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NATIONAL SURVEY OF HEALTH IN THE TATTOO INDUSTRY: OBSERVATIONAL STUDY OF 448 FRENCH TATTOOISTS

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Abstract
Objectives: The data regarding the health of professional tattooists is inexistent. Tattooists are usually heavily tattooed and exposed daily to body fluids and skin-to-skin contacts with customers, tattoo inks, solvents, allergens, irritants, and work for hours often in inadequate positions using vibrating tattoo machines. We analyzed the health status of active French professional tattooists. **Material and Methods:** An observational self-reported Internet survey was performed among 448 tattooists who were members of the French Tattoo Union in November 2013. **Results:** The main physical complaints were musculoskeletal: back pain (65%), finger pain (41.5%) and muscular pain (28.8%). Finger pain, back pain, muscular pain and carpal tunnel symptoms/tingling sensations on the fingers occurred among 88%, 61.5%, 68% and 84% of the cases after having started their activity ($p < 0.001$). Other chronic diseases, autoimmune diseases and cancers remained at a low level here. **Conclusions:** Professional tattooists have a high prevalence of musculoskeletal complaints about back pain due to repetitive movements, awkward postures and use of a vibrating tattoo machine. Tattooists have a unique environment that imply developing intervention and preventive strategies for them. Int J Occup Med Environ Health 2017;30(1):111–120

Key words:
Occupational diseases, Tattooing, Musculoskeletal diseases, Ink, Carpal tunnel syndrome, Raynaud phenomenon

INTRODUCTION

Permanent tattooing, i.e., the introduction of pigments and dyes in the dermis by puncturing the skin to obtain a design, has gained a tremendous popularity for the past 20–25 years. The prevalence of tattooed individuals in Europe, North America and Australia fluctuates from 10% to 20% according to studies [1–5].

Despite of the fact that it has been performed for centuries, tattooing is not a harmless procedure as it may lead to local cutaneous infections, potential sepsis and viral blood borne infections if performed with lack of hygiene. Furthermore, hypersensitivity reactions to tattoo color and chronic dermatoses of the tattoo area are also possible [6]. Besides, for the past years, concerns have been raised by the obscure market of ink manufacturing as metallic salts, potential carcinogenic or pro-carcinogenic compounds, and more recently nanoparticles have been found in tattoo inks in various toxicological studies [7–12].

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Today, it remains unknown whether tattoo ink ingredients may have any further effect on the overall human health beyond the skin when introduced by tattooing.

The profession of tattooists has boomed in parallel to the tattoo market. Even though being a tattooist is not still considered as a specific "profession" in France, tattoo shops or studios have flourished. Therefore, "professional" tattooists who work in tattoo shops constitute a peculiar group of interest for 2 reasons. First, they are usually heavily tattooed themselves and therefore are more likely to be exposed to a potential toxicity of tattoo inks. Second, they work usually several hours, on a daily basis, in close skin-to-skin contact with various customers, with potential exposure to body fluids (blood mainly) but also with specific allergens and irritants such as latex gloves, tattoo inks, disinfectants or solvents. The tattoo machine gun is a vibrating machine and when using it a tattooist has to stay in a specific position (on a chair bending over a customer). To our knowledge, the tattooists have never been studied from an occupational point of view. We have aimed to analyze the health status of French tattooists in an observational self-reported study, with special emphasis on the prevalence of systemic diseases and co-morbidities among this peculiar profession.

MATERIAL AND METHODS

Design

All the active tattooists, who were members of the French Tattoo Union (Syndicat National des Artistes Tatoueurs – SNAT), were invited by e-mail to take part in the Internet study regarding their health and their professional activity. No individual, even from the tattoo industry, with no direct tattooing activity was invited to take part.

A standardized questionnaire was available on Google. Answers were collected from 5 November till 30 November 2013 on an Excel file. Participants were free to take part in the study, questionnaires were anonymous and no incentive was given in exchange for participation to this study. No institutional review board approval was sought for this study. We enquired about social and demographic data (gender, age, marital status, children), health behaviors (diet, sport activities, tobacco and alcohol consumption), and tattooing activity (years of tattooing practice, frequency of tattooing times per week and hours per day). The medical history of each tattooist was investigated by asking them whether they had had certain diseases and conditions, and if so, whether those were diagnosed or appeared, before or after having started to be a tattooist. When necessary, the disease was explained in a simple understandable way under brackets with the questions. We also inquired about the presence of own tattoos (tattooed body surface in percent, presence of colors or not, year of the first tattoo) and the occurrence of complications on their tattoos (data not shown as under publishing).

Statistical analysis

The statistical analysis was conducted with SPSS Statistics 19 (IBM, USA). Patients' characteristics are presented as means (M) and standard deviations (SD) for continuous variables and as frequencies and proportions for categorical variables. Patients' characteristics were compared using the Chi^2 test for categorical variables. Mann-Whitney U test was used for comparing the workload (daily activity) and the occurrence of musculoskeletal symptoms. Statistical significance threshold was set at $p < 0.05$.

RESULTS

Out of the 1000 tattooists of the French union, who had been contacted via e-mail, we received 451 questionnaires (the response rate at 45%). Three questionnaires were excluded as one respondent accidentally resubmitted her answers 3 times and one was totally incomplete. Overall, 448 questionnaires were analyzed: 98 of the respondents were women (21.9%) and 350 men (78.1%, sex ratio 3.6:1). The respondents' characteristics are summarized

in the Table 1. Briefly, 78% of the respondents were aged 25–45 years old. Eighty percent were in a relationship or married (356/445). More than a half of them were active smokers (55.8%, 250/448) and only 17.6% (79/448) had never smoked. They had been tattooists for a M±SD of 11.5±7.7 years, worked 5.1±1.5 h daily, ≥ 4 days a week (89.5%). The women had significantly fewer years of tattoo experience than men (9.3±6.4 years vs. 12.1±7.9 years, p = 0.002). All but one were tattooed themselves (99.8%). They could be considered as being largely tattooed as the mean tattooed area covered approximately 1/3 of their body surface.

The self-reported co-morbidities, diseases and physical symptoms of the tattooists are summarized in the Table 2. For this section, respondents could only answer whether they had a symptom or a disease. A non-response was considered to indicate that the individual was symptom or disease free.

Table 1. Demographic characteristics of the tattooists in France, 2013

Characteristics	Respondents
Sex (N = 448) [n (%)] (ratio 3.6:1)	
men	350 (78.1)
women	98 (21.9)
Age group (N = 448) [n (%), men:women]	
16–25 years	23 (5.1), 1.3:1
26–35 years	143 (31.9), 1.8:1
36–45 years	203 (45.3), 6.5:1
46–55 years	68 (15.2), 7.5:1
56–65 years	11 (2.5), 4.5:1
Marital status (N = 445) [n (%)]	
single	69 (15.5)
in a relationship	200 (44.9)
maried	156 (35.0)
divorced	19 (4.3)
widowed	1 (0.2)
One or more children (N = 448) [n (%)]	272 (60.7)
Diet (N = 338) [n (%)]	
none	278 (82.2)
vegetarian and derivated	30 (8.9)
sport diet	19 (5.6)
miscellaneous	11 (3.3)
Sports activity (N = 446) [n (%)]	
never/hardly ever	130 (29.1)
occasionnaly (1–3 times/month)	131 (29.4)
regularly (at least once/week)	131 (29.4)
intensively (several times/week or competitions)	54 (12.1)
Tobacco smoking (N = 448) [n (%)]	
active smoker	250 (55.8)
past smoker	119 (26.6)
active or past smoker	369 (82.4)
non smoker	79 (17.6)
Alcohol (N = 448) [n (%)]	
never/less than once a month	169 (37.7)
once a week	160 (35.7)
several times a week	119 (26.6)
Tattooing activity (M±SD (range))	
overall [years]	11.5±7.7 (1–55)
daily [h/day]	5.1±1.5 (1–12)
Tattooing frequency (N = 447) [n (%)]	
< 4 times/month	3 (0.7)
1–2 weeks/month	1 (0.2)
2–3 days/week	43 (9.6)
4–5 days/week	290 (64.9)
6–7 days/week	110 (24.6)
< 4 days/week	47 (10.5)
≥ 4 days/week	400 (89.5)
Tattooists with ≥ 1 tattoos (N = 448) [n (%)]	447 (99.8)

N – number of respondents.
M – mean; SD – standard deviation.

Table 2. Self-reported co-morbidities and diseases among the tattooists in France, 2013

Co-morbidity/Disease	Respondents who fell sick [n (%)]		
	total (N = 448)	before starting the tattooing activity	after having started the tattooing activity
Cardio-vascular co-morbidities			
hypertension	31 (6.9)	24 (5.3)	7 (1.6)
overweight/obesity	89 (19.9)	58 (13.0)	31 (6.9)
Non-insulin dependent diabetes	4 (0.8)	3 (0.6)	1 (0.2)
insulin dependent diabetes	2 (0.4)	1 (0.2)	3 (0.6)[b]
dyslipidemia	10 (2.2)	3 (0.6)	7 (1.6)
Respiratory diseases			
asthma	38 (8.5)	36 (8.1)	2 (0.4)
chronic bronchitis	23 (5.1)	20 (4.4)	3 (0.7)
Allergies			
allergic rhinitis, sinusitis, conjunctivitis	66 (14.7)	57 (12.7)	9 (2.0)
allergic contact eczema	22 (4.9)	15 (3.3)	7 (1.6)
atopic dermatitis	16 (3.6)	16 (3.6)	0 (0)
Rheumatic diseases			
finger pain	186 (41.5)	22 (4.9)	164 (36.6)
back pain	292 (65.2)	112 (25.0)	180 (40.0)
back arthrosis	20 (4.5)	10 (2.3)	10 (2.2)
muscular pain	129 (28.8)	41 (9.2)	88 (19.6)
carpal tunnel syndrome/tingling sensations in fingers	90 (20.1)	14 (3.1)	76 (17.0)
Raynaud phenomenon[a]	30 (6.7)	19 (4.2)	11 (2.5)
Vision and hearing problems			
vision issues (presbytia, myopia, astigmatism)	187 (41.7)	91 (20.3)	96 (21.4)
hear loss	68 (15.2)	36 (8.1)	32 (7.1)
tinnitus and acouphenes	54 (12.1)	21 (4.7)	33 (7.4)
cephalagias/migraines	101 (22.5)	57 (12.7)	44 (9.8)
Depressive symptoms	44 (9.8)	31 (6.9)	13 (2.9)
Hepatitis B or C	9 (2.0)	8 (1.8)	1 (0.2)
Auto-immune/inflammatory diseases	5 (1.1)	2 (0.4)	3 (0.7)
Cancer			
skin cancer	2 (0.4)	1 (0.2) (type not specified)	1 (0.2) (melanoma)
other cancer	3 (0.7)	1 (0.3) (thyroid at the age of 11)	2 (0.4) (testicule, tongue)
leukemia	0 (0)	0 (0)	0 (0)
lymphoma	2 (0.4)	0 (0)	2 (0.4) (Hodgkin lymphoma, non Hodgkin lymphoma)

[a] Raynaud phenomenon was presented in the questionnaire as "Raynaud phenomenon (blanching of the fingers or "dead" fingers to cold)."
[b] Including 2 respondents with previous non-insulin dependent diabetes.

Overall, the main physical complaints were musculoskeletal pain: back pain (65%), finger pain (41.5%) and muscular pain (28.8%). Besides, 41.7% had vision issues (presbytia, myopia, astigmatism). The occurrence of the musculoskeletal symptoms appeared more frequently after having started the tattooing activity. Thus, finger pain occurred among 88% of the cases (164/186) during the professional activity. Similar high results included back pain, muscular pain and carpal tunnel symptoms/tingling sensations on the fingers in 61.5% (180/292), 68% (88/129) and 84% (76/90), respectively. Finger, back, muscle pain and carpal tunnel symptoms/tingling sensations on the fingers occurred significantly more ($p < 0.001$) after having started their activity than before.

On the other hand, there was no difference for Raynaud phenomenon/blanching of the fingers or "dead" fingers to cold ($p = 0.172$). The prevalence of finger and back pain was significantly more frequent among female tattooists as compared to males: 51% (50/98) vs. 32% (114/350), $p = 0.001$ and 51% (50/98) vs. 37% (130/350), $p = 0.013$, respectively. When comparing the overall workload, we did not find any difference in the prevalence of musculoskeletal symptoms between the tattooists working ≥ 4 days of week and those working less (Table 3). However, when comparing the number of hours the artist spent tattooing daily (Table 4), we found a statistical significant association with the occurrence of Raynaud phenomenon/blanching

Table 3. Musculoskeletal symptoms among the tattooists in France, 2013, by tattooing activity in a week

Symptom	Respondents [n (%)]		
	total (N = 447)	tattooing activity < 4 days/week (N = 47)	tattooing activity ≥ 4 days/week (N = 400)
Muscle pain	88	8 (17)	80 (20)
Back pain	180	18 (38)	162 (40)
Finger pain	164	16 (34)	148 (37)
Carpal tunnel syndrome/Tingling sensation in fingers	76	12 (25)	64 (16)
Raynaud phenomenon[a]	11	1 (2)	10 (2)

[a] As in Table 2.

Table 4. Musculoskeletal symptoms among the tattooists in France, 2013, by daily tattooing activity[1]

Symptom	Work time [h/day] (M±SD)		p
	tattooists without symptoms	tattooists with symptoms	
Muscle pain	5.10±1.5	5.0±1.4	0.808
Back pain	4.95±1.4	5.2±1.5	0.053
Finger pain	5.15±1.6	5.0±1.3	0.792
Carpal tunnel syndrome/Tingling sensation in fingers	5.10±1.5	4.9±1.6	0.214
Raynaud phenomenon[a]	5.00±1.4	6.5±2.4	0.017*

[1] Data analyzed by Mann-Whitney U test.
* $p < 0.05$.
Other abbreviations as in Table 1 and 2.

Table 5. Musculoskeletal symptoms among the tattooists in France, 2013, by tobacco smoking[1]

Symptom	Respondents [n (%)]			p
	total (N = 448)	active smokers (N = 250)	past or never smokers (N = 198)	
Muscle pain	129	70 (28)	59 (29)	n.s.
Back pain	292	165 (66)	127 (64)	n.s.
Finger pain	186	103 (41)	83 (42)	n.s.
Carpal tunnel syndrome/Tingling sensation in fingers	90	52 (21)	38 (19)	n.s.
Raynaud phenomenon[a]	30	20 (8)	10 (5)	n.s.

[1] Data includes symptoms before and after having started the tattooing activity as the onset of smoking habit is unknown, analyzed by the Chi² test.
[a] As in Table 2.
n.s. – not statistically significant.

of the fingers ($p = 0.017$), but not with muscle pain, finger pain, back pain or canal tunnel syndrome/tingling sensation of the fingers ($p > 0.05$). Tobacco smoking was not associated with any musculoskeletal symptoms (Table 5).

Only one tattooist reported that he may have been infected by hepatitis B or C after tattooing. An auto-immune disease after having started their professional activity was diagnosed for 3 tattooists (lupus (N = 2), Basedow disease (N = 1)). Four tattooists (0.8%) were diagnosed with cancer during their activity: 2 – with lymphoma, 1 – with testicular cancer, and 1 – with tongue cancer. However, in our study, the time span between the beginning of the activity as a tattooist and the diagnosis of the disease or the beginning of the symptoms was not collected. Therefore, we could not perform any statistical analysis in relation to the duration of the activity or the age of the tattooist.

DISCUSSION

Health issues and risks related to tattooing have been the centre of attention for several years now. However, research has mainly explored the complications and (potential) risks for the customers [13]. "Professional" tattooists may be seen as a high-risk group due to their occupational exposure. During their daily activity, they are in constant contact with inks, solvents, disinfectants, and body fluids (mainly blood) and in close skin-to-skin contact with the customers. Often do they have to stay several hours in "uncomfortable" and sometimes awkward positions (Photo 1), bended over the customers, working with strong lights. The tattoo machine gun is a vibrating hand with a rotating speed ranging 3000–35 000/min that produces a low decibel (15 dB) but constant buzzing noise. Lastly, as they are completely immerged in the tattoo culture, they are quite often "heavily" tattooed themselves.

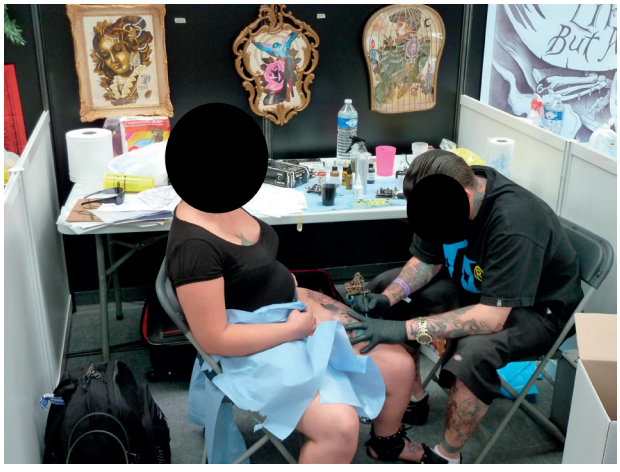

Photo 1. Non-ergonomic tattoo work station in a tattoo convention and uncomfortable position of the tattooist during a session that may last for hours

Therefore the tattooist profession is of peculiar interest as they could be thought to be in the first line to develop complications related to their tattoo practices and tattoo inks especially. The results of this study comprise the largest occupational study related to professional tattooists in France. Such a study has never been performed elsewhere before, according to the best of our knowledge.

Tattooing is still a man's job as illustrated by the sex ratio of 3.6:1. This male predominance arises from the past cultural history of tattooing which involved mainly men (sailors, soldiers, etc.), and in general in any pictorial art, like painting, artists were formerly mostly men. However, a progressive feminization of the profession has to be expected. Indeed, in our study, female tattooists were here more frequent in the youngest group (sex ratio stood at 1.7 among 16–35 year-olds) and they were significantly younger in terms of tattoo experience in our series (9 years vs. 12 years).

Tattooing is also a "recent" activity as 83% of the respondents are aged < 45 years old. Tattooists form a growing and trendy professional group. This may be explained by the popularity of tattoos that has been growing for the past 20 years, on top of the recent celebrities' craze for tattoos, extensive media and social media coverage, and moreover even TV channels broadcast reality shows dedicated to tattooing. More importantly, tattooing requires no qualifying diploma and anyone may become a tattooist, as the material may be bought over the Internet, and open a tattoo shop respecting local regulations.

Most of the tattooists were active smokers (55.8%). Smoking predominance (active smoking or early smoking behaviors) among tattooed individuals had already been observed in other series [5,14]. Less than a third of the surveyed acknowledged consuming alcohol several times a week. However, we did not quantify the alcohol consumption, the type of alcohol consumed (wine, strong alcohol) and when during the week alcohol was mainly consumed. We did not inquire about recreational drug intake in this study.

The main physical complaints concerned symptoms related to musculoskeletal pain as a result of repetitive movements and/or inadequate postures on the workstation. Although aging may be a possible confounding factor, back and finger pain complaints after having started to be a tattooist were the most prevalent in the age group of 25–35-year-old tattooists (Table 6). We noted a trend, but without statistical significance, between back pain complaint and daily tattooing time activity (Table 4). Musculoskeletal disorders due to postural overload are nothing new to tattooists but they appear to be an overlooked health issue and should be considered as "occupational" diseases among tattooists. Tobacco smoking has been reported in the literature to be associated with musculoskeletal disorders [15] but we have failed to find any association in our study. Education by the means of ergonomic interventions and mobility/flexibility exercises is necessary to improve job postures. In this respect, ergonomic sitting devices for tattoo artists have been developed by the Umeå Institute of Design, Sweden [16].

Besides, our study suggests that the repeated flexing of the fingers and wrist added to the prolonged use of the vibrating tattoo machine gun is associated with carpal tunnel syndrome/tingling sensations of the fingers among tattooist. In order to detect the maximum of patients with possible carpal tunnel syndrome symptoms, we asked the tattooists whether they had or had not "carpal tunnel syndrome/tingling sensation of the fingers." Therefore we may have overestimated the number of cases with positive responses non-related to carpal nerve compression. Tingling of the fingers may be related to other conditions such as a cervical degenerative disc. Spinal X-rays, clinical/neurophysiological studies with electromyogram and a control group would help in estimating the true prevalence of carpal tunnel syndrome among tattooists. We also observed that tattooists who had longer time of tattooing activity (6.5 h/day, Table 4) were more at risk of complaining of Raynaud phenomenon/blanching of the fingers to

Table 6. Musculoskeletal symptoms among the tattooists in France, 2013, by age

Symptom	Respondents [n (%)]					
	total (N = 448)	16–25 years old (N = 23)	26–35 years old (N = 143)	36–45 years old (N = 203)	46–55 years old (N = 68)	> 55 years old (N = 11)
Muscle pain	88	4 (17.4)	35 (24.4)	32 (15.7)	15 (22.0)	2 (18.1)
Back pain	180	7 (30.4)	67 (47.0)	77 (38.0)	25 (36.8)	4 (36.7)
Finger pain	164	11 (47.8)	64 (44.7)	63 (31.0)	23 (39.6)	3 (27.2)
Carpal tunnel syndrome/ Tingling sensation in fingers	76	4 (17.4)	29 (20.3)	30 (14.8)	10 (14.7)	3 (27.2)
Raynaud phenomenon[a]	11	0 (0)	3 (2.0)	3 (1.5)	3 (4.4)	2 (18.1)

[a] As in Table 2.

cold. All these suggest that tattooists may be more at risk of experiencing vibration-induced injury related to the vibrating tattoo machine gun.

Apart from the musculoskeletal system disorders and symptoms, we screened for a wide number of general conditions including cardio-vascular, respiratory, allergic, auto-immune diseases and cancer. Except for tobacco consumption, the tattooists did not self-report any excess of cardiac-vascular, lung or allergic diseases. We did not find an excess of hearing symptoms complaints despite the constant buzzing of the machine. This could be explained as the noise reaches only a low level of decibels. Lastly, the prevalence of autoimmune disease and cancer was rather low in our series, which is reassuring regarding the potential carcinogenicity of tattoo inks.

Our study was based on a self-reported Internet survey. By experience, the easiest way to reach tattooed individuals is by phone or by means of the Internet surveys as illustrated before [1–3]. Due to its design, limitations of our study include potential bias of recollection, misunderstanding of the questions, misinterpretation of the own symptoms by the tattooists and the lack of clinical examination by a physician. As any observational study, we lack a control group. As the study was open to all the members of the tattoo union, we may have selected the most motivated tattooists willing to share their experience and also maybe the "healthiest" ones. The tattoo syndicate in France represents approximately 1/3 of the overall number of professional tattooists.

Although unlikely, we cannot rule out a possible underestimation of the prevalence of the complications. In our experience, there is a lot of mistrust from the tattooists toward doctors and medical studies, as tattooists often feel stigmatized by psychological studies regarding risk factors associated with tattooing. To increase the response rate as much as possible, we decided to avoid some questions such as "drug intake" and the questionnaire was designed to be as simple as possible.

Besides, symptoms and co-morbidities could be related to other factors that have nothing to do with the tattooist's activity. Tattooists are exposed to bloodborne pathogen such as hepatitis viruses and human immunodeficiency virus (HIV) [17]. We did not inquire about the hepatitis B virus status of the tattooists. We agree that the lack of standardized clinical and biological parameters is detrimental. Despite such limitations, we gathered almost 450 respondents and an acceptable response rate for such a study (45%). This study allows us to get a glimpse of the health status of the tattooists.

CONCLUSIONS

Until now, there has been no current data regarding the health of professional tattooists, while they are exposed to inks, human contacts, a vibrating machine gun and adopt awkward postures for several hours daily. We have found a high prevalence of musculoskeletal complaints related to inadequate postures at the workstation and vibration related symptoms during tattooing stressing the importance of preventive measures. Tattooists should be considered to represent a specific profession with its own risks. We have not been able to identify any dismal health consequences related to tattoo inks in our material but further studies on this specific topic with an ergonomic assessment are certainly warranted before definite conclusions can be drawn.

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