

RESEARCH PAPER

 OPEN ACCESS

Socio-epidemiologic aspects and cutaneous side effects of permanent tattoos in Germany – Tattoos are not restricted to a specific social phenotype

Cornelia Sigrid Lissi Müller^a, Angela Oertel^b, Rebecca Körner^c, Claudia Pföhler^a, and Thomas Vogt^a

^aSaarland University Hospital, Department of Dermatology, Homburg/Saar, Germany; ^bStädtisches Klinikum Karlsruhe, Department of Obstetrics and Gynecology, Germany; ^cDermatology, Sulzbach/Saar, Germany

ABSTRACT

Background: More and more people of all age classes have a tattoo. Intriguingly, there are multiple prejudices in the general population and published data that concern tattooed persons, such as being criminals, having a low education, being alcohol or drug abusers, or more risky in their life style. **Objective:** To obtain and to evaluate sociodemographic data on tattooed persons, to investigate the incidence of tattoo-related cutaneous complications and to define personal risk factors and course of the persons after being tattooed concerning behavior of personal environment. **Patients and Methods:** We interviewed 426 participants with already existing tattoos and 20 participants just before getting a new tattoo by using an online questionnaire. The participators were asked about socio-epidemiologic aspects of tattoos in general and special aspects of their own tattoo(s) in particular. There were no exclusion criteria. **Results:** Tattoos are interesting for people seeking popular body art, esp. university graduates and financially-secure individuals. 446 persons participated in this study. Most of the persons were female with a mean age of 35. Local pruritus around the tattooed area was the most common cutaneous side effect among the participants. 93.5% of the participants did not want a tattoo removal. Intriguingly, most of the participants experienced no career problems related to the tattoo(s). **Limitations:** The study population is not representative as we included only persons being tattooed prior to or getting newly tattooed. Furthermore, there is a potential selection bias as the participation in this study was voluntary. Only persons that felt involved by the flyer did answer the questionnaire. **Conclusion:** The present data shows that common tattooed persons are not low educated criminals with any drug or alcohol abuse or with risky life style. Nowadays being tattooed encompasses a kind of body art and displays a certain kind of lifestyle habit.

ARTICLE HISTORY

Received 21 November 2016
Revised 22 November 2016
Accepted 23 November 2016

KEYWORDS

body art; cutaneous side effects; permanent tattoo; social affiliation; tattooing; tattoos

Introduction

Currently an estimated 10% of the general population and approximately 25% of the young adult population in Germany is tattooed.¹ A permanent tattoo is a result from stitching colored pigments underneath the skin into the dermis. There is a significant difference in outcome if a tattoo is set by a professional tattoo artist with a tattoo-gun in a studio or by an amateur with less experience using poor hygienic techniques and non-professional instruments and needles.^{2,3} The American Samuel O'Reilly, who invented the electric tattoo gun around 1890, set the trend to modern tattoo art.⁴ Throughout the years not only the tattoo color has changed but also the methods and techniques, that lead to a higher quality in tattoo art.⁴ Tattooing itself is a

ritual that is thousands of years old and used in a number of cultures.⁴ What people used earlier as a form of camouflage while hunting, is now considered as popular art to beautify the body. On the other hand, a variety of prejudices against tattooed persons do exist in the general population of non-tattooed persons. This may be due to tattoos being previously popular for prisoners, prostitutes, seamen or criminals.⁵ Currently, tattooing is considered socially acceptable, and hygienic standards and the art itself have changed to improve quality. With tattoos increasing in popularity, however, a number of mostly cutaneous side effects have also been reported, such as infections, allergic reactions, or even the rise of malignant tumors within the tattoo.⁶⁻⁹ Possible causes of cutaneous side effects may result

CONTACT Cornelia Sigrid Lissi Müller  cornelia.mueller@uks.eu  Saarland University Hospital, Department of Dermatology, D 66421 Homburg/Saar, Germany.

© 2017 Cornelia Sigrid Lissi Müller, Angela Oertel, Rebecca Körner, Claudia Pföhler, Thomas Vogt. Published with license by Taylor & Francis.

This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives License (<http://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited, and is not altered, transformed, or built upon in any way.

from the substances of content of the tattoo color.¹⁰ In the past, color pigments used to contain different metals salts such as chrome, nickel, cadmium, mercury, titan or aluminum, thus being possible causes for foreign body granulomas, allergic reactions and contact dermatitis. The control of the tattoo pigments through the food control authorities secures that nowadays mainly organic substances are used as color pigments.¹¹⁻¹³

Color -specific tattoo reactions are published for almost every ink color and encompass delayed wound healing, infections and keloidal reactions as well as allergic contact dermatitis.¹⁴ In Germany, metal salts are nowadays forbidden as contents of tattoo ink; this is regulated by law so that customers should be protected from adverse events.¹⁵ Additionally, it seems as if there is a difference between self-reported allergies and chronic color -specific dermatitis.

However, it is not yet fully understood what exactly happens to the tattoo pigments after being stitched into the skin. Experiments have shown that 32% of the pigments dissolve out of the tattoo within a time span of 42 d. They are distributed by the blood stream and may lead to systemic toxicity.¹⁶ Macrophages recognize the pigments as foreign material and try to eliminate the pigments via the blood and lymphatic system; this is why tattoo pigments can often be found in lymph nodes.¹⁷ However, it is not the amount of pigment that causes a cutaneous reaction, but the ingredients itself.¹² In the beginning of professional tattoo studios, the people had no to low hygienic standards, needles were used for several different customers and there were no disinfectants. For instance, after occurrence of hepatitis B infections, that were spread throughout New York due to unsterile tattoo utensils, the city even prohibited any kind of tattooing in 1961². A comprehensive overview on reported skin reactions is given in [Table 1](#).

Due to all these facts, prejudices among the general population about tattooed individuals do still exist concerning a risk for getting infectious diseases (e.g. HIV), engaging in illegal behavior, or being associated with poor education and alcohol or drug abuse.¹⁸⁻²⁰ Intriguingly, there is still no consensus on impact of tattoos and piercings concerning risk factors, behavior or psychosocial status of the persons who are tattooed. Published data are contradictory: while Pajor and colleagues stated that tattoos and piercings are no indicators of psychopathology,²¹ most investigations stated that tattooed people

are of increased impulsiveness and risky decision-making and exhibit more frequently risk behavior like smoking, alcohol and drug abuse, visiting night clubs and display lower school grades and additional being of higher mental health risks.^{1, 22-24} A gender specific distribution in motivation and occurrence of body modification seems to exist, with women showing more sensation-seeking behavior.¹ A generally accepted opinion concerning motivation for tattooing is widely negatively perceived conditions of life and reduced social behavior.²⁴ Interestingly, themes of tattoos and their implications differ between the persons that wear it. So called “prison tattoos” (prison-themed or prison-made tattoos) are seen in inmates, independent of number of convictions and cause of arrest. These persons (inmates) differ from inmates with nonprison tattoos, inmates without tattoos or even people with criminal thinking styles by increased recidivism, more institutional behavioral problems and thus increased disciplinary infractions.⁵

Given limited socio-epidemiological data on tattooed persons in Germany, the aim of the current study was not just to determine demographic facts about tattooed persons in the population, but to address probable risk factors leading to cutaneous side effects and to characterize the stereotype personality having body

Results

Participant demographics

4-hundred and 46 (446) people participated in this study. 426/446 (95.5%) already had an old tattoo and 20/446 (4.5%) got a new one. Of the 20 newly tattooed participants, only 17/20 completed the 3 month follow-up questionnaire. Out of the 426 tattooed participants, 308/426 (72.3%) were females, 112/426 (26.3%) were males, and 6/426 (1.4%) did not state their gender. Mean age was 35 y (range 17–65). From the 17 newly tattooed participants who completed the follow-up questionnaires entirely, 14/17 (82.4%) were females and 3/17 (17.6%) males. 3 female participants dropped out before completing the follow-up.

Already tattooed participants

Of all participants that were already tattooed, 43.2% (184/426) had one or 2 tattoos on their body (see [Table 2](#)), and 50.7% of them got a tattoo when they were < 20 y of age. The favourite location for a tattoo was the back (57.3% [n = 244/426]) followed by the

Table 1. Overview on common skin reactions following tattooing.

| Common skin reactions | Symptoms | Duration | Therapy |
|--|--|---|---|
| Aseptic inflammation | Erythema, swelling, edema (SPERRY, 1992), touch-sensitivity (KLUGER, 2012), skin peels off (THUM and BISWAS, 2013) | Variable in intensity depending on tattoo size and length of setting (KLUGER, 2012) | Normal tattoo aftercare |
| Edema of the extremities | Light, temporary erythema, induration and edema with dilatation of the hair follicle (KLUGER, HUBICHE, 2013) | Rapid occurrence and remission | Adequate rest |
| Acute regional swelling of lymph nodes | Healing phase (KLUGER et al., 2008), nach Laserbehandlung DD: Infection, Tumor, | variable | Most of the time spontaneous remission (KLUGER, 2012) |
| Purpura and hematoma | Trauma of smaller blood vessels in dermis (KLÜGL et al., 2010) | Variable | Most of the time rapid remission (KLUGER, 2012) |
| "Tattoo-Blow-Out" | Blue or dark shading around tattoo (KLUGER, 2014) | Permanent | Laser therapy (KLUGER, 2014) |
| "Tattoo-Fall-out" | Color bleaches off (DELIO, 1994) | Permanent | More tattoo color |
| Superficial skin infection | Folliculitis, furuncle, ekthymata or Impetigo contagiosa (KAZANDJIEVA and TSANKOV 2007) | Variable | Antibiotics |
| With bacteria contaminated color | Infection, that is at first restricted to one color | Variable | Antibiotics |
| Severe infection | Erysipelas, gangrene, sepsis (KAZANDJIEVA and TSANKOV 2007) | Variable | Antibiotics |
| Polymicrobial mixed infection | Cellulitis, nekrotic faszits (PORTER et al., 2005), Septicaemia (KORMAN et al., 1997) | Variable | Antibiotics |
| Environmental infection with atypic mykobacteria | Papules, nodules or pustules a tone tattooine of one color (KAZANDJIEVA and TSANKOV, 2007; KAATZ et al., 2008; KLUGER, 2012) | Variable | Antibiotics |
| Viral infection | Wart enclosed in one tattoo, depending on papilloma-virus (TREFZER et al., 2004) or Molluscum contagiosum virus (Salmaso et al., 2001) | variable | variable |
| Mycosis | Transmission of candida albicans, trichopyton rubrum and epidermophyton floxxosum (MATAIX and SILVESTRE, 2009; KAZANDJIEVA and TSANKOV, 2007) | Variable | Antimycotics |
| Systemic complications | For example Hepatitis B or C or even HIV | | |
| Hypersensitivity reaction | Allergic contact dermatitis or fotoallergic dermatitis (KAUR et al., 2009), swelling and Erythema, additional itching and skin irritation in one pigment (MORTIMER et al., 2003) | Occurance possible after weeks, months or even years (MATAIX and SILVESTRE, 2009) | Cortison therapy up to surgical exzision |
| Foreign body reaction | Classical foreign body reaction with granuloma, sarkoidosis (KÖRNER et al., 2013) | variable | Cortison therapy up to surgical exzision |
| Foto-induced reaction | Fotosensibility (KAZANDJIEVA and TSANKOV, 2007) | | |
| Köbner phenomenon | Trigger factor for other dermatosis (MATAIX and SILVESTRE, 2009) | variable | Cortison |
| Skin tumor | Malignant Melanoma (WOLFORT et al., 1974), Keratoakanthoma (KLUGER et al., 2008), squamous cell- (PITARCH et al., 2007) and basal cell-carcinoma (DOUMAT et al., 2004) | Variable | Surgical exzision |

arms 56.3% (n = 240) (Table 3). Nearly 2-thirds of participants (61.5% [n = 262/426]) had a colored tattoo and only 38.5% (n = 164/426) had a purely black tattoo (Fig. 4). 150/426 (35.2%) were classified as multi-colored with >3 different pigments. The most common individual color had a red pigment (16.7% [n = 71/426]). Both, males and females mostly had tattoos >20 cm in size (50.5% [n = 215/426]) (Table 1). The tattooed area mostly involved the back (28.8%) and arms (28.4%) followed by the legs with 25.1%. The face has been tattooed only in 0,6% of all cases (see Table 3). 88.5% (n = 377/426) never had a complication with their tattoo, while 4.7% (n = 20/426) stated that their

skin was irritated for a longer period of time, 2.8% (n = 12/426) had local inflammation that was mostly self-induced due to poor diligence and care, and 1.6% (n = 7/426) displayed disturbed wound healing (Table 4). Only 1.2% (5/426) of the participants showed a contact allergic reaction; 2/5 against red color, 1/5 against purple pigment, 1/5 did not tell what pigment was the causative, and 1/5 had had an allergic reaction to the care product. 5 out of 426 (1.2%) participants stated that the color bleached off. 273/426 (64.1%) of the participants also had a piercing somewhere on their body, including ear piercings, of whom 28.2% (77/273) had a complication due to this piercing. 373/426 (87.6%) did

Table 2. Frequency distribution of number of tattoos, tattoo size and motivation to get a tattoo for tattooed individuals.

| Number of tattoos | frequency | percent |
|-------------------------------|-----------|---------|
| 1–2 tattoos | 184 | 43,2% |
| 3–5 tattoos | 121 | 28,4% |
| 6–10 tattoos | 70 | 16,4% |
| > 10 tattoos | 48 | 11,3% |
| No answer | 3 | 0,7% |
| Tattoo size | | |
| < 5 cm | 12 | 2,8% |
| 5–10 cm | 45 | 10,6% |
| 10–15 cm | 52 | 12,2% |
| 15–20 cm | 100 | 23,5% |
| > 20 cm | 215 | 50,5% |
| No answer | 2 | 0,5% |
| Motivation | | |
| Pleasure, to be in style | 74 | 17,4% |
| Bodyart, beauty ideal | 71 | 16,7% |
| Memories | 66 | 15,5% |
| Changing life experience | 40 | 9,4% |
| Family | 25 | 5,9% |
| Immortalization, eternal bond | 24 | 5,6% |
| No significance, curiosity | 22 | 5,2% |
| To feel the pain | 8 | 1,9% |
| Others | 63 | 14,8% |
| No answer | 33 | 7,7% |

not have an underlying systemic disease. 2 of the participants reported an active hepatitis, (0.5%). No participants displayed positivity to HI-Virus.

One-hundred and 69 participants (39.7%) were non-smokers. Additionally, 15.3% (n = 65/426) individuals stopped smoking recently and 45.1% (n = 192/426) were active smokers. 3-hundred and 10 participants (72.8%) denied regular alcohol intake. Most of the drinking behavior reported was drinking alcohol on special occasions or weekends (8.6% [n = 37/426]). Only 31/426 participants (7.3%) consumed alcohol more than once per week. 401/426 (94.1%) denied any drug abuse. 10/426 participants (2.3%)

Table 3. Frequency and gender distribution of tattooed body areas.

| Tattooed body area | frequency | Percent | Gender distribution | Job problems |
|--------------------|-----------|---------|--|-----------------|
| Face | 5 | 0,6% | 4 female One male | none |
| Chest, Abdomen | 145 | 17,1% | 103 female 41 male One no answer | 11 participants |
| Back | 244 | 28,8% | 195 female 44 male Five no answer | 18 participants |
| Legs | 212 | 25,1% | 155 female 54 male Three no answer | 22 participants |
| Arms | 240 | 28,4% | 148 female 89 male Three no answer | 17 participants |

Table 4. Frequency and gender distribution of complications after getting a tattoo.

| Complications after tattooing | frequency | percent | Gender distribution |
|----------------------------------|-----------|---------|---|
| No, none | 377 | 88,5% | 273 female 99 male Five no answer |
| Irritated skin for a long period | 20 | 4,7% | 15 female Four male One no answer |
| Inflammation | 12 | 2,8% | 6 female Six male |
| Wound healing disorders | 7 | 1,6% | 5 female Two male |
| Allergy | 5 | 1,2% | 5 female |
| Color pigments bleached off | 5 | 1,2% | 4 female One male |

stated occasional drug use and 1/426 (0.2%) admitted daily drug intake. 8 participants (1.9%) had stopped using drugs and 6/426 (1.4%) did not answer this question. There were no responses regarding the kind of drugs used.

2-hundred and 13 (50%) participants were employed, 20.8% (n = 89/426) were students, and 4 (0.9%) were trainees. 29 participants (6.8%) were in leading positions, 30 (7%) were self-employed, and 11 (2.6%) had retired. 11 participants (2.6%) were housewives and 11 (2.6%) were currently unemployed and looking for a job. 397/426 participants (93.2%) never had problems in their job because of their tattoo, while 11/426 (2.6%) had to conceal their tattoos during work (Table 5). The annual income of working participants is shown in Fig. 5 (Fig. 5). Family members and

Table 5. Frequency distribution and causes of career problems and seeking tattoo removal.

| Career problems | frequency | percent |
|-------------------------------------|-----------|---------|
| None | 397 | 93,2% |
| Not accepted | 3 | 0,7% |
| Covering the tattoo | 11 | 2,6% |
| Wrong impression/bias | 6 | 1,4% |
| Rejection/mobbing | 7 | 1,6% |
| Yes, without a cause given | 2 | 0,5% |
| Tattoo removal | | |
| no | 397 | 93,2% |
| Yes, poorly tattooed | 5 | 1,2% |
| Yes, wrong motif | 3 | 0,7% |
| Yes, wrong body area | 3 | 0,7% |
| Yes, no significance anymore | 4 | 0,9% |
| Yes, because of age now | 2 | 0,5% |
| Yes, all in all no pleasure anymore | 6 | 1,4% |
| Yes, color bleached out | 1 | 0,2% |
| Yes, because of skin reaction | 1 | 0,2% |
| Yes, because of family/friends | 1 | 0,2% |
| No answer | 3 | 0,7% |

close friends of 276/426 participants (64.8%) did not have tattoos themselves.

Skin reactions right after tattooing is interpreted as being quite normal and can differ in outcome depending on the time spent placing the tattoo and the size of the tattoo. 72 participants (16.9%) did not have any skin reactions. Most of the tattooed individuals had cutaneous erythema ($n = 254$ [59.6%]), swelling ($n = 213$ [50%]), hyperthermia ($n = 160$ [37.6%]), incrustation ($n = 157$ [36.9%]), and itching ($n = 151$ [35.4%]).

Self-reported skin reactions afterwards were denied by 342/426 participants (80.3%). The most common side effect afterwards was itching of the skin ($n = 34$ [8%]) and swelling ($n = 23$ [5.4%]) as illustrated in Fig. 6 (Fig. 6). Systemic disorders right after tattooing were denied by 93.4% of the participants ($n = 398$). Other skin changes were rather cosmetic than relevant complications. There was a high rate of content with the tattoo itself. 3-hundred and 97 participants (93.2%) never thought about getting their tattoo removed. Individual reasons for removal of a tattoo included the choice of motif, its application on disadvantageous body parts, or a poorly tattooed picture (Table 5).

Newly-tattooed participants

Of the 20 newly tattooed participants, 6 (30%) already had >10 tattoos. Only one female got the first tattoo on her body. New tattoos were mostly located on the arms ($n = 8/20$ [40%]), and 50% ($n = 10/20$) had a multi-colored tattoo. Previous complications were inflammation in 2 cases (10%) due to poor care. 14 out of 20 (70%) were smokers and only 6/20 (30%) non-smokers. Regular alcohol intake was denied by 12/20 (60%) people and occasional marijuana intake was admitted by 2/20 (10%) individuals.

8 people (40%) were employees and 4 (20%) were students or trainees. One participant (5%) was a housewife and 1 (5%) had retired. 3 participants (15%) were self-employed. 2 (10%) individuals had to cover their tattoos during work. There were no relevant disorders or allergies in this subgroup. 15 participants (75%) did not use a solarium regularly. Only one person used a tanning bed more than 4 or 5 times a month.

Questionnaire results 1 week after being tattooed

Due to 3 drop-outs the following questionnaires could only be analyzed for 17 participants. After 1 week, 13/

17 (76.5%) individuals no longer felt pain; only 4/17 (23.5%) felt minimal pain. 8 participants (47.1%) had no further skin reactions. 6 participants (35.3%) experienced some swelling, 5 (29.4%) had hyperthermia, 4 (23.5%) had redness of the skin, and 2 (11.8%) had incrustation, as illustrated in Fig. 7 (Fig. 7). 6 participants (35.3%) experienced itching after 1 week. No one had a systemic reaction or had to take oral analgesics. No one stayed longer in direct sunlight.

Questionnaire results 1 month after being tattooed

After 1 month, no participant suffered from pain on the newly tattooed body part anymore. 6 participants (35.3%) experienced itching, 4 (23.5%) had hyperthermia and redness, and 3 (17.6%) had swelling and incrustation. All of the tattoos were located at highly used body areas. Fig. 8 shows one of the tattoos (Fig. 8). Because it did not seem to be inflamed, we interpreted this as a longer healing period. After 1 month, none of the participants had to take analgesics; no one had a systemic reaction or stayed longer in direct sunlight.

Questionnaire results 3 month after being tattooed

After 3 months, all tattoos were healed and did not show any skin reactions except of one tattoo located on the elbow that showed some redness and incrustation. This seemed to be due to the high amount of mechanical demand and not to inflammation. All tattoos were still treated with wound and healing cream and 3 tattoos were exposed to direct sunlight without any skin reactions.

Discussion

Since 2005, requirements concerning contents of tattoo pigments in Germany have been included in the food and feed code.²² However, it remains problematic as color pigments can be purchased in foreign countries without such regulations and are used in Germany for tattooing.¹² Health problems due to tattooing may result from dissolving and metabolization of pigments in the body.¹⁶

Given the data of this study, the average tattooed participant was female with a mean age of 35, had already one or 2 tattoos at the back that were applied at the age of 20 y and younger with a tattoo size of 20cm and more. Additionally she had no body

Questionnaire for tattooed participants

1. Birthday? _____

2. Postal code: _____

3. Gender? female male

4. How many tattoos do you have?
 0 1-2 3-5 6-10 >10

5. How old were you when you got your first tattoo?
 < 20 20-30 30-40 40-50 >50

6. What was your motivation to get a tattoo/ or a certain motif?

7. Where do you have a tattoo?
 Face Chest/Abdomen Back Legs Arms

8. Do you have coloured tattoos; if yes, which colour?
 no yes, _____

9. How big is your biggest tattoo?
 < 5cm 5-10 cm 10-15cm 15-20cm > 20cm

10. Did you already have complications after getting a tattoo?
 no yes, what kind? _____

11. Do you have piercings? no yes
 If yes, how many 1-2 3-4 5-6 7-8 9-10 >10
 If yes, where? Eyebrow Nose Tongue Lips belly button
 Genital area Ear corner of the mouth Tongue frenulum
 other body areas _____
 If yes, did you have any complications? no yes, what kind? _____

12. Do you have any severe diseases? Since when? no
 Tumor, what kind? _____
 Autoimmune disease, which kind? _____

Figure 1. Questionnaire for tattooed participants.

piercings, with exception of eventually one or 2 small ones in the ear lobes. No comorbidity, she is smoking approximately one package of cigarettes per day, takes no drugs and drinks alcohol not regularly. She is an

employee, unmarried and has no kids yet. She does not want to have the tattoo removed.

There are certain restrictions concerning this study. We surely accepted a selection bias as the participants

| | |
|---|--|
| <input type="checkbox"/> Hepatitis? | _____ |
| <input type="checkbox"/> HIV? | _____ |
| <input type="checkbox"/> Others | _____ |
| 13. Do you have allergies? | <input type="checkbox"/> no <input type="checkbox"/> yes |
| If yes, what kind? | |
| <input type="checkbox"/> Pollen | _____ <input type="checkbox"/> Grass _____ |
| <input type="checkbox"/> Food | _____ <input type="checkbox"/> animal fur _____ |
| <input type="checkbox"/> Medicine | _____ <input type="checkbox"/> Metalls _____ |
| <input type="checkbox"/> Domestic mites | <input type="checkbox"/> Latex _____ |
| <input type="checkbox"/> Others | _____ |
| 14. Did/Do you have any skin diseases? | <input type="checkbox"/> no |
| <input type="checkbox"/> Neurodermatitis | <input type="checkbox"/> Psoriasis <input type="checkbox"/> Acne <input type="checkbox"/> Urticaria |
| <input type="checkbox"/> Others | _____ |
| 15. Do you have any wound healing disorders? | <input type="checkbox"/> no <input type="checkbox"/> yes |
| 16. Do you have increased bleeding tendencies? | <input type="checkbox"/> no <input type="checkbox"/> yes |
| 17. Did/Do you have swollen lymph nodes? | <input type="checkbox"/> no <input type="checkbox"/> yes |
| 18. If yes, do you know why? | _____ |
| 19. Are you vaccinated? | <input type="checkbox"/> no, none of these |
| <input type="checkbox"/> Tetanus | <input type="checkbox"/> Hepatitis A <input type="checkbox"/> Hepatitis B <input type="checkbox"/> Influenza |
| 20. Do you smoke? | |
| <input type="checkbox"/> no | <input type="checkbox"/> yes, how much? _____ <input type="checkbox"/> stopped since _____ |

Figure 1. (Continued).

were primarily recruited among Facebook users and students. This probably led to the observation that more participants were tattooed and pierced as reported in the literature.^{25, 26} Internet-population is typically not representative for the whole population as not the whole population is using the Internet. This is called the “volunteer effect” as has to be taken into account also in the study presented herein²⁶ According to the observation of Stirn and colleagues the participants of our study were mostly female with a mean age in the middle of the third decade of life.¹ Nearly half of all participants in our study are employees. Due to the long-term follow-up of the newly-tattooed people herein, it was not as easy to collect participants for this part of the study. The small amount of people

limits the significance of cutaneous reactions reported, however, data are appropriate as a subject of discussion. We had mixed spectrum of participants: one who got their very first tattoo, some with several tattoos, and one person with a so-called “Japanese Body-suit,” in which most parts of the body were already covered in several single settings of tattooing.

Published data show that allergic reactions to red ink are the most prominent complication next to infections. A process of haptization seems to be responsible for formation of relevant allergens in the skin.²⁷

In the study herein, allergic reactions were not observed more frequently in red inked tattoos than in others. A potential explanation for this could be the

21. Do you have regular alcohol intake?
 no yes, how much? _____ stopped since _____

22. Do you take drugs?
 no yes, what kind? _____ stopped since _____

23. Do you need to take medicine regularly?
 no yes, what kind? _____

24. Do you go to the tanning booth regularly?
 no 1 x or less per month 2-3x per month 4x or more per month

25. What is your career?
 Trainee in managing position employee self-employed
 unemployed college student in school housewife
 others: _____

26. Family situation?
 single married divorced widowed

27. Do you have kids?
 no yes, how many? _____

28. How high is your annual income?
 < 10.000 € 10-20.000 € 20-30.000 € 30-40.000 €
 40-50.000 € > 50.000 €

29. How was the reaction of your frineds/family after getting a tattoo?
 very positive positive mediocre indifferent negative

30. Did/do you have any kind of career problems due to your tattooes?
 no yes, why? _____

31. Are most of your friends/ family members tattooed as well?
 no yes

32. When did you receive your last tattoo? _____

33. On a visual pain scale from 1 to 10, where 10 is the most painful and 1 is no pain at all, how severe was the pain during tattooing?
 1 2 3 4 5 6 7 8 9 10

34. Did you see any skin reaction right after tattoing?

Figure 1. (Continued).

high quality and control of tattoo inks in Germany in general.

A comparison between tattoos and piercings showed that piercings have a much higher rate of complications than tattoos depending on hygiene

regimens, the need of meticulous care, the materials used as well as site-specific problems.²⁸

In our study, we found 11.5% of the participants with self-reported tattoo complications prior to the current study and 28.2% with a complication after

| | | | |
|---|---|-------------------------------------|--|
| <input type="checkbox"/> Erythema | <input type="checkbox"/> Swelling | <input type="checkbox"/> Pain | <input type="checkbox"/> Hyperthermia |
| <input type="checkbox"/> Loss of function | <input type="checkbox"/> Incrustation | <input type="checkbox"/> Itching | |
| <input type="checkbox"/> Blistering | <input type="checkbox"/> Others | _____ | |
| 35. Did you see any skin reaction later on? | | | |
| <input type="checkbox"/> Erythema | <input type="checkbox"/> Swelling | <input type="checkbox"/> Pain | <input type="checkbox"/> Hyperthermia |
| <input type="checkbox"/> Loss of function | <input type="checkbox"/> Incrustation | <input type="checkbox"/> Itching | |
| <input type="checkbox"/> Blistering | <input type="checkbox"/> Others | _____ | |
| 36. Did you feel sick after getting a tattoo? | | | |
| <input type="checkbox"/> no | | | |
| <input type="checkbox"/> yes, with: | <input type="checkbox"/> Fever | <input type="checkbox"/> Shivering | <input type="checkbox"/> Swelling of lymph nodes |
| | <input type="checkbox"/> Cough | <input type="checkbox"/> runny nose | <input type="checkbox"/> Loss of efficiency |
| | <input type="checkbox"/> Others | _____ | |
| 37. Did you use any after care product? | | | |
| <input type="checkbox"/> no | <input type="checkbox"/> yes, what kind? | _____ | |
| 38. Did you use any pain killers after tattooing? | | | |
| <input type="checkbox"/> no | <input type="checkbox"/> yes, what kind and how much? | _____ | |
| 39. Did you use any other medicine? _____ | | | |
| 40. Did you ever think about getting a tattoo removal? | | | |
| <input type="checkbox"/> no | <input type="checkbox"/> yes, why? | _____ | |
| 41. Are you content with your tattoo and your choice of motif today? | | | |
| <input type="checkbox"/> yes | <input type="checkbox"/> no, why not? | _____ | |

Figure 1. (Continued).

getting a piercing. At defined parts of the body, full recovery of the skin after getting a piercing may require 6 to 9 months.⁸ Relevant disorders, allergies, skin diseases, regular pharmaceutical intake, and high-risk behavior, such as smoking, alcohol or drug abuse, were not observed in the participants of our study. Hence, this study did not compare substance abuse between tattooed people and people with no tattoos. We did not observe delayed wound healing disorders and complications after tattooing. 70 percent of our study participants were smokers. Because smoking

has a negative influence on effective wound healing, we considered smoking as risk factor. The same applies to regular alcohol or drug intake, but no one of the participants that stated regular alcohol or drug intake reported delayed or complicated wound healing. 15 percent of the participants used a solarium regularly. UV radiation is regarded as a further risk factor for skin reactions, although none of the persons with intensive tanning behaviors reported any complications. During the healing period, no participant was exposed to sunlight, so we cannot analyze this as a

Questionnaire for newly-tattooed individuals before tattooing

1. Birthday? _____

2. Postal code: _____

3. Gender? female male

4. How many tattoos do you have?
 0 1-2 3-5 6-10 >10

5. How old were you when you got your first tattoo?
 < 20 20-30 30-40 40-50 >50

6. What kind of motif do you want to get now?

7. Why do you want to get it? _____

8. Where do you want to get the tattoo?
 Face Chest/Abdomen Back Legs Arms

9. In which colour do you want to get it?
 black colorful, which one? _____

10. How big do you plan the new tattoo?
 < 5cm 5-10 cm 10-15cm 15-20cm > 20cm

11. Did you already have complications with other tattoos?
 no yes, what kind? _____

12. Do you have piercings? no yes
 If yes, how many 1-2 3-4 5-6 7-8 9-10 >10
 If yes, where? Eyebrow Nose Tongue Lips belly button
 Genital area Ear corner of the mouth Tongue frenulum
 other body areas _____
 If yes, did you have any complications? no yes, what kind? _____

13. Do you have any severe diseases? Since when? no
 Tumor, what kind? _____

Figure 2. Questionnaire for newly-tattooed individuals before tattooing.

risk factor. All participants who liked tanning avoided natural or artificial sunlight during the healing period.

Systemic viral infections, such as HIV and hepatitis C, were not noted in this study. There was only one

participant with an infectious hepatitis of unknown origin. Intravenous drug abuse is able to pass a high virus load from one person to another, whereas tattooing is only able to pass small amounts. Therefore, the

Autoimmune disease, which kind? _____

Hepatitis? _____

HIV? _____

Others _____

14. Do you have allergies? no yes

If yes, what kind?

Pollen _____ Grass _____

Food _____ animal fur _____

Medicine _____ Metals _____

Domestic mites _____ Latex _____

Others _____

15. Did/Do you have any skin diseases? no

Neurodermatitis Psoriasis Acne Urticaria

Others _____

16. Do you have any wound healing disorders? no yes

17. Do you have increased bleeding tendencies? no yes

18. Did/Do you have swollen lymph nodes? no yes

19. If yes, do you know why? _____

20. Are you vaccinated? no, none of these

Tetanus Hepatitis A Hepatitis B Influenza

21. Do you smoke?

no yes, how much? _____ stopped since _____

Figure 2. (Continued).

risk of being infected with an infectious viral disease by tattooing rather seems to be improbable.

There is no correlation between being tattooed and education.²⁵ Our study showed that even people in managing positions and those who were already retired had tattoos. Furthermore, a lot of college and university students participated. In contrast to Stirn et al. we included nearly 50% of participants with an annual income higher than 30.000 €. Because we did not limit the time span for skin reactions, we are not sure whether these complications were the results of a longer healing period or if they occurred years after getting the tattoo. In 2010 Klügl and colleagues compared the severity of skin reactions of tattooed

Germans. 6 percent stated persistent problems. Out of these, only 1.8% considered their complications as severe and 0.8% had to take medications to relieve their skin reactions.²⁶ Approximately 7 percent of our participants were not satisfied with at least one of their tattoos and thought about getting a tattoo removal, mostly because of a bad decision or bad tattooing skills of the artist. Only 0.5% of the participants wanted a tattoo removal due to skin reaction or bleaching out of the color.

One week after tattooing, all of the observed tattoos showed normal skin reactions after tattooing, where regeneration has to take place. No tattoo seemed to be infected or needed any further therapy than external

22. Do you have regular alcohol intake?
 no yes, how much? _____ stopped since _____

23. Do you take drugs?
 no yes, what kind? _____ stopped since _____

24. Do you need to take medicine regularly?
 no yes, what kind? _____

25. Do you go to the tanning booth regularly?
 no 1 x or less per month 2-3x per month 4x or more per month

26. What is your career?
 Trainee in managing position employee self-employed
 unemployed college student in school housewife
 others: _____

27. Family situation?
 single married divorced widowed

28. Do you have kids?
 no yes, how many? _____

29. How high is your annual income?
 < 10.000 € 10-20.000 € 20-30.000 € 30-40.000 €
 40-50.000 € > 50.000 €

30. How do you think the reaction of your friends/family is going to be after getting a tattoo?
 very positive positive mediocre indifferent negative

31. Did/do you have any kind of career problems due to your tattoos?
 no yes, why? _____

32. Are most of your friends/ family members tattooed as well?
 no yes

Figure 2. (Continued).

care. After one month, 6 (17.6%) persons experienced itching of the skin. No one specified the intensity of their symptoms or triggers. Theoretically, this could be a symptom for a foreign body reaction that no one seemed to have in this study. Tattoos that were placed on a body area with higher mechanical demand showed a longer healing period than usual, but no therapy was provided. After 3 months all tattoos were healed completely. Only one tattoo, located on the elbow, showed some discrete reddening and incrustation. Because there were no signs of an infection, we

did not initiate any further therapy than the usual care concept.

In summary, all of the tattoos in this study showed a normal healing course. Though some tattoos needed more time to heal than others, we observed no additional complications and did not have to intervene. Severe diseases, like allergies, are rare. Long-term skin complications are mostly related to cosmetic aspects and do not need any additional therapy. However, there remains uncertainty what happens to the tattoo color in the body. Therefore, the risk for long-term

Questionnaire for newly-tattooed participants after one week, one month, three months

1. Tattoo size
 < 5cm 5-10 cm 10-15cm 15-20cm > 20cm

2. On a visual pain scale from 1 to 10, where 10 is the most painful and 1 is no pain at all, how severe was the pain during tattooing?
 1 2 3 4 5 6 7 8 9 10

3. On a visual pain scale from 1 to 10, where 10 is the most painful and 1 is no pain at all, how severe was the pain now?
 1 2 3 4 5 6 7 8 9 10

4. Did you see any skin reaction after tattooing?
 Erythema Swelling Pain Hyperthermia
 Loss of function Incrustation Itching
 Blistering Others _____

5. Have you been in direct sunlight after getting the tattoo?
 No yes, how long? _____

6. Did you feel sick after getting a tattoo?
 no
 yes, with: Fever Shivering Swelling of lymph nodes
 Cough runny nose Loss of efficiency
 Others _____

7. How was the reaction of your frineds/family after getting the tattoo?
 very positive positive mediocre indifferent negative

8. Did you use any after care product?
 no yes, what kind? _____

9. Did you use any pain killers after tattooing?
 no yes, what kind and how much? _____

10. Did you use any other medicine? _____

Figure 3. Questionnaire for newly-tattooed participants after one week, one month, and 3 months.

problems remains. A good choice of motif, size, and body part is crucial for later content. More research and legal requirements are needed to make tattooing more secure worldwide.

The data of our study show that tattoos are widely accepted, and not used only by criminals, as general

prejudices may believe and not limited to lower educational status with reduced social integration. Intriguingly, tattoos are interesting for those people seeking popular body art or in other words with sensation-seeking behavior, esp university graduates and financially-secure individuals.

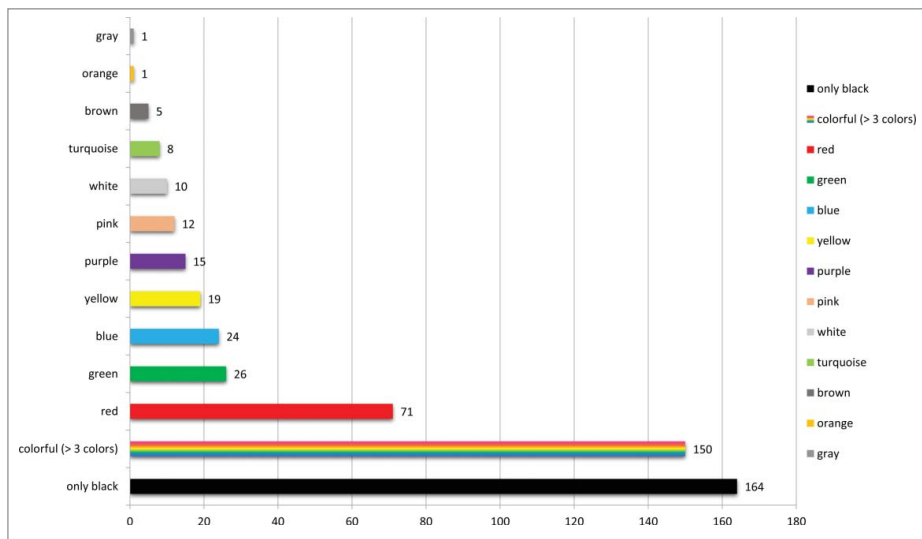


Figure 4. Frequency of different colors used in already tattooed individuals.

Material and methods

An anonymous online questionnaire was accessible between May 2013 and March 2014 to investigate tattoos, piercings, socio-epidemiological aspects and complications as possible risk factors for cutaneous side effects. The questionnaire was available online during that period at www.soscisurvey.de/tattoostudie2013. Social networks such as Facebook as well as printed flyers distributed at public places (university campus, public libraries, swimming pools, gyms, tanning booths, cafés and medical practices for dermatology) were used to announce the study. The participants of the study were divided into 2 groups: persons who already had a tattoo and those that got a

new one. Persons who already had a tattoo received a questionnaire containing 41 questions freely available online for everyone being tattooed and interested in participating in this study (Fig. 1). People who planned getting a new tattoo had to complete a questionnaire with 32 questions before getting the tattoo (Fig. 2) and an additional questionnaire (Fig. 3) with 10 questions after one week, one month, and 3 months. In addition, they had to document their tattoo by taking photographs. All participants needed a password to access the online questionnaires, so it was assured that only selected individuals who were also willing to do the 3 months follow-up were able to participate. All data were surveyed anonymously. The study had been approved by local ethics committee.

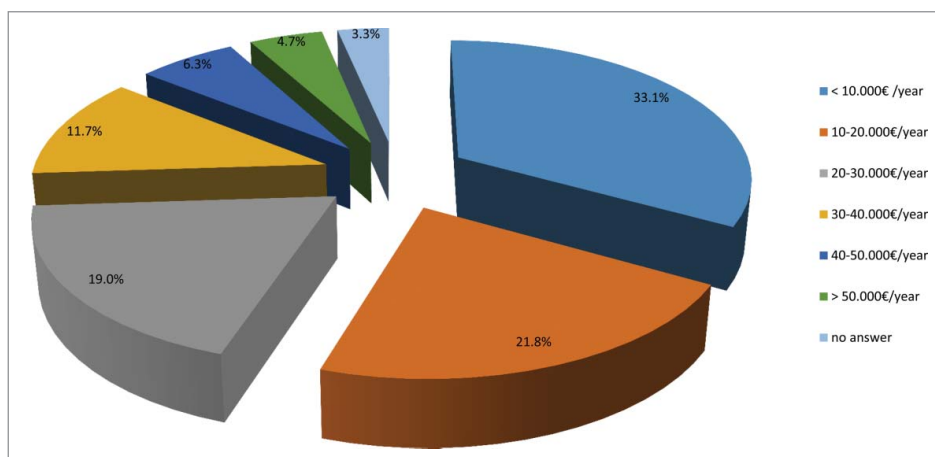


Figure 5. Frequency of annual income of the participants.

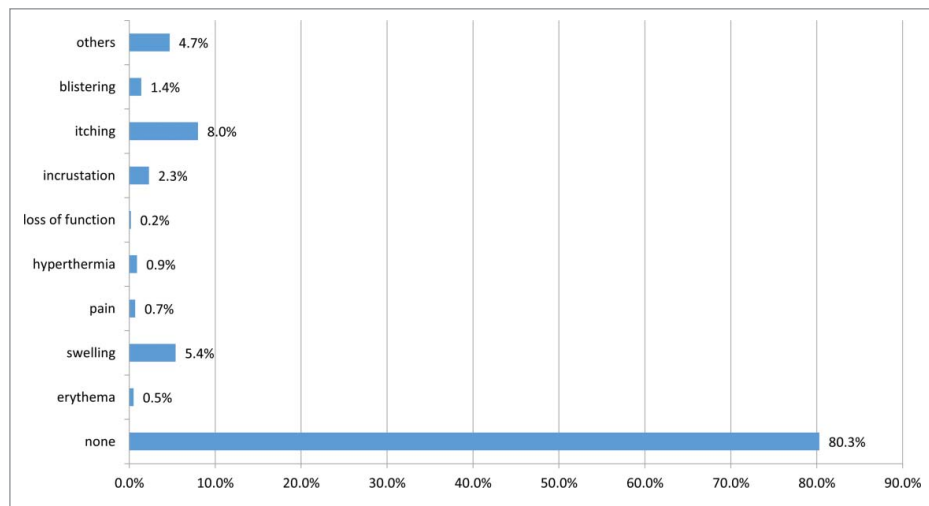


Figure 6. Frequency of distribution of delayed skin reactions.

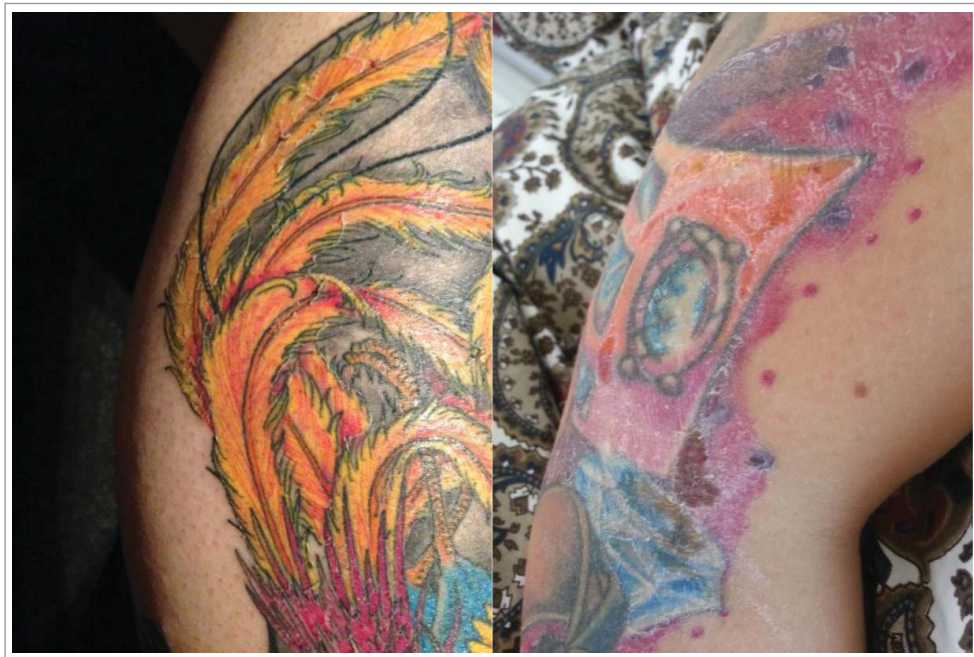


Figure 7. 2 tattoos one week after tattooing. Please note skin peels off (1) slightly and (2) severely.



Figure 8. Tattoo follow-up at a highly mechanically used body area. (Left) directly after tattooing (bright yellow, barely skin reaction), (Middle) 1 month later: color already intensely bleached out, sparse incrustation. (Right) 3 months later: completely healed skin, color intensely bleached out.

Statistical analysis

Statistical analysis was performed with SPSS17 for Windows (SPSS, GmbH, Munich, Germany).

Disclosure of potential conflicts of interest

No potential conflicts of interest were disclosed.

References

- [1] Stirn A, Brahler E, Hinz A. [Prevalence, sociodemography, mental health and gender differences of tattooing and body piercing]. *Psychother Psychosom Med Psychol* 2006; 56(11):445-9; PMID:17091447; <http://dx.doi.org/10.1055/s-2006-951817>
- [2] Brown KM, Perlmutter P, McDermott RJ. Youth and tattoos: what school health personnel should know. *J Sch Health* 2000; 70(9):355-60; PMID:11126997; <http://dx.doi.org/10.1111/j.1746-1561.2000.tb07273.x>
- [3] Goldstein N. Tattoos defined. *Clin Dermatol* 2007; 25(4):417-20; PMID:17697927; <http://dx.doi.org/10.1016/j.clindermatol.2007.05.015>
- [4] Sperry K. Tattoos and tattooing. Part I: History and methodology. *Am J Forensic Med Pathol* 1991; 12(4):313-9; PMID:1807141; <http://dx.doi.org/10.1097/0000433-199112000-00008>
- [5] Lozano AT, Morgan RD, Murray DD, Varghese F. Prison tattoos as a reflection of the criminal lifestyle. *Int J Offender Ther Comp Criminol* 2011; 55(4):509-29; PMID:20508085; <http://dx.doi.org/10.1177/0306624X10370829>
- [6] Cruz FA, Lage D, Frigério RM, Zaniboni MC, Arruda LH. Reactions to the different pigments in tattoos: a report of two cases. *An Bras Dermatol* 2010; 85(5):708-11; PMID:21152800; <http://dx.doi.org/10.1590/S0365-05962010000500019>
- [7] Kaur RR, Kirby W, Maibach H. Cutaneous allergic reactions to tattoo ink. *J Cosmet Dermatol* 2009; 8(4):295-300; PMID:19958434; <http://dx.doi.org/10.1111/j.1473-2165.2009.00469.x>
- [8] Kluger N, Cohen-Valensi R, Nezri M. Black lymph nodes—and a colourful skin. *Lancet* 2008; 371(9619):1214; PMID:18395584; [http://dx.doi.org/10.1016/S0140-6736\(08\)60529-2](http://dx.doi.org/10.1016/S0140-6736(08)60529-2)
- [9] Mataix J, Silvestre JF. [Cutaneous adverse reactions to tattoos and piercings]. *Actas Dermosifiliogr* 2009; 100(8):643-56; PMID:19775542; [http://dx.doi.org/10.1016/S0001-7310\(09\)72277-X](http://dx.doi.org/10.1016/S0001-7310(09)72277-X)
- [10] Kluger N, Koljonen V. Tattoos, inks, and cancer. *Lancet Oncol* 2012; 13(4):e161-8; PMID:22469126; [http://dx.doi.org/10.1016/S1470-2045\(11\)70340-0](http://dx.doi.org/10.1016/S1470-2045(11)70340-0)
- [11] Regensburger J, Lehner K, Maisch T, Vasold R, Santarelli F, Engel E, Gollmer A, König B, Landthaler M, Bäumler W. Tattoo inks contain polycyclic aromatic hydrocarbons that additionally generate deleterious singlet oxygen. *Exp Dermatol* 2010; 19(8):e275-81; PMID:20545755; <http://dx.doi.org/10.1111/j.1600-0625.2010.01068.x>
- [12] Schmitz I, Muller KM. [Elemental analysis of tattoo dyes—is there a potential risk from tattoo dyes?]. *J Dtsch Dermatol Ges* 2004; 2(5):350-3; PMID:16281523; <http://dx.doi.org/10.1046/j.1439-0353.2004.04755.x>
- [13] Vasold R, Engel E, König B, Landthaler M, Bäumler W. Health risks of tattoo colors. *Anal Bioanal Chem* 2008; 391(1):9-13; PMID:18327571; <http://dx.doi.org/10.1007/s00216-008-1978-z>
- [14] Brady BG, Gold H, Leger EA, Leger MC. Self-reported adverse tattoo reactions: a New York City Central Park study. *Contact Dermatitis* 2015; 73(2):91-9; PMID:26016445; <http://dx.doi.org/10.1111/cod.12425>
- [15] Risikobewertung BF. Anforderungen an Tätowiermittel. Stellungnahme Nr. 013/2013. Bundesinstitut für Risikobewertung (Hg.).
- [16] Engel E, Vasold R, Santarelli F, Maisch T, Gopee NV, Howard PC, Landthaler M, Bäumler W. Tattooing of skin results in transportation and light-induced decomposition of tattoo pigments—a first quantification in vivo using a mouse model. *Exp Dermatol* 2010; 19(1):54-60; PMID:19703227; <http://dx.doi.org/10.1111/j.1600-0625.2009.00925.x>
- [17] Gopee NV, Cui Y, Olson G, Warbritton AR, Miller BJ, Couch LH, Wamer WG, Howard PC. Response of mouse skin to tattooing: use of SKH-1 mice as a surrogate model for human tattooing. *Toxicol Appl Pharmacol* 2005; 209(2):145-58; PMID:15913690; <http://dx.doi.org/10.1016/j.taap.2005.04.003>
- [18] Braithwaite R, Robillard A, Woodring T, Stephens T, Arriola KJ. Tattooing and body piercing among adolescent detainees: relationship to alcohol and other drug use. *J Subst Abuse* 2001; 13(1-2):5-16; PMID:11547624; [http://dx.doi.org/10.1016/S0899-3289\(01\)00061-X](http://dx.doi.org/10.1016/S0899-3289(01)00061-X)
- [19] Drews DR, Allison CK, Probst JR. Behavioral and self-concept differences in tattooed and nontattooed college students. *Psychol Rep* 2000; 86(2):475-81; PMID:10840898; <http://dx.doi.org/10.2466/pr0.2000.86.2.475>
- [20] Heywood W, Patrick K, Smith AM, Simpson JM, Pitts MK, Richters J, Shelley JM. Who gets tattoos? Demographic and behavioral correlates of ever being tattooed in a representative sample of men and women. *Ann Epidemiol* 2012; 22(1):51-6; PMID:22153289; <http://dx.doi.org/10.1016/j.annepidem.2011.10.005>
- [21] Pajor AJ, Broniarczyk-Dyla G, Switalska J. Satisfaction with life, self-esteem and evaluation of mental health in people with tattoos or piercings. *Psychiatr Pol* 2015; 49(3):559-73; PMID:26276922; <http://dx.doi.org/10.12740/PP/27266>
- [22] Ekinçi O, et al. The association of tattooing/body piercing and psychopathology in adolescents: a community based study from Istanbul. *Community Ment Health J* 2012; 48(6):798-803; PMID:22438142; <http://dx.doi.org/10.1007/s10597-012-9509-y>
- [23] Kertzman S, Topcuoglu V, Sabuncuoglu O, Berkem M, Akin E, Gumustas FO. Interactions between risky decisions, impulsiveness and smoking in young tattooed women. *BMC Psychiatry* 2013; 13:278; PMID:24180254; <http://dx.doi.org/10.1186/1471-244X-13-278>

- [24] Stirn A, Hinz A, Brahler E. Prevalence of tattooing and body piercing in Germany and perception of health, mental disorders, and sensation seeking among tattooed and body-pierced individuals. *J Psychosom Res* 2006; 60 (5):531-4; PMID:16650594; <http://dx.doi.org/10.1016/j.jpsychores.2005.09.002>
- [25] Andreeva VA, Salanave B, Castetbon K, Deschamps V, Vernay M, Kesse-Guyot E, Hercberg S. Comparison of the sociodemographic characteristics of the large Nutri-Net-Sante e-cohort with French Census data: the issue of volunteer bias revisited. *J Epidemiol Community Health* 2015; 69(9):893-8; PMID:25832451; <http://dx.doi.org/10.1136/jech-2014-205263>
- [26] Eysenbach G, Wyatt J. Using the Internet for surveys and health research. *J Med Internet Res* 2002; 4(2): E13; PMID:12554560; <http://dx.doi.org/10.2196/jmir.4.2.e13>
- [27] Hutton Carlsen K, Køcks M, Sepehri M, Serup J. Allergic reactions in red tattoos: Raman spectroscopy for 'fingerprint' detection of chemical risk spectra in tattooed skin and culprit tattoo inks. *Skin Res Technol* 2016; 22 (4):460-469; PMID:26991512
- [28] Holbrook J, Minocha J, Laumann A. Body piercing: complications and prevention of health risks. *Am J Clin Dermatol* 2012; 13(1):1-17; PMID:22175301; <http://dx.doi.org/10.2165/11593220-000000000-00000>