures to ensure the safe use of UV nail lamps. This aspect of people education is especially important in individuals with increased risk for skin cancer, such as fair skinned individuals, immunosuppressed patients, people with a tanning bed history or those with a family history of skin cancer. Secondly, these preventive measures and health education regarding nail lamps are also important for patients with photosensitivity disorders or taking medicines, since not all patients may know the nail lamps have UV light output [14]. In this study, 25% of women did not know what kind of lamp (UV/LED) was used during UV manicure. For almost 40% of women, the safety of manicure was not important and they did not pay attention if the lamp is properly selected for the type of manicure performed.

People should be aware that there are many medicines that can increase the sensitivity to UV light, such as some antibiotics. People taking these drugs should particularly protect their skin during a gel manicure to avoid burns on their hands. In this study, every fourth woman admitted that she got UV manicure during antibiotic therapy.

The possible harmfulness of UV radiation depends not only on the received UV dose but also on the sensitivity of the individual. The effects of UV exposure are different for various skin phototypes characterised by Fitzpatrick. Almost half of respondents knew their phototype. In contrast, only 9% of Germans were able to name their own skin type [24].

Skin cancers are one of the most frequently diagnosed forms of cancer and the best preventive measure is to limit the exposure of the skin to UV. Awareness of the health consequences of UV exposure can significantly reduce the risk of skin cancer. However, the knowledge of respondents about UV radiation was poor. Half of respondents knew the correct answer for more than 5 out of 10 questions. Only 12% had good knowledge related to UV. They did not know if there is a risk of skin cancer according to UV nail exposure. Almost 70% thought that there was a correlation between UV nail lamps and potential clinical risk of cancer. Similar results were reported by Bollard et al. In that study, 306 people (72% of respondents) believed that there was a cancer risk associated with either light-emitting diodes or UV nail lamps [23].

Age seems to play a role regarding knowledge of UV and its impact on behaviour before and during UV manicure. Very young women had the least knowledge, they got UV manicures statistically more often than the older ones and they mostly got it at home. The level of knowledge is particularly dangerous if women use UV lamps at home. The use of UV nail drying devices is unregulated. There is no standard defining how long hands should be kept under the UV lamp to varnish the gel. Moreover, each gel has its own recommended curing time, which may or may not be followed at home use. More regulation is required concerning UV nail lamps in the beauty and cosmetic industry because curing time recommendations may not be followed also by a manicurist in a beauty salon [15]. It is probable that home UV manicure may be associated with greater risk, especially because majority of respondents did not read the manual of curing lamp. Women should be warned that improper use of home UV nail lamps could result in increased risk of cancer.

Limitations

Findings presented in this paper should be interpreted in the context of the study's design and limitations. First of all a sample size was relatively small. However, the Covid -19 pandemic and lockdown in Poland could have an impact on frequency and the manner of getting manicure that's why the study was interrupted in March 2020. It

is probably the first study concerning UV manicure knowledge and behavior among Polish women. It would be of great benefit to conduct further studies with larger samples in a broad age groups. There are also potential bias resulting from that the study was based on a self-administered survey.

Conclusions

In conclusion, while existing research suggests a low risk of carcinogenesis resulting from UV nail lamp use, ways to minimize any risk should be kept in mind. Dermatologists should educate patients, especially those with photosensitivity disorders, tanning bed history, or with family history of skin cancer and raise their awareness about the potential health risk of UV manicure. Photoprotection and fingerless gloves should be accessible in beauty salons and recommended to use during UV manicure. Safety regulations concerning UV lamps are needed because they are very often self-operated by many women at home.

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