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Analiza powikłań celowej pigmentacji skóry z uwzględnieniem poziomu wiedzy na temat związanych z nią zagrożeń zdrowotnych w wybranych populacjach

ROZPRAWA NA STOPIEŃ DOKTORA NAUK MEDYCZNYCH

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Spis treści

I. Wstęp

1. Etiologia i epidemiologia powikłań celowej pigmentacji skóry

Popularność i społeczna akceptacja tatuaży znacząco wzrosła w ostatnich latach, szczególnie w populacji osób młodych [1]. Tatuowanie jest najczęściej wykonywane w celach ozdobnych jako tzw. tatuaż lub mikropigmentacja skóry określana potocznie terminem: makijaż permanentny (PMU, *ang. permanent make-up*). Szacuje się, że około 20-30% mieszkańców krajów zachodnioeuropejskich posiada przynajmniej jeden tatuaż [2]. Celowa pigmentacja skóry znajduje coraz szersze zastosowanie ze wskazań pozaestetycznych i jest określana terminem dermatografii medycznej [3].

Procedura celowej pigmentacji skóry jest zabiegiem polegającym na przerwaniu ciągłości tkanek i wprowadzeniu do organizmu mieszanin różnych związków chemicznych, co wiąże się z ryzykiem komplikacji zdrowotnych [4]. Powikłania tatuaży manifestują się zmianami morfologicznymi i/lub powodują dolegliwości subiektywne o nasileniu skłaniającym pacjentów do szukania pomocy medycznej [5]. Najczęściej obserwuje się zmiany skórne, które niekiedy mogą współistnieć z objawami ogólnoustrojowymi [6].

Gwałtownie rozwijający się rynek tatuatorski, niska świadomość społeczna dotycząca ryzyka zdrowotnego celowej pigmentacji skóry, brak standaryzacji składów substancji barwiących używanych do tatuowania oraz niedostateczne kwalifikacje osób wykonujących zabiegi naruszające ciągłość tkanek prowadzi do coraz częstszego występowania powikłań zdrowotnych tatuaży. Niektórym z nich można zapobiec poprzez poprawę świadomości ryzyka zdrowotnego zarówno wśród osób poddającym się zabiegom pigmentacji skóry, jak i osób zajmujących się ich wykonywaniem [7,8].

2. Podział i obraz kliniczny powikłań celowej pigmentacji skóry

Najczęściej obserwowane skórne powikłania tatuowania to miejscowe odczyny alergiczne, zapalne reakcje w czarnych tatuażach, infekcje, wysiewy niektórych dermatoz w miejscu pigmentacji, bliznowacenie, powikłania neurosensoryczne, czy odczyny fototoksyczne [9,10]. Tatuaże mogą uniemożliwić lub znacznie utrudnić przeprowadzanie niektórych badań diagnostycznych [11,12]. Szczegółowy podział komplikacji zdrowotnych związanych z celową pigmentacją skóry przedstawiono w tab. 1.

Powikłania infekcyjne

Uszkodzenie bariery naskórkowo-skórnej, powstające podczas celowej pigmentacji skóry sprzyja przeniesieniu patogenów zarówno w trakcie jak i po zabiegu [13]. Najczęściej obserwuje się powierzchowne infekcje bakteryjne ograniczone do wytatuowanej skóry, wywołane przez powszechnie występujące patogeny, takie jak *Staphylococcus aureus,* czy *Streptococcus pyogenes* [14]. Infekcje wirusowe w obrębie tatuaży mogą być wywołane przez wirusa brodawczaka ludzkiego (HPV, *Human Papilloma Virus*), wirusa mięczaka zakaźnego (MCV, *Molluscum Contagiosum Virus*) i wirusa opryszczki (HSV, *Herpes Simplex Virus*) [15]. Sporadycznie opisywane są przypadki zakażeń atypowymi bakteriami (m.in. *Mycobacterium spp.*), grzybic oraz infestacji pasożytniczych w miejscu pigmentacji [16–18].

Reakcje alergiczne

Wśród odczynów alergicznych w tatuażach dominują ostre reakcje wypryskowe i przewlekłe reakcje nadwrażliwości ograniczone do jednego koloru pigmentu. Pierwsze charakteryzują się zmianami skórnymi obejmującymi cały obszar wytatuowanej skóry, oraz pojawieniem się w krótkim odstępie czasu od tatuowania [19]. Przewlekłe reakcje nadwrażliwości mogą wystąpić po kilku tygodniach, miesiącach, czy nawet latach od zabiegu celowej pigmentacji skóry, a zmiany skórne lokalizują się zazwyczaj w jednym kolorze

tatuażu. Zdecydowana większość odczynów dotyczy alergii na czerwony pigment [20]. Reakcje te mogą prezentować zróżnicowany obraz kliniczny. Najczęściej stwierdza się uniesienie czerwonych fragmentów tatuażu ponad powierzchnie skóry i/lub pogrubienie i delikatne złuszczanie w tych miejscach. Rzadziej może dojść do nasilonej hiperkeratozy, a nawet powierzchownego rozpadu (owrzodzenia) [21]. Zmianom zwykle towarzyszy przewlekły świąd i bolesność, wpływając negatywnie na jakość życia pacjentów [22].

Przewlekłe reakcje zapalne w czarnych tatuażach, CIBTR (ang. Chronic Inflammatory Black Tattoo Reactions)

Przewlekłe reakcje zapalne czarnych tatuażach mogą być ograniczone wyłącznie do skóry lub towarzyszyć chorobie układowej [23]. Zmiany skórne mają zazwyczaj charakter bezobjawowych grudek i guzków, obejmujących całą powierzchnie lub tylko niektóre fragmenty tatuażu [24]. W badaniu histopatologicznym stwierdza się cechy zapalenia ziarniniakowego (nieserowaciejące ziarniniaki skupione wokół cząsteczek pigmentu) [25]. Reakcje mogą pojawić się w różnym odstępie czasowym od tatuowania, nawet wiele lat od zabiegu. Kliniczne znaczenie przewlekłych reakcji zapalnych w czarnych tatuażach jest znamienne, ponieważ mogą stanowić one pierwszą manifestację sarkoidozy układowej lub zespołu TAGU (*ang. Tattoo Associated Granulomas and Uveitis),* czyli związanych z tatuażami ziarniniaków i zapalenia błony naczyniowej oka [26].

Wysiew przewlekłych dermatoz

Przewlekłe dermatozy nie stanowią bezwzględnego przeciwwskazania do zabiegu celowej pigmentacji skóry, jednak nie powinno się go wykonywać w trakcie aktywnej fazy choroby oraz podczas leczenia immunosupresyjnego [27]. Wysiew zmian skórnych w przebiegu przewlekłych dermatoz zapalnych m.in. łuszczycy, liszaja płaskiego, bielactwa, tocznia rumieniowatego czy liszaja twardzinowego może pojawić się w miejscu nowo wykonanego

tatuażu lub makijażu permanentnego [28]. Zjawisko to przebiega w mechanizmie objawu Koebnera, polegającego na pojawieniu się nowych zmian na skórze kilka dni po zadziałaniu urazu mechanicznego w danej okolicy [29].

Nowotwory i znamiona w tatuażu

Choć w literaturze istnieją doniesienia na temat złośliwych nowotworów rozwijających się na podłożu tatuażu, nie potwierdzono dotychczas związku epidemiologicznego pomiędzy tatuowaniem a częstszym występowaniem nowotworów skóry [30]. W praktyce klinicznej często obserwuje się występowanie znamion i łagodnych guzów na wytatuowanej skórze. Tatuaże mogą maskować obraz kliniczny i dermoskopowy zmian skórnych, co może prowadzić do opóźnienia w rozpoznaniu nowotworów skóry, zwłaszcza czerniaka [31].

Inne powikłania

Pozostałe powikłania celowej pigmentacji skóry to m.in. bliznowacenie, reakcje neurosensoryczne i fototoksyczne, defekty estetyczne spowodowane aplikacją tuszu (migracja barwnika, przeładowanie pigmentem, utrata koloru pigmentu), powikłania związane z usuwaniem tatuażu, utrudnienia w przeprowadzeniu niektórych badań diagnostycznych, czy zaburzenia psychospołeczne związane z posiadanym tatuażem [9,10].

Tabela 1. Powikłania zdrowotne celowej pigmentacji skóry

Infekcje	**Reakcje alergiczne**	**Przewlekłe reakcje zapalne w czarnych tatuażach**
• bakteryjne • wirusowe • grzybicze • pasożytnicze	• ostre reakcje wypryskowe • przewlekłe reakcje nadwrażliwości ograniczone do jednego koloru tatuażu • reakcje anafilaktoidalne	• zapalenie ziarnianiakowe ograniczone do skóry • sarkoidoza • związane z tatuażem ziarniniaki i zapalenie błony naczyniowej oka
Wysiew przewlekłych dermatoz	**Nowotwory i znamiona w tatuażu**	**Inne**
• łuszczyca • liszaj płaski • bielactwo • toczeń rumieniowaty • liszaj twardzinowy • ziarniniak obrączkowaty	• znamiona melanocytarne • łagodne nowotwory skóry • czerniak • rogowiak kolczystokomórkowy • raki skóry	• bliznowacenie • reakcje neurosensoryczne • reakcje fototoksyczne • defekty estetyczne spowodowane aplikacją tuszu • utrudnienie niektórych badań diagnostycznych • powikłania związane z usuwaniem tatuażu/PMU • powikłania psychospołeczne

3. Diagnostyka powikłań celowej pigmentacji skóry

Przy podejrzeniu przewlekłej zapalnej reakcji w czarnych tatuażach konieczne jest pobranie biopsji ze zmian skórnych [24]. Stwierdzenie zapalenia ziarniniakowego w badaniu histopatologicznym wymaga przeprowadzenia pogłębionej diagnostyki w kierunku sarkoidozy układowej [32].

W diagnostyce przewlekłych odczynów nadwrażliwości ograniczonych do jednego koloru pigmentu, identyfikacja alergenu jest często niemożliwa [33]. Czynniki prowokujące reakcje wydają się wynikać z powolnych i skomplikowanych procesów haptenizacji potencjalnych alergenów w skórze właściwej, mogących toczyć się nawet przez wiele lat od wykonania tatuażu [34]. Przyczyny trudności diagnostycznych przewlekłych reakcji nadwrażliwości ograniczonych do jednego koloru pigmentu zamieszczono w tab. 2.

Badanie dermoskopowe może być przydatne w rozpoznaniu niektórych zakażeń wirusowych, ze względu na ich charakterystyczne cechy w obrazie mikroskopowym [35].

Tabela 2. Przyczyny trudności w diagnostyce czynnika sprawczego reakcji alergicznych w obrębie tatuażu

- brak standaryzacji w etykietowaniu składów tuszów
- nieujawnianie pełnego składu tuszów przez producentów
- zanieczyszczenia obecne w tuszach
- mieszaniny różnych tuszów tworzone przez tatuażystów celem uzyskania określonych barw
- dekompozycja substancji zawartych w tuszach pod wpływem światła
- przemiany enzymatyczne substancji zawartych w tuszach zachodzące w skórze
- dekompozycja pigmentów wywołana przez laser

4. Metody leczenia powikłań celowej pigmentacji skóry

Do tej pory nie zostały opracowane wystandaryzowane protokoły lecznicze powikłań tatuowania. Współistnienie choroby układowej wymaga stosowania terapii systemowej [23]. Leczenie powikłań infekcyjnych w obrębie tatuaży nie różni się znacząco od terapii zakażeń przebiegających na skórze niewytatuowanej [14]. W leczeniu odczynów alergicznych stosuje się głównie preparaty glikokortykosteroidowe podawane miejscowo lub doogniskowo. W przypadku braku skuteczności leczenia przeciwzapalnego, konieczne może być usunięcie tatuażu objętego reakcją (metody chirurgiczne, lasery ablacyjne) [36].

II. Cele pracy

1. Analiza i charakterystyka różnorodnych obrazów klinicznych powikłań dermatologicznych celowej pigmentacji skóry wśród mieszkańców północnej Polski.

2. Ocena poziomu wiedzy na temat zdrowotnych aspektów tatuowania w populacji studentów trójmiejskich uczelni wyższych.

3. Ocena świadomości zagrożeń zdrowotnych celowej pigmentacji skóry w populacji pacjentów chorujących na łuszczycę.

III. Wykaz publikacji wchodzących w skład rozprawy

1. Patrycja Rogowska, Michał Sobjanek, Martyna Sławińska, Roman Nowicki, Aneta Szczerkowska-Dobosz. **Tattoos Dermatological Complications: Analysis of 53 Cases from Northern Poland** [published online ahead of print, 2021 Dec 30]. Dermatology. 2021;1-8.
   DOI:10.1159/000520752
   Impact Factor: 5.366; Punktacja ministerstwa: 100,000

2. Patrycja Rogowska, Aneta Szczerkowska-Dobosz, Róża Kaczorowska, Justyna Słomka, Roman Nowicki. **Tattoos: Evaluation of knowledge about health complications and their prevention among students of Tricity universities.** J Cosmet Dermatol. 2018;17(1):27-32.
   DOI:10.1111/jocd.12479
   Impact Factor: 1.311; Punktacja ministerstwa: 20,000

3. Patrycja Rogowska, Paula Walczak, Karolina Wrzosek-Dobrzyniecka, Roman Nowicki, Aneta Szczerkowska-Dobosz. **Tattooing in Psoriasis: A Questionnaire-Based Analysis of 150 Patients.** Clin Cosmet Investig Dermatol. 2022;15:587-593. Published 2022 Apr 6.
   DOI:10.2147/CCID.S348165
   Impact Factor: 2.489; Punktacja ministerstwa: 100,000

Sumaryczny współczynnik Impact Factor: **9,166**

Sumaryczna punktacja ministerstwa: **220,000**

IV. Materiał i metody

Do grup badawczych poszczególnych prac zostały odpowiednio zakwalifikowane:

1. 53 osoby (27 M, 26 K; średni wiek 34 lata), u których wystąpiły powikłania związane z wykonaniem tatuażu/PMU. Uczestnicy badania byli diagnozowani w Klinice Dermatologii, Wenerologii i Alergologii i/lub Poradni Dermatologicznej Uniwersyteckiego Centrum Klinicznego w Gdańsku. Badanie pacjentów składało się z wywiadu lekarskiego uwzględniającego informacje dotyczące przebytych zabiegów celowej pigmentacji skóry oraz ocenie klinicznej i dokumentacji fotograficznej zmian skórnych. W zależności od charakteru klinicznego zmian wykonywano dodatkowe badania diagnostyczne (biopsję skórną z oceną histopatologiczną, badanie dermoskopowe, alergiczne skórne testy płatkowe, badania laboratoryjne i obrazowe).

2. 1199 studentów trójmiejskich uczelni wyższych (911 K, 288 M; średni wiek 22 lata), z których 326 (27%) posiadała przynajmniej jeden tatuaż. Ocena poziomu wiedzy została przeprowadzana za pomocą specjalnie zaprojektowanego kwestionariusza.

3. 150 pacjentów chorujących na łuszczycę (16 M, 134 K; średni wiek 32 lata), poddających się zabiegom celowej pigmentacji skóry. Wyniki uzyskano za pomocą autorskiego kwestionariusza.

Wyniki obliczono w programie Microsoft Excel za pomocą analizy częstości (analiza rozkładu odpowiedzi badanych w próbie celem przedstawienia informacji o ogólnych liczebnościach oraz udziale procentowym poszczególnych odpowiedzi badanych).

Wyniki pracy doktorskiej na kolejnych etapach jej realizacji oraz innych prac związanych z tematyką celowej pigmentacji skóry, zaprezentowano podczas konferencji krajowych i zagranicznych:

- prezentacja ustna pracy pt. ,,My skin - A study of the emotional-cognitive representation of skin among people who have tattoos" podczas międzynarodowej konferencji 4th European Congress on Tattoo and Pigment Research, 26 - 28 March 2019, Berno, Szwajcaria

- prezentacja ustna pracy pt. ,,Safe tattoo: an educational campaign in Poland" podczas międzynarodowej konferencji 5th Word Congress on Tattoo and Pigment Research, 24 - 26 August 2021, Amsterdam, Holandia

- prezentacja ustna przypadku pt. ,,Sarkoidoza w tatuażu" podczas Zjazdu Sekcji Forum Młodych Polskiego Towarzystwa Dermatologicznego, Łódź, Polska, 24-25.10.2019

- prezentacja ustna pracy pt. ,,Celowa pigmentacja skóry : nowe wyzwanie dla dermatologów" podczas 16. Międzynarodowej Akademii Dermatologii i Alergologii, Gdynia, Polska, 7-9.02.2020

- prezentacja ustna pracy pt. ,,Dermatologiczne powikłania celowej pigmentacji skóry" podczas 18. Międzynarodowej Akademii Dermatologii i Alergologii, Gdynia, Polska, 11-13.02.2022

- prezentacja pracy pt. ,,My skin - A study of the emotional-cognitive representation of skin among people who have tattoos*"* w formie plakatowej podczas międzynarodowej konferencji 27th European Academy of Dermatology and Venereology Congress, Paryż, Francja, 12-16.09.2018

- prezentacja pracy pt. ,,Prevalence and clinical spectrum of tattoos dermatological complications: a first study from Poland" w formie plakatowej podczas międzynarodowej konferencji 29th European Academy of Dermatology and Venereology Congress, Wiedeń, Austria, 29-30.10.2020

- prezentacja pracy pt. ,,Traumatic tattoos mimicking pigmented skin tumors on videodermoscopy: a case series" w formie plakatowej podczas międzynarodowej konferencji 30th European Academy of Dermatology and Venereology Virtual Congress, 29.09-02.10.2021

- autorstwo rozdziału „Powikłania celowej pigmentacji skóry", w książce „Dermatologiczne powikłania tatuaży" wydawnictwa PZWL, skierowanej do lekarzy, tatuażystów i osób poddających się zabiegom celowej pigmentacji skóry. Warszawa, PZWL 2022.

W trakcie prowadzenia badań nad celową pigmentacją skóry zainicjowano i przeprowadzono akcję społecznościową „Bezpieczny tatuaż", promującą bezpieczeństwo u osób decydujących się

na wykonanie tatuażu, stworzoną we współpracy z Dermatologicznym Studenckim Kołem Naukowym Gdańskiego Uniwersytetu Medycznego.

V. Omówienie publikacji wchodzących w skład rozprawy

Na rozprawę doktorską składają się trzy prace oryginalne.

1. Praca orginalna pt. **„Tattoos Dermatological Complications: Analysis of 53 Cases from Northern Poland"** opublikowana w czasopiśmie *Dermatology* (Impact Factor: 5.366; Punktacja ministerstwa: 100,000) w 2021 roku stanowi analizę obrazu klinicznego powikłań celowej pigmentacji skóry u pięćdziesięciu trzech pacjentów Kliniki Dermatologii, Wenerologii i Alergologii i/lub Poradni Dermatologicznej Uniwersyteckiego Centrum Klinicznego w Gdańsku w latach 2018-2021. U każdego pacjenta przeprowadzono: wywiad lekarski uwzględniający informacje dotyczące przebytych zabiegów celowej pigmentacji skóry, ocenę kliniczną i dokumentację fotograficzną zmian skórnych. Badanie dermoskopowe wykonano u szesnastu pacjentów, z czego u czterech z nich obraz dermoskopowy zmian skórnych umożliwił postawienie rozpoznania. U dwudziestu pacjentów pobrano biopsję skóry do badania histopatologicznego. Na podstawie przeprowadzonych badań wykazano, że u dwudziestu jeden pacjentów (40%) występowały reakcje nadwrażliwości ograniczone do jednego koloru pigmentu, z czego w osiemnastu na dwadzieścia jeden przypadków dotyczyły one koloru czerwonego. W jedenastu przypadkach (21%) stwierdzono ostre kontaktowe zapalenie skóry, które rozwinęło się bezpośrednio po wykonaniu tatuażu. U dziewięciu pacjentów (17%) rozpoznano powikłania infekcyjne, w tym miejscowe zakażenia bakteryjne, infekcje wirusowe (brodawki zwykłe, mięczak zakaźny) i infestacje pasożytniczą (nużyca). Reakcje grudkowo-guzkowe w czarnych tatuażach obserwowano u ośmiu pacjentów (15%), wśród których u sześciu (11%) stwierdzono obecność ziarniniaków sarkoidalnych w badaniu histopatologicznym biopsji skórnej. U dwóch chorych (4%) rozpoznano reakcje anafilaktoidalną, najprawdopodobniej związaną z procedurą okołozabiegową celowej pigmentacji skóry. Wysiew zmian łuszczycowych w tatuażu w mechanizmie objawu Koebnera stwierdzono u dwóch pacjentów (4%). Obserwacje te przedstawiono za pomocą dwóch tabeli szczegółowo prezentujących dane pacjentów oraz ich podział na podstawie postawionego rozpoznania. Uzyskane wyniki odniesiono w dyskusji do danych literaturowych. W piśmiennictwie dostępnych jest bardzo niewiele publikacji dotyczących powikłań tatuowania skóry w krajach Europy Środkowo-Wschodniej [13,37]. Powyższa praca jest pierwszym doniesieniem analizującym obraz kliniczny powikłań dermatologicznych celowej pigmentacji skóry w Polsce. Wyniki badania są zgodne z doniesieniami literaturowymi z krajów Europy Zachodniej [17,38–41], prezentując podobny rozkład powikłań tatuowania i potwierdzając, że

pośród wszystkich używanych pigmentów, kolor czerwony jest najczęściej odpowiedzialny za reakcje alergiczne w tatuażach. Dodatkową oryginalną obserwacją w publikacji było zwrócenie uwagi na znaczenie badania dermoskopowego w rozpoznawaniu powikłań infekcyjnych tatuaży, jak również na rzadkie, aczkolwiek potencjalnie zagrażające życiu, reakcje anafilaktoidalne związane z procedurą tatuowania.

Wkład doktorantki w powstanie publikacji: tworzenie koncepcji pracy oraz opracowanie metodologii, koordynacja projektu, rekrutacja grupy badanej, zbieranie wywiadu medycznego, dokumentacji fotograficznej zmian skórnych oraz przeprowadzanie badania fizykalnego i dermoskopowego, pozyskiwanie materiału badawczego (pobieranie wycinków skóry), stworzenie bazy danych, analiza zebranych danych i przygotowanie rycin, zbiór i analiza piśmiennictwa, redakcja manuskryptu, redagowanie pracy zgodnie z zaleceniami recenzentów i redakcji, pełnienie funkcji autora odpowiedzialnego za korespondencję z redakcją.

2. W pracy pt. **„Tattoos: Evaluation of knowledge about health complications and their prevention among students of Tricity universities”**, opublikowanej w 2018 roku w czasopiśmie *Journal of Cosmetic Dermatology* (Impact Factor: 1.311; Punktacja ministerstwa: 20,000), podjęto próbę oceny wiedzy na temat zdrowotnych aspektów tatuowania w populacji studenckiej. Badanie przeprowadzono wśród 1199 studentów trójmiejskich uczelni wyższych, z których 326 (27%) posiadało przynajmniej jeden tatuaż. Wyniki uzyskano za pomocą anonimowego kwestionariusza zaprojektowanego przez autorów pracy, zawierającego 25 pytań. Jako grupa badana została wybrana populacja studentów, czyli osób na wczesnym etapie dorosłości, ponieważ w tym okresie tatuowanie jest szczególnie powszechne [42,43]. Tatuaże obserwowane są także coraz częściej u personelu medycznego oraz studentów uczelni medycznych [44]. W kolejnym etapie pracy porównano poziom wiedzy między osobami poddającymi się zabiegom celowej pigmentacji skóry, a osobami nie poddającymi się tym zabiegom. Ponad to analizie poddany został wpływ profilu edukacji studentów (uczelnie medyczne i niemedyczne) na poziom wiedzy dotyczący aspektów zdrowotnych tatuowania. Wyniki przeprowadzonych badań wykazały, że 88% studentów Gdańskiego Uniwersytetu Medycznego prawidłowo wskazało ryzyko zakażenia wirusem zapalenia wątroby typu C w trakcie tatuowania, podczas gdy jedynie 34% studentów z innych trójmiejskich uczelni wyższych było świadomych tego ryzyka. Aż 67% ankietowanych posiadających tatuaże błędnie twierdziło, że ich posiadanie nie ma wpływu na jakiekolwiek procedury diagnostyczne i/lub terapeutyczne (m.in. badanie rezonansu magnetycznego, badanie skóry pod kątem zmian nowotworowych). Większość badanych podała tatuażystę (79%) i Internet (73%) jako źródło informacji przez planowym zabiegiem celowej pigmentacji skóry, a zaledwie 5% osób udało się na konsultacje lekarską lub czytało fachową literaturę medyczną (8%). Prawie połowa ankietowanych posiadających przynajmniej jeden tatuaż (49%), przyznała, że tatuażysta nie zebrał z nimi wywiadu na temat chorób przewlekłych i przyjmowanych leków przed zabiegiem tatuowania. Obserwacje te przedstawiono za pomocą czterech wykresów szczegółowo prezentujących odpowiedzi studentów z podziałem na osoby posiadające tatuaże i ich nie posiadające oraz uczące się w uniwersytecie o medycznym lub niemedycznym profilu. Uzyskane wyniki odniesiono w dyskusji do danych literaturowych. Badanie wykazało, że poziom wiedzy na temat medycznych aspektów celowej pigmentacji skóry wśród studentów trójmiejskich uczelni wyższych jest niewystarczający. Co więcej, zarówno studenci Gdańskiego Uniwersytetu Medycznego, jak i innych trójmiejskich uczelni wyższych prezentowali niski poziom wiedzy na temat zdrowotnych aspektów tatuowania, choć zgodnie z założeniami pracy, studenci o medycznym profilu nauczania częściej

wskazywali prawidłowe odpowiedzi. Na podstawie otrzymanych danych, w pracy wysunięto wniosek, że wiedza młodych osób z niższym poziomem edukacji w porównaniu do studentów uczelni wyższych jest również niewystarczająca i wskazana jest edukacja społeczna dotycząca bezpieczeństwa zabiegów celowej pigmentacji skóry.

Wkład doktorantki w powstanie publikacji: tworzenie koncepcji pracy oraz opracowanie metodologii, zaprojektowanie autorskiego kwestionariusza, koordynacja projektu, rekrutacja grupy badanej, stworzenie bazy danych, analiza zebranych danych i przygotowanie rycin, zbiór i analiza piśmiennictwa, redakcja manuskryptu, redagowanie pracy zgodnie z zaleceniami recenzentów i redakcji, pełnienie funkcji autora odpowiedzialnego za korespondencję z redakcją.

3. W pracy pt. **„Tattooing in Psoriasis: A Questionnaire-Based Analysis of 150 Patients”**, opublikowanej w 2022 roku w czasopiśmie *Clinical, Cosmetic and Investigational Dermatology* (Impact Factor: 2.489; Punktacja ministerstwa: 100,000), ocenie poddano świadomość zagrożeń zdrowotnych celowej pigmentacji skóry w populacji chorych na łuszczycę. Łuszczyca nie jest bezwzględnym przeciwwskazaniem do tatuowania, jednak wykonywanie tatuażu w trakcie aktywnej fazy choroby lub podczas terapii lekami immunosupresyjnymi nie jest wskazane [27]. Tatuowanie może mieć pozytywny wpływ na osoby chorujące na przewlekłe dermatozy, umożliwiając im podkreślenie swojej indywidualności i niezależności od przewlekłej choroby (tzn. negatywne piętno związane z chorobą zostaje „zastąpione” pozytywnym, jakim jest posiadanie tatuażu). Tym samym tatuowanie w tej grupie chorych może zwiększyć poziom akceptacji łuszczycy oraz poprawić samoocenę [45]. W badaniu analizie poddano 150 pacjentów chorujących na łuszczyce, którzy poddali się co najmniej jednemu zabiegowi celowej pigmentacji skóry. Wyniki uzyskano za pomocą anonimowego kwestionariusza zaprojektowanego przez autorów badania. Na podstawie przeprowadzonej analizy odpowiedzi respondentów wykazano, że jedynie 8% ankietowanych pacjentów zasięgnęło konsultacji lekarskiej przed wykonaniem tatuażu. Podczas zabiegu celowej pigmentacji skóry dwadzieścia trzy osoby (15.3%) były w takcie leczenie ogólnego łuszczycy, w tym osiem osób (5.3%) było leczonych metotreksatem, pięć osób (3.3%) cyklosporyną A, jedna osoba (0.7%) acytretyną i dziewięć osób (6%) lekami biologicznymi. Powikłania tatuowania wystąpiły u trzynastu badanych (8.7%), wśród których u ośmiu (5.3%) wystąpił wysiew nowych zmian łuszczycowych na wytatuowanej skórze w mechanizmie objawu Koebnera. Posiadanie tatuażu wpłynęło na wzrost samooceny u siedemdziesięciu sześciu pacjentów (50.7%). Uzyskane wyniki odniesiono w dyskusji do danych literaturowych. We wnioskach pracy podkreślono, iż niezbędna jest edukacja pacjentów, lekarzy oraz tatuażystów, na temat ryzyka zdrowotnego celowej pigmentacji skóry u chorych z łuszczycą i innymi przewlekłymi dermatozami.

Wkład doktorantki w powstanie publikacji: tworzenie koncepcji pracy oraz opracowanie metodologii, zaprojektowanie autorskiego kwestionariusza, koordynacja projektu, rekrutacja grupy badanej, stworzenie bazy danych, analiza zebranych danych i przygotowanie rycin, zbiór i analiza piśmiennictwa, redakcja manuskryptu, redagowanie pracy zgodnie z zaleceniami recenzentów i redakcji, pełnienie funkcji autora odpowiedzialnego za korespondencję z redakcją.

VI. Wnioski

1. Obraz kliniczny powikłań celowej pigmentacji skóry w wybranej populacji Polski północnej osób z tatuażami jest zróżnicowany. Najczęściej obserwuje się reakcje ograniczone do czerwonego koloru pigmentu, reakcje wypryskowe, miejscowe infekcje oraz przewlekłe reakcje zapalne w czarnych tatuażach. Szczególne znaczenie ma diagnostyka reakcji ziarniniakowych w tatuażach, gdyż mogą być one wyrazem procesu ogólnoustrojowego.

2. Poziom wiedzy na temat medycznych aspektów celowej pigmentacji skóry wśród studentów trójmiejskich uczelni wyższych jest niewystarczający i konieczna jest edukacja na temat zagrożeń zdrowotnych związanych z tatuowaniem.

3. Wiedza na temat bezpieczeństwa zabiegów celowej pigmentacji skóry w populacji pacjentów chorujących na łuszczycę jest niska. Wskazane jest szerzenie edukacji na temat ryzyka tatuowania w tej populacji chorych oraz w populacji osób z innymi przewlekłymi schorzeniami skóry.

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VIII. Streszczenie pracy w języku angielskim

Introduction:

The popularity and social acceptance of tattooing have significantly increased in the last two decades, especially in the population of young people. Tattoos, which are defined as permanent changes in the skin caused by the injection of dye molecules into the dermis, may cause undesirable health consequences. The most common dermatological complications of tattoos are allergic reactions, local infections, chronic inflammatory black tattoo reactions (CIBTR), flares of chronic dermatoses at the tattoo site, scarring, neurosensoric and photosensitive reactions, as well as difficulties during certain diagnostic procedures. Tattoos may also hinder the development of skin neoplasm, especially melanoma, and consequently delay the diagnosis. The rapidly growing tattoo market, low public awareness of the health risk connected with tattooing, lack of tattoo inks regulations, and insufficient qualifications of tattooists lead to an increased occurrence of tattoo complications. Some of them can be prevented by improving the health risk awareness among both, tattooists and people who are getting tattoos.

Aims:

1. Analysis and characteristics of various dermatological complications associated with tattooing among the selected tattooed inhabitants of Northern Poland.

2. Evaluation of knowledge about the health aspects connected with tattoos in the population of students from Tri-City universities.

3. Assessment of the tattooing-related health risk awareness in the population of patients suffering from psoriasis.

Material and methodology:

1. 53 people (27 M, 26 F; mean age 34 years) who developed tattoo-related cutaneous conditions were analyzed. All of the patients were consulted in the Dermatology, Venereology, and Allergology Clinic in Gdańsk in the years 2018– 2021. Medical history,

dermatological assessment, and photographic documentation of skin lesions were performed in each case. Dermoscopic examination was carried out in 16 cases and 20 skin biopsies of the tattoo reactions were performed.

2. 1,199 students of Tri-City universities (911 F, 288 M; average age 22), of whom 326 (27%) had at least one tattoo. The level of knowledge concerning tattoo health complications was assessed using a specially designed questionnaire.

3. 150 psoriatic patients (16 M, 134 F; mean age 32 years) with at least one tattoo were analyzed. The results were obtained using a specially designed questionnaire.

The results were calculated in Microsoft Excel with the use of frequency analysis.

Results:

1. Twenty-one patients (40%) presented tattoo ink hypersensitivity reactions, out of which 18 were triggered by the red ink. In 11 cases (21%), contact dermatitis has developed after tattooing, while 9 of the patients (17%) presented tattoo infectious complications, including local bacterial infections, common warts, molluscum contagiosum, and demodicosis. We collected 8 cases (15%) of papulonodular reactions in black tattoos, and in 6 of them, histology showed granuloma formation. In 2 cases (4%), symptoms of anaphylaxis were observed after the tattooing procedure, and in another 2 cases (4%), the Koebner phenomenon in the tattoo was diagnosed. Dermoscopy was the clue to the diagnosis in 4 cases.

2. Eighty-six percent of the students from the Medical University of Gdansk indicated the risk of HCV virus infection during tattooing, while only 34% of students from other Tricity universities were aware of this danger. Sixty-seven percent of people with tattoos felt that having them does not affect any diagnostic and therapeutic procedures. Most of the respondents mentioned the tattoo artist (79%) and the Internet (73%) as a source of information before having a tattoo, while only 5% and 8% of respondents asked a doctor or read medical literature about it. Forty-nine percent of respondents reported that before the procedure, tattooists failed to ask them about their health conditions and medications.

3. Eight percent of the surveyed psoriatic patients sought medical advice before getting a tattoo. While undergoing the tattooing procedure, 23 (15.3%) of the respondents received systemic psoriasis treatment: 8 (5.3%) being treated with methotrexate, 5 (3.3%) with cyclosporine A, one (0.7%) acitretin, and 9 (6%) patients were under biological treatment. Thirteen (8.7%) of the participants experienced complications associated with their tattoos, among which, the insurgence of the Koebner phenomenon on the tattoo, was the most frequent one (8 cases- 5.3%). Getting tattooed improved patients' self-esteem in 76 (50.7%) of the cases.

Conclusions:

1. Clinical presentation of tattoo-associated dermatological complications in the selected population of Northern Poland varies. The most commonly observed are red-tattoo reactions, acute contact eczema, local infections, and chronic inflammatory reactions in black tattoos. The diagnosis of granulomatous tattoo reactions is of particular importance, as it might be a manifestation of systemic disease.

2. The level of knowledge about the medical aspects of tattooing among students of Tri-City universities is insufficient and education concerning health risks connected with tattoos is needed.

3. The knowledge about the safety of tattooing in the population of patients suffering from psoriasis is low. Education about the risks associated with tattoos is advisable in this population, as well as in the population of patients suffering from other chronic dermatoses.

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Tattoos Dermatological Complications: Analysis of 53 Cases from Northern Poland

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Abstract
Background: The frequency of tattoos varies from 10% to 30% across the population worldwide. The growing popularity of tattooing increases the number of cutaneous reactions connected with this procedure. As we have not found any previous studies in the literature concerning tattoo complications in Poland and other Eastern European countries, we believe this to be the first study of this kind. ***Objective:*** The primary objective of this study was to evaluate the clinical spectrum of complications associated with the procedure of permanent tattooing among patients from Northern Poland. ***Methods:*** Medical data of 53 patients who developed tattoo-related cutaneous conditions were analyzed. All of the patients were consulted in the Dermatology, Venereology and Allergology Clinic in Gdańsk in the years 2018–2021. Medical history, dermatological assessment, and photographic documentation of skin lesions were performed in each case. Dermoscopic examination was carried out in 16 cases and 20 skin biopsies of the tattoo reactions were performed. ***Results:*** Twenty-one patients (40%) presented tattoo ink hypersensitivity reactions, out of which 18 were triggered by the red ink. In 11 cases (21%), contact dermatitis has developed after tattooing, while 9 of the patients (17%) presented tattoo infectious complications, including local bacterial infections, common warts, molluscum contagiosum, and demodicosis. We collected 8 cases (15%) of papulonodular reactions in black tattoos, and in 6 of them, histology showed granuloma formation. In 2 cases (4%), symptoms of anaphylaxis were observed after the tattooing procedure, and in another 2 cases (4%), Koebner phenomenon in the tattoo was diagnosed. Dermoscopy was the clue to the diagnosis in 4 cases. ***Conclusions:*** This is the first report presenting multiple cases of tattoo complications from Eastern Europe. The results of the study are consistent with other researches, showing a similar distribution of tattoo complications and that across the different pigments used, the red ink is most frequently responsible for tattoo reactions. We emphasize the usefulness of dermoscopic examination in the diagnosis of tattoo-related infections and draw the reader's attention to the rare, yet hazardous complications connected with peri-tattooing anaphylaxis.

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Introduction

Tattooing is defined as the introduction of exogenous pigments and dyes into the dermis in order to induce a permanent design on the skin [1]. In the latest study measuring the prevalence of tattooing in 5 major countries in the world, the percentage of tattooed people varied from 10% in Russia to up to 30% in the USA [2]. In Europe, it is estimated that about 15–25% of the population have at least one tattoo or more [3]. According to the most recent available report concerning Poland, the CBOS (Polish Public Opinion Research Center) analysis published in 2017, this percentage was equal to 8%. The number of tattooed individuals was especially high among younger generations – 16% of tattooed Poles were between 25 and 34 years old [4]. Minors between 16 and 18 years old can legally get a tattoo in Poland while having parental approval. Currently, the Polish government has not officially adopted any specific tattoo or permanent make-up (PMU) restrictions concerning the usage of pigments nor has set precise requirements regulating the profession of tattoo artists. Poland, in contrast to many EU countries, has not enforced national legislation in line with the recommendations of the Council of Europe Resolution, (CoE ResAP)(2008)1, on requirements and criteria for the safety of tattoos and PMU [5]. Becoming a professional tattoo artist in Poland does not require any specific training nor license. There is no obligation to declare tattooists' activity in any state institution, thus, it is difficult to assess the actual number of tattoo artists in Poland.

It is estimated that about 10% of tattooed people have encountered an adverse tattooing-related health incidence in their life [6, 7]. Various tattoo complications were reported in the previous Western and Northern European studies. Hypersensitivity reactions (especially to red pigment), cutaneous sarcoidosis (associated mostly with black ink), and local infections were most commonly observed in cohorts from Finland, Spain, Denmark, and Italy [8–11]. On the contrary, very limited literature can be found about the frequency and clinical manifestations of tattoo reactions in central and eastern European countries, where the popularity of tattooing is also rising. The aim of this study was to evaluate the clinical spectrum of complications resulting from or associated with the procedure of permanent tattooing in the area of Northern Poland.

Materials and Methods

We studied all patients with tattoo and PMU complications that came to the Dermatology, Venereology and Allergology Clinic starting from October 2018. In total, we analyzed 53 patients (27 men and 26 women) with a mean age of 34 years (range 20–70). One case has been previously published as an independent paper [12]. In 10 patients, tattoo complications appeared before October 2018; however, they were seen for follow-up in the clinic during the time of the study. Patients came directly to the clinic (27 cases) or were referred to the clinic from dermatological offices (20 cases), as well as tattoo parlors (6 cases). We created an educational campaign called "Safe Tattoo" directed to tattooists and tattooed individuals, in order to increase awareness about tattoo health issues and, consequently, recruit study participants by offering them free-of-charge medical advice. Patients who presented cutaneous reactions related to tattoo/PMU (inhabitants of the Northern Poland region, particularly Pomeranian Voivodeship) were included in the study. Patients with skin tumors and nevi found in the tattooed skin were excluded from the study, as the presence of those lesions in the tattoo was considered most probably coincidental. All patients were examined in the Dermatology, Venereology and Allergology Clinic of the University Clinical Center in Gdańsk. Medical history, dermatological assessment, demographic data, and photographic documentation of the skin lesions were collected in every case. Allergic patch tests (European standard series) were executed in 2 patients. The dermoscopic examination was carried out in 16 patients, and 20 skin biopsies of the tattoo reactions were performed. Various treatment methods were applied when necessary. The characteristics of the study group are summarized in Table 1.

Results

Tattoo Ink Hypersensitivity Reactions

We collected 21 cases (40%) of patients with tattoo complications showing noninfectious, immune-mediated reactions restricted to small tattoo areas of specific ink color. In 18 cases, red ink was the trigger; however, in 2 of them, other colors (green and yellow) were also partially affected. In the remaining 3 cases, the cause was blue (2 cases) and green ink (1 case). A biopsy was performed in 8 cases of the red-ink reactions. Histology of the biopsied tattoos showed pseudolymphomatous [3], lichenoid [2], lymphocytic [1], lymphoplasmacytic [1], and lymphohistiocytic pattern [1]. Most of the patients (19/21) presented a plaque-like elevation of the red tattoo parts with the appearance of scales, crusts, and thickening (Fig. 1). Two patients with pseudolymphomatous patterns observed in histology showed papules and nodules scattered in the tattoo without the complete color infiltration. We did not observe any cross-sensitization, which is when a new tattoo induces a reaction in the patient's older tattoos of the same color [13]. Additional symptoms involved chronic itch (16/21) and mild to severe pain (9/21). The median period between tattooing and the onset of the first symptoms was 12 weeks, ranging from 2 weeks to 1 year. In 1 of the patients, a red-ink

Table 1. Characteristics of patients in the studied group

Parameters	
Patients	53 (100%)
Mean age (range), years	34 (20–70)
Sex	
Men	27 (51%)
Women	26 (49%)
Tattoo location	
Face	2 (4%)
Shoulder and arm	8 (15%)
Hand	1 (2%)
Forearm	19 (36%)
Neck and upper back	8 (15%)
Chest	1 (2%)
Abdomen	2 (4%)
Thigh	1 (2%)
Calf	7 (13%)
Ankle	3 (6%)
More than 3 areas	1 (2%)
Tattoo type	
Decorative	51 (96%)
Permanent make-up	2 (4%)
Tattoo color	
Black	23 (43%)
Other colors	30 (57%)
Tattoo size[a]	
<1%	29 (55%)
1–5%	16 (30%)
>5%	8 (15%)
Tattoo character	
Professional	51 (96%)
Amateur	2 (4%)

Values are *n* (%) unless otherwise indicated. Note: Percentages may not total 100% due to rounding. [a] Defined in % of the patient's body surface area covered with the affected tattoo/s.

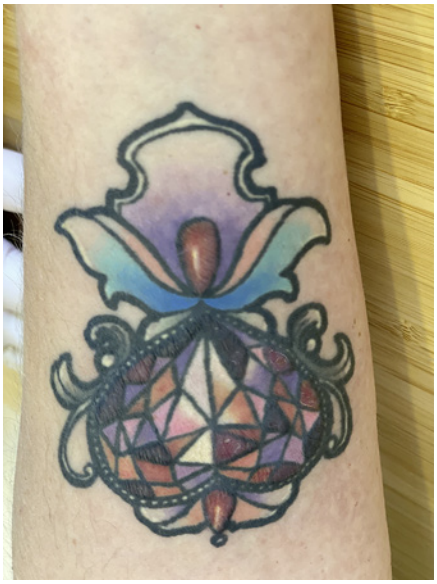

Fig. 1. Allergic reaction for a red pigment within a tattoo. Pruritic infiltration with scaling restricted to red pigment deposits.

reaction occurred directly after sun exposure of tattooed skin. In the majority of the cases (17/21), topical clobetasol applied once daily was implemented as a treatment with satisfying results. One patient, who had not responded to steroid ointment, presented a significant reduction of the inflammatory lesions after 2 series of triamcinolone intralesional injections. Another 3 patients had their tattoo treated with picosecond laser due to the previous unsuccessful treatment with corticosteroids (under occlusion and intralesional). The patients' consent was obtained after a full explanation of possible complications. Small parts of the tattoo with red ink hypersensitivity reaction were treated (1–2 sessions under the intake of an oral antihistaminic drug), without the total tattoo removal. During and several hours after the procedure, patients remained under close observation. The treatment resulted in the reduction of inflammation and pruritus.

Contact Dermatitis

Eleven (21%) of the examined patients presented eczematous rash restricted to their tattoos within days after tattooing (Fig. 2). In 4 cases, skin lesions were most probably triggered by a wound adhesive dressing, which was used as a protection on the freshly made tattoo. Two patients underwent a biopsy, which revealed signs of spongiotic dermatitis. Allergic patch tests (European standard series) were performed on 2 patients, and in either case revealed a positive reaction for textile dye mix (a combination of 8 disperse dyes: Blue 35, Orange 1, ORANGE 3, Red 1, RED 17, Yellow 3, Blue 106, Blue 124). Although the allergens used in textile dye screens are not actual pigments used as tattoo inks, cross-reactions between azo dyes are quite common [14]. In the remaining cases, the causative allergen was not identified. In all of the patients, the lesions resolved within a few weeks after the treatment with topical steroids (clobetasol or mometasone ointments applied once daily).

Tattoo Infections

In 9 (17%) of the examined cases, infectious complications, including bacterial infections, common warts, molluscum contagiosum, and demodicosis, were present.

Fig. 2. Contact dermatitis induced by exposure to unidentified tattooing-related agent. Diffuse edematous erythema seen within the tattoo and on the surrounding skin.

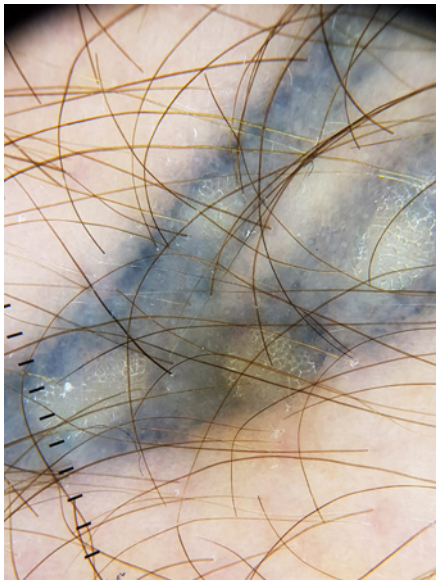

Fig. 3. Common warts within an amateur tattoo made with dark-blue pigment. Dermoscopy shows white lines in reticular distribution (DermLite® DL4, polarized dermoscopy, ×20 magnification).

Fig. 4. Cutaneous sarcoidosis in a tattoo as a form of scar sarcoidosis. Papules and elevated nodules seen in the black tattoo on the back of the patient are clearly visible in the upper right part of the tattoo. Of note, red tiger eyes stayed unchanged.

Five patients were diagnosed with local bacterial infection localized on newly tattooed skin. All of the infections were superficial and limited to the tattoo area. We did not perform swabs of the infected tattoo wounds, since through the physical examination they showed characteristic signs of bacterial contamination (erythema, purulent exudation, yellowish crusts). A therapy based on topical antibiotics (systemic antibiotic was used in only 1 case due to the more extensive area of the infected tattoo) was implemented with a satisfactory response. All tattoos diagnosed with bacterial infection were performed in tattoo parlors and located on the extremities of the patients.

Viral skin infections were identified in 3 cases. Two patients presented multiple, skin-colored papules, strictly limited to the tattooed skin with no associated symptoms. Dermoscopy of the papules revealed white lines in reticular distribution, as well as tiny, dotted vessels, characteristic of human papillomavirus presence in the skin (Fig. 3) [15]. Both tattoos were made using dark pigments. Detailed medical history revealed that in 1 case, the tattoo was made by an amateur tattooist. The third patient presented with multiple white papules on the extensive, black abdomen tattoo made 2 months earlier. Videodermoscopy showed round, shiny papules with a yellowish-white structureless area and central orifice. The lesions were surrounded with vessels forming a crown vascular pattern [16, 17]. The dark color of the ink was showing through the lesions, yet typical dermoscopic presentation was preserved. Molluscum contagiosum virus infection was diagnosed, and curettage of the lesions was performed with good clinical response and acceptable esthetic outcome. We had also observed a patient with demodicosis infestation restricted to the tattooed skin; the case was published in detail in *Clinical and Experimental Dermatology* [12].

Papulonodular Reactions

Eight patients (15%) with black tattoos presented papulonodular reactions. A biopsy of the lesions was performed in every case. Microscopic findings revealed sarcoid granulomas in 6 of the 8 patients with papulonodular reactions (11%). In those 6 cases, scattered papules and nodules as well as infiltrative plaques were seen within the tattoos (Fig. 4). All of the patients with granulomas found in the tattoo biopsy were checked for the presence of systemic sarcoidosis, and in 3 cases, the disease was confirmed. One patient was diagnosed with pulmonary and ocular sarcoidosis before the appearance of lesions within tattoos, while for the other 2 patients, the tattoo reaction was the first manifestation of systemic sarcoidosis; a chest computed tomography scan revealed mediastinal and bilateral hilar lymphadenopathy

Table 2. Characteristics of the 53 cases of tattoo complications

Type of complication	*N* (%)
Tattoo ink hypersensitivity reactions	21 (40%)
Red	18 (34%)
Blue	2 (4%)
Green	1 (2%)
Contact dermatitis	11 (21%)
Infections	9 (17%)
Bacterial	5 (9%)
Common warts	2 (4%)
Molluscum contagiosum	1 (2%)
Demodicosis	1 (2%)
Papulonodular reactions	8 (15%)
Sarcoidal granulomas	6 (11%)
Pigment overload	2 (4%)
Immediate IgE-mediated reactions	2 (4%)
Koebner phenomenon	2 (4%)

Note: Percentages may not total 100% due to rounding.

with numerous parenchymal nodules, indicating the second stage, pulmonary sarcoidosis. The average time of onset of the tattoo granulomatous reaction was about 5 years (range from 1 week to 15 years after the tattoo procedure). An additional 2 patients (4%) presented few, small, asymptomatic papules on the tattoo surface. Sarcoidosis was excluded since no granuloma formation was observed on histopathological examination. Those cases were classified as "pigment overload," which occurs when too much pigment (usually black) is injected into the skin [18].

Immediate IgE-Mediated Reactions

Two patients (4%) in the study presented symptoms of type I hypersensitivity (according to the Gell and Coombs classification of immunological reactions). The reactions have been classified as grade II of anaphylaxis (symptoms of more than 1 organ dysfunction were present) according to the World Allergy Organization grading system [19]. A 35-year-old male patient, without any chronic illnesses, presented shortness of breath, tongue numbness, and swallowing difficulties several hours after getting a black tattoo on the scapular area. Concomitant flushing of the skin in the upper back, cleavage, and neck was observed. The second patient, a 42-year-old woman, with a positive history of anaphylactic shock after exposure to bee venom, developed the reaction immediately after the procedure of PMU of the upper eyelids. The symptoms included tachycardia, dyspnea, and a sensation of heat and weakness. Erythema and swelling of the eyelids were observed. In both cases, the reaction occurred in less than 24 h after the tattooing procedure. Immediate treatment at the emergency department with systemic glucocorticoids and antihistaminic medications was implemented with a positive outcome, and none of the patients developed anaphylactic shock. The causative allergen was not confirmed with accessory investigations; however, in both cases, the procedure of tattooing was the most suspicious factor that could trigger such symptoms.

Koebner Phenomenon

In 2 cases (4%), erythematous, scaly plaques within the tattoo lines appeared several days after the procedure of tattooing. The first patient presented lesions limited only to the tattoo area; however, the second patient was having similar papules and plaques also on untattooed skin, which occurred simultaneously with the tattoo reaction. Either patient had a negative history of chronic skin diseases. Biopsies of the reactions were performed, and in both cases, the diagnosis of psoriasis was confirmed in the microscopic examination.

The characteristics of all the 53 cases of tattoo complications are summarized in Table 2.

Discussion/Conclusion

According to the recent study assessing infection risk among clients and staff of Polish tattoo services, only one-third of the questioned tattooists indicated that they had attended training concerning infection prophylaxis, post-exposure, sterilization, and disinfection procedures. Moreover, 1 in 5 of those tattoo artists reported having needlestick injuries while tattooing their customers [20]. Without proper knowledge concerning the transmission of infectious diseases and precautions that could be taken to limit the risks, tattooing remains a threat for both clients and tattooists. A certain amount of cutaneous infections may result from the improper care of the tattoo wound, and in this matter, customers education is indispensable. We can assume that more tattoo restrictions could possibly help to lower the number of infectious complications in our country. Moreover, basic health knowledge required from tattooists could be beneficial for the patients, especially those who are more prone to develop tattoo complications (under immunosuppressive treatment, suffering from chronic diseases, etc.). Our hypothesis has been reinforced by the experience we gained running an educational campaign on tattoo safety, where we observed a strong need for tattoo artists to co-

operate with dermatologists, as well as to receive appropriate medical training.

Additionally, tattoo inks restrictions could limit the injections of unverified substances into the skin. To date, tattooing products are not recognized by Polish law (opposed to cosmetics or medical products) and are classified the same as chemicals that are used in paints, cleaning products, clothing, furniture, or electrical equipment. The difference between Poland (almost completely lacking tattoo restrictions) and Western European countries in the field of tattoo legislation is striking. As an example, in France, tattooists are legally obliged to officially declare their activity, undergo hygiene training, and inform their clients about the possible risks associated with the procedure. Furthermore, tattoo inks are recognized by French law since 2004 [21].

In our study, we demonstrate the usefulness of imaging techniques in the management of tattoo infectious complications. Dermoscopy is a noninvasive skin examination that allows dermatological diagnosis with higher accuracy due to the magnification of lesions. It is becoming almost an indispensable tool in the diagnosis of many infectious skin diseases [22]. Common warts can be easily confirmed in dermoscopy due to their characteristic features, without the performance of unnecessary biopsies with the side effect of disrupting the tattoo design [15, 23]. Dotted or lopped vessels, hemorrhagic points surrounded by a whitish halo are typical dermoscopic signs that can facilitate the recognition of common warts [22]. In unchanged, but itching tattoos we suggest performing dermoscopy in search of demodicosis infection [12]. "Demodex tails," which corresponds to Demodex mites, grey or red dots, and scales captured in dermoscopy are the clues to a proper diagnosis [23]. We also present a case of molluscum contagiosum infection within a tattoo, which was revealed using dermoscopy. Round-shaped, pearly papules containing a white discoid area with an orifice in the center seen in dermoscopic images are representative of molluscum contagiosum virus infection [24]. Crown vascular (vessels surrounding the lesion), radial, and punctiform patterns are considered most common; however, different variations of mixed vascular patterns with or without central orifice may also occur [17].

In addition, dermoscopy can be utilized in the recognition of noninfectious tattoo complications. Orangish or yellow-orangish structureless areas are highly suggestive for dermal granulomas and sometimes can be observed in tattoo granulomatous reactions [25]. In the early or active stages of the disease, whitish areas and vessels may be captured as well [26]. We suggest that dermoscopy may be particularly useful in the diagnosis of papulonodular reactions in PMU tattoos, as during this technique usually less pigment is injected into the skin and it is placed more superficially (mostly in the epidermis and subepidermal layers of the dermis) compared to classical tattoos [27]. In the literature, we found 2 cases of granulomatous PMU tattoo reactions within the eyebrows with characteristic features described in dermoscopy [25, 28]. Therefore, in all of the patients with papulonodular reactions in our study, we did not observe any orange nor yellow color in dermoscopy. We assume that in our cases, the dermoscopic image of lesions was illegible due to the high concentration of black pigment in the tattoos (all of the granulomatous reactions that we diagnosed were present in traditional black tattoos).

Currently, little is known about the etiology of noninfectious, immune-mediated tattoo complications. While tattooing, a customer is exposed to various potential allergens. Skin disinfectants, anesthetic ointments, inks, needles, and tattoo aftercare products (ointments, creams, dressings) could be suspected of triggering different types of allergic reactions. Allergies to specific ink color, usually considered as type IV hypersensitivity reactions, and acute eczemas on the tattoo and skin nearby (not necessarily linked to ink) are most frequently reported. Only a few examples of type I hypersensitivity reactions emerging after tattooing can be found in the literature [29, 30]. We report 2 cases of anaphylaxis, with the presence of potentially life-threatening symptoms, which had occurred after tattooing; however, objective accessory investigations were not performed. Identification of the provocative factor can be challenging as manufacturers are not required to reveal the full composition of inks [31]. Preservatives, such as formaldehyde, added to tattoo inks in order to stabilize them after opening, can be considered as potential triggers [32]. Moreover, latex particles present in the gloves worn by the tattooists may be responsible for anaphylaxis in already sensitized patients [33].

The distribution of tattoo complications presented in this study is consistent with the other case series to be found in the literature. Similar to other research from different European countries, the majority of the patients presented in our study (40%) developed tattoo ink hypersensitivity reactions, and red pigment was the most common trigger in those cases [8–10, 34]. Moreover, the rate of infectious complications in our study (17%) was in line with the results of the studies from France (18%) and Denmark (11%) [10, 34]. The percentage of patients with tattoo granulomatous reactions in our studied group was 11%, which is comparable to the Spanish (8.7%) and

French (9%) studies, however, is less than in the Italian study (26.3%) [9, 11, 34]. Differently from the Danish and Spanish researchers, we did not observe any tattoo-related neuropathy and we did not include skin tumors and naevi arising within tattoos as in the study from Finland [8–10]. Additionally, we diagnosed 2 cases of type I hypersensitivity reactions after tattooing, 2 patients with the Koebner phenomenon in the tattoo, as well as the first case of an isolated tattoo demodicosis [12].

A potential limitation of this study concerns the relatively small number of biopsies performed since more histopathological examinations of the tattoo reactions could have strengthened our results. However, some patients refused to have their tattoo biopsied, as they wanted to preserve the whole design of their tattoos. The latter aspects paired with a relatively limited amount of the total number of analyzed cases might play a role in the ability of our study to produce more broadly generalizable findings. In the Department of Dermatology, Venereology and Allergology of the Medical University of Gdańsk, we created a center for diagnosing and treating tattoo complications. We also run education campaigns on social media, maintain a dedicated website, and hold direct meetings addressed to tattoo artists and future tattoo owners. In this study, we present a wide spectrum of dermatological conditions directly arising from or being associated with the procedure of tattooing among the population of Northern Poland. We can conclude that in some circumstances, the use of dermoscopy as a noninvasive tattoo examination could facilitate the diagnostic process and reduce the number of unnecessary biopsies. Furthermore, we discuss the issue of rare, yet life-threatening, complications connected with peri-tattooing anaphylaxis. Nevertheless, taking into consideration the local character of this study, we suggest that larger, multi-centered investigations are needed to increase the knowledge on the epidemiology of tattoo complications in Poland.

Key Message

We emphasize that tattoo complications are not an uncommon issue in dermatology practice.

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Statement of Ethics

All research participants have given their written informed consent also for the publication of the photographs. The approval of the Ethics Commission of the Medical University of Gdańsk was granted for this study.

Conflict of Interest Statement

The authors declare no conflicts of interest with regard to this article.

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Author Contributions

P. Rogowska wrote the manuscript. P. Rogowska, A. Szczerkowska-Dobosz, M. Sobjanek, M. Sławińska, and R.J. Nowicki provided data and conducted the patient interviews and examinations. All authors reviewed the final manuscript.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author.

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Tattoos: Evaluation of knowledge about health complications and their prevention among students of Tricity universities

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Summary

Introduction: Tattooing is a very popular form of body modification among young people. However, this kind of procedure entails the risk of various health complications. The objective of the study was to evaluate the students' knowledge about contraindications, complications, and health risks that skin tattooing may cause. Additionally, the purpose of the study was to assess how the profile of education (medical vs nonmedical) impacts on the knowledge of the respondents.

Methods: We surveyed a group of 1199 people, of which 326 (27%) had tattoos. The base of the study is an anonymously filled, author's online survey consisting of 25 questions.

Results: Eighty six percent of the students from the Medical University of Gdańsk indicated the risk of HCV virus infection during tattooing, while only 34% of students from other Tricity universities were aware of this danger. Sixty seven percent of people with tattoos felt that having them does not affect any diagnostic and therapeutic procedures. Most of respondents mentioned the tattoo artist (79%) and the Internet (73%) as a source of information before having a tattoo, while only 5% and 8% respondents asked a doctor or read medical literature about it. Fourty nine percent of respondents reported that before the procedure, tattooist failed to ask them about their health condition and medications.

Conclusions: Knowledge of students about safety, contraindications, and complications associated with the performance of tattooing is insufficient. As a result, a need for a better education on the topic for both people who are getting tattoos and tattooists appears evident.

KEYWORDS
dermatitis, infection, infectious risk, MRI, tattoo, tattoo removal

1 | INTRODUCTION

The tattoo is a permanent change in the skin caused by the injection of the dye molecule into the dermis layer of the skin. Depending on whether the dye was introduced into the skin intentionally or by accident, tattoos can be decorative, medical, or accidental.[1] Accidental tattoos arise as a result of injuries.[2] Tattoos are used in medicine as a camouflage technique in the presence of vitiligo, scars, hair loss as well as in reconstruction of breast areola after breast cancer surgery.[3] Tattooing is also commonly used as a form of "permanent makeup" performed by beauticians.[2] Tattooing the skin for decorative purposes is very popular among young people.[3,4] It is estimated that over 100 million Europeans have tattoos.[5] In fact, tattooing is certainly as old as humanity itself. We have indirect proof of this in

the grotto of Arcy-sur-Cure (France) where various sharp bones and dyes were found, dated 35 000 years ago.[6] The oldest tattooed body actually found is a mummified human body nicknamed Ötzi and is dated as old as 5300 years.[7] The history of ornamental tattooing is still an integral part of many cultures.[8]

Tattooing the skin is a procedure burdened with the risk of complications associated with both poor performances of the tattoo and the skin response to a foreign body, that is the presence of dye. These complications can be divided into 3 groups: infectious, inflammatory, and neoplastic. Their frequency is estimated at approximately 2%, and the number is growing with the increase in popularity of tattoos.[9] The most common skin response to tattooing reported in the literature is a transient acute inflammatory reaction, superficial and deep local infection, systemic infection, allergic contact dermatitis, photodermatitis, granulomatous and lichenoid reaction, skin disease provoked and localized on tattooed areas—such as eczema, psoriasis, lichen planus, and morphea.[3,10] Inappropriate hygiene rules in tattoo saloons and nonmedical wound care are major risk factors causing tattoo-related bacterial, viral, and fungal infections.[11,12] The interest in tattooing is steadily growing; however, at the present time, there are no legislations that would regulate which qualifications are required from tattoo artists as well as formally classifying the ink composition to be injected into the skin.

Most tattoos can be removed by Q-switched laser treatment,[13] and more recently picosecond laser treatment.[14] Nevertheless, patients should be informed that multiple treatments may be necessary and complete removal may not always be possible.[13]

2 | AIMS

The goal of our study was to evaluate the students' knowledge about contraindications, complications, and health risks arising from tattooing the skin. We sought respondents in their early adulthood as it is in this stage of life that tattoos are particularly popular.[3,4] Additionally, the purpose of the study was to assess whether the tattooed people are more aware of the risks that might follow from tattooing than people without tattoos. Lastly, we would like to know how the profile of education (medical vs nonmedical) impacts on the knowledge of the respondents.

3 | MATERIALS AND METHODS

The results were collected in a period ranging from December 2015 to February 2016. A total population of 1199 people (911 women and 288 men) was surveyed, of which 326 (27%) were people with tattoos. The average age of respondents was 22 ± 2.5 years. Within the entire sample population, 214 people were students of the Medical University of Gdańsk. The remaining 985 respondents were studying in other universities in Gdańsk, Sopot, or Gdynia (the "Tricity") of which 29% were students of the University of Gdańsk, 15% of the Gdańsk University of Technology, 12% of the Academy of Fine Arts in Gdańsk, and 26% were students of other Tricity universities.

The study was based upon an anonymously filled, online survey prepared by the authors. The questionnaire consisted of 25 questions divided into 2 parts. The first part has been sent to all the students and consisted of 8 single choice questions and 3 multiple choice questions. Single choice questions concerned information about sex, age, university, the general opinion about tattoos, knowledge about their safety, removal, and impact on medical procedures. Multiple choice questions concerned the problem of infections, complications, and contraindications associated with tattooing. The second part of the questionnaire was addressed only to people who are having tattoos and consisted of 9 single choice and 5 multiple choice questions. Single choice questions asked the age of having had the first tattoo carried out, the number of tattoos, in which location/circumstances the tattooing procedure had taken place, if the received guidelines for proper wound care had been followed, eventual complications after the procedure, whether the tattoo artist had collected medical history of the client prior to tattooing, any tattoo removals and, lastly, about any plans for next tattoos in the future.

Multiple choice questions investigated as follows: which aspects respondents had considered in the choice of the tattoo saloon, the compliance with hygiene measures in the tattoo parlor, which of the guidelines about wound care they had been informed about, the reasons behind the decision about where to place the tattoo on the body, where did they seek knowledge about safety measures, complications and contraindications associated with tattooing.

The results were collected with the help of Google Forms and analyzed in Microsoft Excel 2016.

4 | RESULTS

The results of the survey have shown that at least 1 tattoo was present on the body of 17% of those students studying at the Medical University of Gdańsk and on 29% of the students studying at others Tricity universities. Only 29% of respondents were aware that tattooing complications could occur regardless of a good compliance with hygiene measures by the tattoo artist. The risk of getting HCV virus infection during tattooing was indicated by 86% of students from the Medical University of Gdańsk, while only 34% of students from other Tricity universities were aware of the danger (Figure 1). Among the tattooed respondents, HCV virus infection was chosen by only 25% (Figure 2).

The results stemming from the multiple choice questions, regarding the complications which may occur after tattooing, were as follows: Eighty seven percent of respondents marked inflammation of the skin in the place of the tattoo, 78%—allergic skin reactions, 60%—virus hepatitis, 51%—scars, 48%—hypersensitivity of the tattoo to the sun, 36%—anaphylactic shock, 26%—increased risk of developing skin cancer, 15%—inflammation and heart failure, 9% of respondents said they did not have knowledge about any complications related to tattooing.

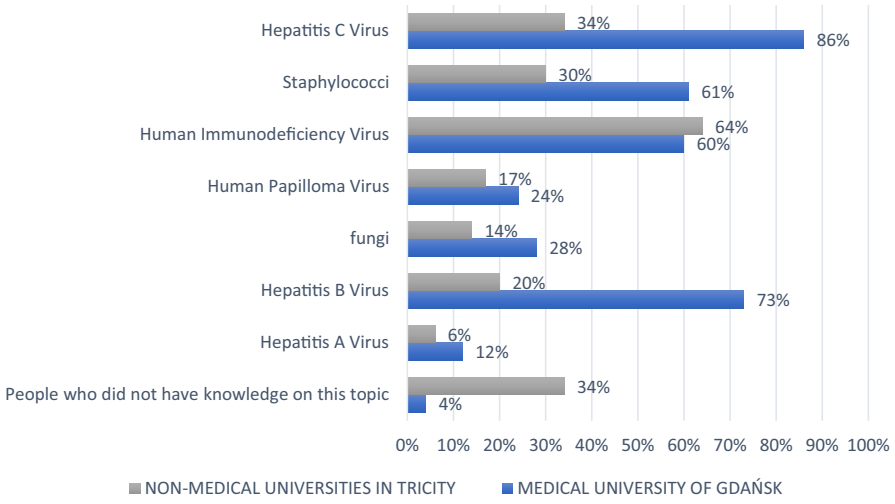

FIGURE 1 Comparison of percentage of medical (n = 214) vs nonmedical (n = 985) students, who claimed that while being tattooed, there is a risk of being infected with the following microorganisms

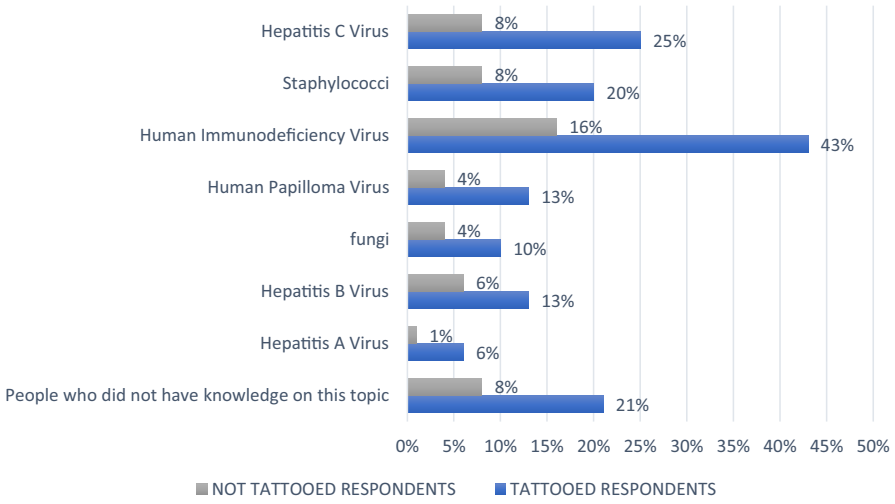

FIGURE 2 Comparison of percentage of tattooed (n = 326) vs not tattooed (n = 873) respondents, who claimed that while being tattooed, there is a risk of being infected with the following microorganisms

Among those surveyed with tattoos, 67% untruthfully believed that tattoos cannot have an impact on the performance of certain diagnostic and therapeutic procedures including magnetic resonance imaging, surgeries, and diagnosis of melanoma and skin cancers (Figure 3). Fifty five percent of students from the Medical University of Gdańsk and 25% of students from nonmedical universities in Tricity correctly believed that tattoos can interfere with the performance of certain medical procedures (Figure 4).

As to the question about conditions to be seen as contraindications for tattooing: Eighty two percent of respondents indicated skin diseases, 64%—blood clotting disorders, 60%—pregnancy, 51%—allergies, 45%—state after organ transplantation, 39%—autoimmune diseases, 31%—chronic intake of certain drugs, 29%—diabetes, 11%—heart defects. Twelve percent of the total student population did not have any knowledge of contraindications for tattooing. Among all of the respondents, nearly 50% answered that in their opinion, possessing tattoos increases the attractiveness of the person. Twenty percent of people with tattoos had their first tattoo before the age of 18. Regarding the question about the number of tattoos owned 54% of respondents reported having only 1 tattoo, 40% between 1 and 5, and 6% more than 5. Among the participants, 83% acquired their tattoos in a professional tattoo parlor, 15% in the private house of a person without qualifications, and 1% during a party. According to the survey, the major factors used in choosing a tattoo parlor were the artistic capabilities of the tattoo artist and the compliance with hygienic standards at a rate of 78% and 68%, respectively. Fourty seven percent of respondents were guided by the opinion of their friends, 25% by the information's found on the Internet, 19% by prices, and 17% by the proximity of the parlor. In the surveyed group, 96% of the respondents paid attention to the disinfection of the skin before, and after tattooing, 95% at the use of disposable gloves changed after each client, 93% to the use of disposable needles by tattoo artist, and 68% at the use of disposable ink containers. Only 2% of respondents did not pay attention at the compliance of the hygiene measures in the tattoo studio. Ninety nine percent of the interviewed were aware of the principles of proper wound care, and 19% admitted that they did not follow them carefully. Eighty percent of students indicated that their main source of information on safety, contraindications, and complications associated with getting a tattoo was the tattoo artist. Seventy three percent of respondents sought the information on the Internet, 42% talked to their friends, 8% read medical literature, 5% consulted a doctor, and 2% visited a beautician.

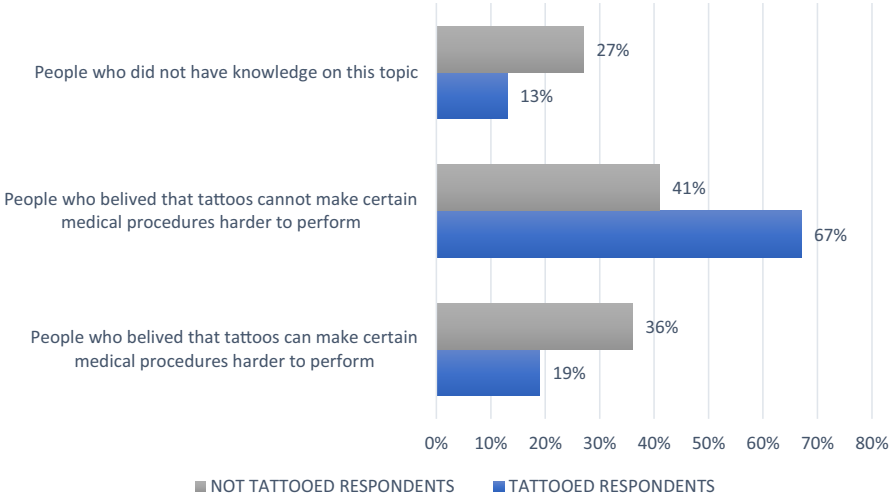

FIGURE 3 Comparison of percentage of tattooed (n = 326) vs not tattooed (n = 873) respondents, who believed that tattoos can interfere with the performance of certain medical procedures

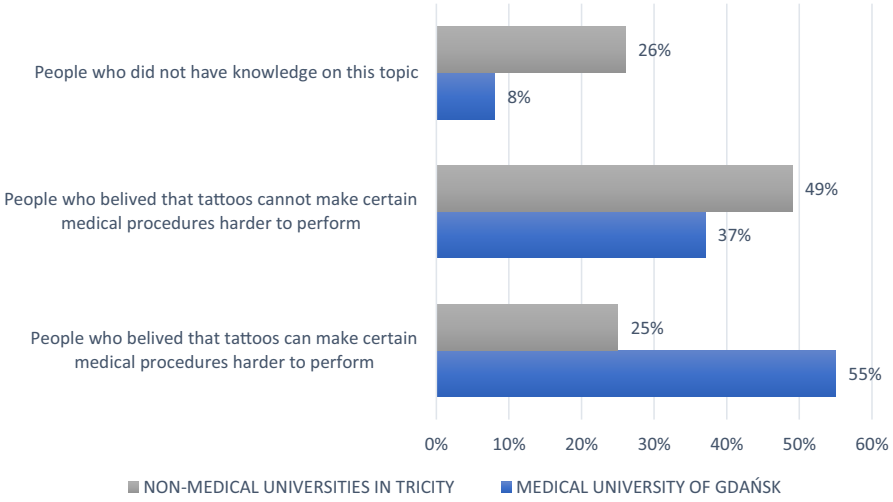

FIGURE 4 Comparison of percentage of medical (n = 214) vs nonmedical (n = 985) students, who believed that tattoos can interfere with the performance of certain medical procedures

6% of participants chose to forgo any additional safety information. Before the procedure, the tattoo artist had not asked almost 50% of respondents about their current state of health, any chronic illness, and medication taken. Fifty three percent of persons with tattoos admitted that the tattoo artist did not check whether the wound was healing properly. While choosing the placement of their tattoo, most of respondents were guided by their taste (88%) and the ability to hide it under clothing (56%). The risk of complications that might occur from exposing the tattoo to direct sunlight was indicated only by 6% of respondents. Complications after tattooing have been reported to occur in 10% of the participants, most of which were dermatitis reactions. In the study group, 73% of tattooed students answered that they are planning on getting more tattoos in the future, and 25% did not exclude such a possibility.

5 | DISCUSSION

To evaluate the knowledge about contraindications, complications, and health risk connected with tattooing, we chose to investigate the population of students, because they belong to an age group whose interest in tattoos is particularly high.[3,4] Additionally, students represent the part of young people with higher educational level; therefore, it can be assumed that they should have better knowledge about the risks connected with tattoos than other young people.

The results of the survey showed that almost half of respondents believe that having tattoos increases the attractiveness of the person. This may indicate that skin tattooing gives young people the opportunity to stand out from the crowd and make their image unique.

It is widely believed that the risk associated with tattoos occurs only with the lack of hygiene. However, even when the tattoo parlor maintains the highest standards of hygienic practices, there remains a risk of inflammatory complications. In the surveyed group, only a few of respondents indicated the possibility of complications other than infectious ones.

It is relevant to underline that tattooing is considered to be a risk factor of hepatitis C virus transmission.[15,16] The chances of getting HCV virus infection during tattooing were indicated by most of students from the Medical University of Gdańsk (which does not come as a surprise given their educational background), while much fewer students from other Tricity universities were aware of the danger.

Tattoos, especially the larger ones, may hinder the diagnosis of various benign skin lesions, as well as melanoma and skin cancers.[17] In addition, some authors believe that the inks used for tattooing may contain immunogenic or even carcinogenic substances such as polycyclic aromatic hydrocarbons that accumulate in the organism and are dangerous for the health.[18] However, currently, there are no legislations that would regulate the composition of the inks that can be injected into the skin.

Inks used for tattooing contain filings of metals, which can theoretically create an electric current during magnetic resonance imagining that increases the local skin temperature enough to cause pain and skin burns.[19] Among the respondents with tattoos, most of them untruthfully believed that tattoos cannot interfere with the performance of certain diagnostic and therapeutic procedures including magnetic resonance imaging, surgeries, and diagnosis of melanoma and skin cancers. Regarding this latter question, as previously, a significantly higher knowledge is showed by the students from the Medical University of Gdańsk, as more than half of them answered this question correctly. On the other hand, the correct answer was given by only 25% of the time by students of other Tricity universities.

There are various medical situations in which the risk of health problems related to tattooing increases significantly[20,21]. According to the respondents, when asked about them, the most common contraindications to the tattooing procedure were skin diseases and bleeding disorders. Less frequently, were marked such answers as: state after an organ transplantation, diabetes and heart failure; in which infections can pose serious health consequences[20,21]. Worryingly, before performing the tattoo, almost half of respondents had not been questioned by the tattoo artist about their current state of health, any chronic diseases, and medications taken. Additionally, 20% of respondents have gotten their first tattoo before the age of 18. This may indicate that tattoo artists are conducting insufficient interviews with the clients before the procedure. This negligence can have a significant impact on the health of a person who is getting a tattoo.

A positive result of the investigation is given by the fact that most of respondents with tattoos had them performed in a professional parlor. While choosing the studio, the majority of people were guided by the artistic capacities of the tattoo artist and secondly, by the compliance with hygiene rules. Analyzing these results, we can conclude that people who are debating on getting a tattoo put a higher value on esthetics over safety. Interestingly, as for the primary source of information about safety, contraindications, and complications of getting a tattoo, for most of respondents, it was the tattoo artist followed by Internet sources. Only a few of the people who were surveyed were decided to read medical literature and even less to visit a doctor. This latter choice, where to obtain information, may be caused by insufficient knowledge about potential contraindications and health problems associated with getting a tattoo.

Analyzing the sex of the surveyed population (911 women and 288 men), it can be assumed that women were more willing to fill out the online questionnaire than men.

Summarizing the results of the study, students of the Medical University of Gdańsk answered more questions correctly as compared to their counterparts at Tricity universities. This phenomenon can be explained as students in the medical field being better educated on this topic. In the study group, most of students with tattoos answered that they are planning to get more tattoos and many of them did not exclude such a possibility. These results confirm that due to the high interest in tattoos, problems associated with them may increase in the future.

The results of our study are based on an anonymously filled, online survey. It should be taken into consideration that because of its specificity, the adopted research method to collect data presents the risk of the data being biased to a certain degree.

This study, evaluating the students' knowledge about contraindications, complications and health risks arising from the tattooing of the skin, shows as young educated people have insufficient knowledge of the risks associated with this procedure. Specifically, both students' groups—from the Medical University of Gdańsk and other Tricity universities—share a relatively low level of knowledge on the researched topic. Nevertheless, in line with our expectations, more knowledgeable students about the risks associated with tattooing were found at the Medical University of Gdańsk, in respect to other Tricity universities. In addition, we can assume that the specific knowledge of other young people with lower educational level is also insufficient.

Consequently, this study, we hope, shows the need for a better education on the topic for both young people and the tattoo artists. Moreover, we believe there is a need for establishing regulations that would supervise the procedure of skin tattooing.

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Clinical, Cosmetic and Investigational Dermatology

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ORIGINAL RESEARCH

Tattooing in Psoriasis: A Questionnaire-Based Analysis of 150 Patients

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Purpose: Among populations of Western countries, tattoos have become an accepted form of skin ornamenting. With tattoos growing in popularity, also patients suffering from chronic dermatoses may more often be willing to get tattooed. Psoriasis is not considered as a strict contraindication for tattooing; however, it is not advised to get a tattoo while undergoing immunosuppressive treatment and during an active stage of the disease. We attempted to assess the knowledge level of tattooed psoriatic patients about the potential risks connected with tattooing, as well as to explore their attitudes and tendencies towards this procedure. Moreover, we analyzed the frequency and type of tattoo complications in this study group.

Patients and Methods: An anonymous, online questionnaire was performed among online communities dedicated to psoriasis. Data from 150 tattooed psoriatic patients have been scrutinized.

Results: Eight percent of the surveyed psoriatic patients sought medical advice before getting a tattoo. While undergoing the tattooing procedure, 23 (15.3%) of the respondents received systemic psoriasis treatment: 8 (5.3%) being treated with methotrexate, 5 (3.3%) with cyclosporine A, one (0.7%) acitretin, and 9 (6%) patients were under biological treatment. Thirteen (8.7%) of the participants experienced complications associated with their tattoos, among which, the insurgence of the Koebner phenomenon on the tattoo, was the most frequent one (8 cases- 5.3%). Getting tattooed improved patients' self-esteem in 76 (50.7%) of the cases.

Conclusion: An increased level of education among patients, medical practitioners, and tattooists concerning general precautions of tattooing in psoriasis is advisable.

Keywords: tattoo, psoriasis, psoriasis therapy, immunosuppression, Koebner phenomenon

Introduction

Tattooing the skin for decorative purposes is a popular procedure in the general population of Western countries with an estimated prevalence of about 10–30% among them.[1] With both growing interest in tattooing and its social acceptance, also people suffering from chronic dermatoses may be willing to get a tattoo. Psoriasis is not considered as a strict contraindication for tattooing, however, there are certain controversies about whether it is safe to get a tattoo in the active stage of the disease and while undergoing immunosuppressive treatment.[2] The most frequent complication in tattooed psoriatic patients appears to be the appearance within tattoo lines of the Koebner phenomenon, that is when new skin lesions appear on previously unaffected skin following trauma.[3] In fact, approximately 25% of patients with psoriasis are prone to koebnerisation, however, this tendency might change during lifetime.[4] Patients with a previous history of the Koebner phenomenon show a higher risk of its occurrence on the tattoo site.[5] Tattooing might also provoke generalized flare of psoriasis, characterized by the appearance of lesions not exclusively on tattoos, but also on untattooed skin. Finally, a coincidental presence of psoriatic plaques on the tattoo area can be observed.[3] Moreover, tattooing is a burden with a risk of various complications unrelated to psoriasis, such as infections, hypersensitivity to ink, or granulomatous reactions.[6,7] The risk of developing infectious complications after tattooing is higher while undergoing immunosuppressive therapies. Those are commonly used in the treatment of moderate to severe psoriasis and

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psoriatic arthritis.[8–10] It is advised for patients suffering from psoriasis to receive proper counseling from their dermatologist before tattooing in order to minimize the risk of such potential complications.

From a psychological perspective, tattooing may have a positive impact on people suffering from psoriasis. In this case, tattoos are in fact an opportunity to emphasize independence from the chronic skin disease. The negative stigma associated with psoriasis becomes "replaced" by a more positive one, which is having a tattoo; thus it can improve the patients' level of acceptance of their disease and increase their self-esteem.[5] In this study, we attempted to assess the knowledge of tattooed psoriatic patients about the potential risks connected with tattooing, but also explore their attitudes and tendencies towards undergoing such a procedure. Moreover, we analyzed the frequency and type of tattoo complications within this group. Lastly, we studied patients' motivations for tattooing and its influence on their self-esteem and psoriasis acceptance.

Materials and Methods

The authors' questionnaire has been conducted anonymously among 150 tattooed psoriatic patients (134 females, 16 males; mean age 32 years old). One hundred forty three (95.3%) participants were diagnosed with the type I psoriasis (diagnosis made before 40 years of age). Detailed characteristics of the respondents are shown in Table 1. The data were collected in the period from April to September 2020. The survey was constructed using Google Forms and published in the largest and most popular polish online communities dedicated to psoriasis. An online form to collect data has been chosen based on the study assumptions that many psoriatic patients might not seek medical consultation prior tattooing. Our intention was to include patients who decided to get a tattoo without asking their doctor's approval. The study exclusion criteria were: not being tattooed or not being given the diagnosis of psoriasis. The questionnaire consisted of three main parts: demographic data, medical history of psoriasis and the inquiry about the tattooing procedure. The first section contained general questions concerning age, sex, education, and place of residence; in the second part the participants were asked about the onset, course and treatment of psoriasis, while the third part concerned the influence of tattooing on psoriasis acceptance and self-esteem. In the psoriasis-dedicated section, patients were asked about the age of diagnosis, the predominant location of the psoriatic lesions on their body, as well as, whether they were receiving psoriasis treatment and if they had any, what kind of treatment it was (topical, systemic, phototherapy), and if they were receiving it at the moment of tattooing. Patients who were undergoing a systemic treatment when being tattooed, have been asked about the specific type of the therapy (photochemotherapy, methotrexate, cyclosporin A, acitretin, biologics). The tattoo-related part of the survey contained questions about the number of tattoos and the percentage of the tattooed body (for this purpose participants were asked to estimate the area of their tattoos considering the dimensions of their palm and assuming this was equal to 1% of their body surface area [BSA]); color and type of the tattoos; motivations for tattooing; if they were tattooed by a professional or amateur tattooist; whether the tattoo was done before or after the psoriasis diagnosis and if a medical consultation had taken place before tattooing. The final questions concerned the impact of psoriasis behind the reasons for getting tattooed and the consequences of tattooing on the participants' self-esteem. The results were later downloaded and analyzed using Microsoft Excel 2020.

Results

All the surveyed patients had at least one decorative tattoo on their skin. Ninety-six (64%) participants showed only black-colored tattoos, while the rest of them in multiple colors. Tattoos were covering less than 1% of the BSA in 38% of the respondents, 1–5% in 40.7%, 5–10% in 12% and more than 10% in 9.3% of them. One hundred thirty (86.7%) participants declared that they had been tattooed in a professional tattoo parlor, while 20 (13.3%) that had made their tattoo in amateur conditions. While choosing a tattoo parlor most of the respondents were seeking information about it on the Internet and through their acquaintances. In 114 (76%) cases, tattoos were carried out after being given the diagnosis of psoriasis. Eight percent of the patients had consulted a dermatologist before receiving a tattoo. Medical consultation prior to the procedure had been proposed by the tattooist in 18% of cases. One hundred one (67.3%) of respondents were undergoing psoriasis treatment at the moment of tattooing (as shown in Table 2). Out of these, topical treatment was received by 69 respondents (46%), systemic treatment by 23 (15.3%), phototherapy by 9 (6%). Eight (5.3%) were treated with methotrexate, 5 (3.3%) were taking cyclosporine A, 1 (0.7%)-acitretin. Nine (6%) patients were receiving biologics.

Table 1 Characteristics of Patients in the Studied Group

Parameter	n (%)
Patients	150
Age range	16–62
Mean age	32
Sex	
Men	16 (10.7%)
Women	134 (89.3%)
Place of residence	
Urban area	119 (79.3%)
Non-urban area	31 (20.7%)
Education	
Elementary	16 (10.7%)
High-school	73 (48.7%)
Higher education	61 (40.7%)
Type of psoriasis	
First type	143 (95.3%)
Second type	7 (4.7%)
First psoriasis onset	
Before tattooing	114 (76%)
After tattooing	36 (24%)
Tattoo type	
Decorative	149 (99.3%)
Permanent make-up	1 (0.7%)
Tattoo color	
Black	96 (64%)
Multiple colors	54 (36%)
Tattoo size (defined in % of the patient's body surface area covered with the affected tattoo/s)	
<1%	57 (38%)
1–5%	61 (40.7%)
5–10%	18 (12%)
>10%	14 (9.3%)
Amateur or professional tattoo	
Amateur	20 (13.3%)
Professional	130 (86.7%)

Table 2 Psoriasis Therapies Received by the Patients While Tattooing

Type of Therapy	n (%)
Topical treatment	69 (46%)
Phototherapy	9 (6%)
UVB 311	6 (4%)
PUVA-therapy	3 (2%)
Systemic therapy	23 (15.3%)
Methotrexate	8 (5.3%)
Cyclosporin A	5 (3.3%)
Acitretin	1 (0.7%)
Biological drugs	9 (6%)

Thirteen (8.7%) of the respondents experienced cutaneous complications associated with their tattoos. The most frequent complication reported, was the occurrence of the Koebner phenomenon in a tattoo (8 cases- 5.3%). Only in one of those cases, a koebnerisation secondary to tattoo has been the first onset of psoriasis. Generalized psoriasis flare-up was observed in 2 cases (1.3%). Other complications involved two cases (1.3%) of pruritic rash on the tattoo area and one case (0.7%) of a disrupted healing process characterized by the appearance of a prolonged inflammatory state in the tattoo wound. Out of those 13 patients who developed tattoo complications, 7 were during treatment while getting a tattoo (5 were using topical psoriasis treatment, one methotrexate and one PUVA-therapy). In only one case out of 13 a dermatological consultation has taken place before tattooing. The main motivation for getting a tattoo was seeking an improvement in body appearance (76%), followed by a desire to better express their personality (60%) and to commemorate important life events (39.3%). Four (2.7%) participants decided for tattooing because they wanted to camouflage psoriatic lesions and 7 (4.7%) expected tattoos to draw people's attention away from psoriasis. In the subjective measurement of the respondents, having a tattoo improved their level of psoriasis acceptance in 27 (18%) of the investigated cases, while self-esteem increased in 76 respondents (50.7%).

Discussion

Psoriasis is a common inflammatory skin disease with a prevalence of approximately 2% in the population of Europe and North America.[11] As in other life-long diseases a certain percentage of patients with psoriasis either have or plan to get a tattoo. Complications of tattooing in psoriatic patients are usually mild and transient, with a tendency to appear more frequently in the active stage of the disease or while undergoing systemic treatment. Nevertheless, patients interested in getting tattooed should be precisely informed about the potential consequences that might occur after the procedure.[3] In certain individuals, antibiotic prophylactic can be introduced in order to minimize the infectious risk of the procedure.[12] Only 8% of patients in our study discussed with a doctor their wish to get a tattoo. Similar results were obtained in a study from Finland, in which only 8.5% of psoriasis patients asked for a doctor's opinion on tattooing.[5] Low attendance at medical offices could result from patients' lack of knowledge about the risks associated with being tattooed, but also from the fear of being judged by the doctor who may not approve their decision for tattooing. According to the study performed by Grodner et al, the majority of dermatologists considered tattooing as a problem in psoriasis and more than half of them had an unfavorable opinion about this practice, regardless the fact that only 23.3% of them had actually encountered a tattoo complication in a psoriatic patient.[13] Alarmingly, 13.3% of the surveyed psoriatic patients had their tattoo performed in amateur conditions, instead of visiting a professional tattoo parlor. In the study evaluating the knowledge about tattoo complications among polish university students, it has been noticed that only 51% of tattooists inquire their prospective clients' health condition and taken medications.[14] In Poland there are no specific requirements in order to become a tattoo artist, despite the invasiveness of the tattooing procedure.

First-line treatment for moderate to severe psoriasis include therapies with oral systemic medications (methotrexate, acitretin, and cyclosporin A), phototherapy (UV-B or psoralen and UV-A), while biological drugs (TNF-α, IL12/23, IL17, or IL23 inhibitors) are used as second-line treatment.[9,11] Tattooing while under systemic therapy of psoriasis might be burdened by various potential health complications. Oral retinoids can cause excessive dryness and thinness of the skin and, consequently, impair the healing process of the tattoo wound, making it more prone to infections.[15] Phototherapy may trigger photosensitive tattoo reactions, as well as a premature fading of the ink.[7,16] Immunosuppressive treatments increase the risk of local and systemic infections, especially when a tattoo is performed in uncertain hygienic conditions. There are only a few cases of serious tattoo-related infectious complications caused by immunosuppression described in the literature, however, this risk should not be ignored.[8] Bacterial tattoo infections are a common complication of tattooing and are usually correlated with inadequate hygiene standards in a tattoo parlor, contamination of the tattoo ink bottles, but also with an improper care of the tattoo wound.[17] While most tattoo infections have a local character and are easily treatable, under certain circumstances they might lead to life-threatening septicemia.[18] The majority (67.3%) of the study participants required psoriatic treatment at the time of tattooing and 15.3% of them were under systemic treatment with biologics, methotrexate, cyclosporin A, or acitretin. Surprisingly, none of the patients receiving systemic drugs consulted a doctor before getting a tattoo. Considering those results, we noticed as most of the respondents, even those suffering from moderate to severe psoriasis, show little to no awareness of the potential health risks connected with tattooing. This confirms previous literature findings where it was observed as such patients do not have a tendency to seek any medical advice before tattooing, especially when their disease is

fully controlled by medications.[10] On the other hand, in our study, only one of the 23 patients who were undergoing systemic therapy while tattooing, developed a tattoo-related complication and it was not severe. Therefore, we believe more studies should be performed to access the influence of systemic treatment on the safety of tattooing.

The average latency period between the development of Koebner phenomenon after skin injury is about 10 to 20 days, but it can require several years.[4] Many different mechanisms are involved in the development of new psoriatic lesions after cutaneous trauma, of which disruption of the epidermis is a critical initiating factor.[19] Koebnerisation secondary to tattoo may occur in patients with already diagnosed psoriasis, but also "de novo" in patients with no previous history of psoriasis. Kluger et al described five different profiles of a tattoo-related outburst of psoriasis, depending on the previous history of the disease, its activity, and the distribution of psoriatic plaques on the skin.[20] In our study group, 13 out of 150 surveyed psoriatic patients experienced complications after tattooing, among which the occurrence of the Koebner phenomenon in the tattoo was the most frequent one (8 cases). In one patient, the development of psoriatic lesions in the new tattoo was the first symptom of psoriasis. A possible mechanism of the koebnerisation process secondary to tattoo could be clarified as a local alteration of the immune response after pigment injection. This theory of the "immunocompromised district" might lead to a possible explanation of viral infections, tumors, and other dysimmune reactions appearing on the tattoo sites.[21] It is not advised to get a tattoo during flares of psoriasis, as it is considered that during active and unstable stages of the disease, patients' skin might be more prone to koebnerisation.[4] Given the evidence, that Koebner's isomorphic response could develop years after the trauma, psoriatic lesions might appear in a tattoo even a long time after tattooing.[4] As pathogenic memory is formed within the skin due to epidermal memory T-cells, psoriasis has a tendency to recur in previously affected areas.[22] Consequently, once a Koebner phenomenon appears in a tattooed skin, it might continue to reoccur in the same location, which might permanently disturb the tattoo design.

Generalized flares of psoriasis after tattooing, that is when psoriatic lesions appeared in various body regions (not only in the tattoo area), were reported in two cases (1.3%). Taking into consideration that the psoriasis onset might be triggered by different factors, we can assume that being tattooed can cause an exacerbation of psoriasis as it entails a mechanical skin trauma and can be a stressful procedure for the patient.[11]

Pruritic rash localized on the tattoo appeared in two cases and in one case a prolonged healing process was described, however, those complications are quite common in tattooed individuals and were probably unrelated to psoriasis.[23]

Psoriatic patients, especially women and people of a younger age, are significantly associated with a higher risk of psychological distress, depression, anxiety, and suicidality.[24] Nevertheless, tattooing might have a positive influence on the mental health of patients suffering from chronic dermatoses, by creating a sense of control over their skin appearance. Moreover, tattooing could be a great tool for enhancing one's own identity and increasing sexual attractiveness. Only 4.7% of the patients in our study decided to get a tattoo to distract others from psoriasis, however, 18% admitted that their level of psoriasis acceptance has increased. Self-esteem levels improved in 50.7% of the cases. Those results implicate that tattooing might have a beneficial influence on the psychological well-being of psoriatic patients, which medical practitioners should also take into consideration while advising them about tattoos.

Limitations

Our research has some limitations, which should be discussed. The main restriction of the research is the inconsistency of demographic data and its survey-based methodology. The use of an online questionnaire for the data collection creates various methodological problems, like, for instance, the risk of underreporting patients who are not active in online communities. Nevertheless, as the Internet is currently an essential part of younger people's lives and online support groups have become a very popular communication tool, we believe that the population sample that we have studied is representative enough. Moreover, gathering data online allowed us to recruit more patients and was the most convenient option during the SARS-CoV-2 pandemic, that had an outburst during the time of our research. Another possible limitation was the predominance of female participants in the analyzed group. This phenomenon might suggest that women with psoriasis are more prone to tattooing rather than men. On the other hand, it could also signify that men are less likely to fill out questionnaires than women, which can be observed in various studies of this kind.[5,14]

Conclusion

To summarize, in our opinion, dermatological counseling is recommended for patients with psoriasis considering getting a tattoo, in order to advise them on choosing the best time for tattooing and the safest location for the tattoo on the body. Every patient under systemic treatment who is willing to get a tattoo should have an individual assessment of its risks performed by a doctor. Moreover, tattooists should be educated about the possible health complications connected with tattooing and on the precautions that should be followed. Furthermore, we believe that a standardized questionnaire, inclusive query about the client's medical history and medications, could be implemented by tattooists for the benefit of the whole tattoo-society.

Ethics Statement

The Ethics Commission of Medical University of Gdańsk approval was granted for this study. The informed consent was received from all of the study participants. Guidelines outlined in the Declaration of Helsinki were followed.

Disclosure

The authors report no conflicts of interest in this work.

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