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

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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 lifestyle. 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 participants 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 lifestyle. Nowadays being tattooed encompasses a kind of body art and displays a certain kind of lifestyle habit.

Introduction

Currently an estimated 10% of the general population and approximately 25% of the young adult population in Germany is tattooed. 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. The American Samuel O’Reilly, who invented the electric tattoo gun around 1890, set the trend to modern tattoo art. 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. Tattooing itself is a ritual that is thousands of years old and used in a number of cultures. 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. 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.
from the substances of content of the tattoo color.\textsuperscript{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.\textsuperscript{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.\textsuperscript{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.\textsuperscript{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.\textsuperscript{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.\textsuperscript{17} However, it is not the amount of pigment that causes a cutaneous reaction, but the ingredients itself.\textsuperscript{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 1961\textsuperscript{2}. 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.\textsuperscript{18-20} Intriguingly, there is still no consensus on impact of tattoos and piercings concerning risk factors, behavior or psychological 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,\textsuperscript{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.\textsuperscript{1, 22-24} A gender specific distribution in motivation and occurrence of body modification seems to exist, with women showing more sensation-seeking behavior.\textsuperscript{1} A generally accepted opinion concerning motivation for tattooing is widely negatively perceived conditions of life and reduced social behavior.\textsuperscript{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.\textsuperscript{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
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 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 piercing somewhere on their body.
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%) 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 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% |

| 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 | none |
| Chest, Abdomen | 145 | 17.1% | 103 female 41 male | 11 participants |
|  |  |  | One male One no answer | |
| Back | 244 | 28.8% | 195 female 44 male | 18 participants |
|  |  |  | 55 female 44 male | |
|  |  |  | Five no answer | |
| Legs | 212 | 25.1% | 155 female 54 male | 22 participants |
|  |  |  | Three no answer | |
|  |  |  | Three no answer | |
| Arms | 240 | 28.4% | 148 female 89 male | 17 participants |
|  |  |  | 89 male | |
|  |  |  | Three no answer | |

| 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 |
| Irritated skin for a long period | 20 | 4.7% | 15 female |
| Inflammation | 12 | 2.8% | 6 male |
| Wound healing disorders | 7 | 1.6% | 5 female |
| Allergy | 5 | 1.2% | 5 female |
| Color pigments bleached off | 5 | 1.2% | 4 female |

| 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 marihuana 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. However, it remains problematic as color pigments can be purchased in foreign countries without such regulations and are used in Germany for tattooing. Health problems due to tattooing may result from dissolving and metabolism of pigments in the body.

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
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

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**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 where 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 tattooes; if yes, which colour?
   □ no □ yes, __________________________
9. How big is your biggest tattoo?
   □ < 5cm □ 5-10 cm □ 10-15 cm □ 15-20 cm □ > 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? __________________________

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Figure 1. Questionnaire for tattooed participants.
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. 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 herein. 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. 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 haptenization seems to be responsible for formation of relevant allergens in the skin. 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
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
getting a piercing. At defined parts of the body, full recovery of the skin after getting a piercing may require 6 to 9 months. 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

Figure 1. (Continued).
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

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

| Question                                                                 | Options            |
|-------------------------------------------------------------------------|--------------------|
| 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 ☐, 5-10cm ☐, 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?                                                       |                   |
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. 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. 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...
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...
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 3. Questionnaire for newly-tattooed participants after one week, one month, and 3 months.
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 4. Frequency of different colors used in already tattooed individuals.

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.

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