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The Oxford Handbook of the Archaeology and Anthropology of Body Modification

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Franz Manni (ed.), Francesco d'Errico (ed.)

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CHAPTER

The Medical Anthropology of Tattooing, Past and Present

Michael Smetana, Christopher D. Lynn, Marco Samadelli

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Abstract

This chapter reviews the medical anthropology of tattooing from prehistoric to modern applications. The tattooing found on the 5,300-year-old Tyrolean frozen mummy called the “Iceman” is among the earliest evidence there is that tattooing was used to treat illness—notably, it may have alleviated the pain the Iceman likely suffered from arthrosis, biliary calculi, Lyme disease, or the prolonged use of the bow. Radiological studies have highlighted the direct relationship between lesion and cure, and the multispectral photography technique used to map the Iceman’s tattoos illuminated marks not otherwise visible. The chapter examines the cross-cultural use of tattooing for therapeutic and medical purposes, recent studies of how tattooing may prime the body’s healthy immune and endocrine responses, and dermatological and behavioral risk studies associated with tattooing. Finally, it advocates for newer research perspectives that consider tattooing forms as diverse, prosocial cultural practices with the potential to heal.

Keywords: [Iceman](#), [medical tattooing](#), [medicinal tattooing](#), [pigmented cicatrix](#), [therapeutic tattooing](#), [tattooing](#)

Subject: [Archaeological Methodology and Techniques](#), [Archaeology](#)

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Introduction

Tattooing is a form of body modification that humans have practiced for thousands of years. Tattoos can serve as a way of expressing one's identity, culture, beliefs, or aesthetics. However, the idea that tattooing can be medicinal or therapeutic may seem counterintuitive, since tattoos begin as dermal injuries that open the body to potential infection, disease transmission, and other health risks. Before the introduction of modern hygienic practices, infection from tattooing was common, and death was not infrequent (Jouveny 1896, 279–280; Moe 1989, 119; Parkman 1867, xxxiii). Given the potential risks, why has this form of body modification persisted since prehistory to occupy such a popular position across cultures and social classes today?

Anthropologists have been interested in tattooing since the emergence of the discipline and the distinction between decorative and “medicinal” tattooing was established in nineteenth-century studies of Egyptian mummy tattoos and noted in early twentieth-century studies of Arab tattooing in Iraq (Fouquet 1898; Krutak 2019; Smeaton 1937). Here, we take a medical anthropology approach to explore medicinal or therapeutic tattooing across cultures and throughout time and space. Medical anthropology is the study of health and illness with respect to ecological context, which includes sociocultural, political-economic, and globalizing factors. More generally, *medical anthropology* is the term used to group empirical and theoretical works produced by anthropologists related to sociocultural representations of health, illness, and care (McElroy and Townsend 2004; Scotch 1963). Through this lens, we see tattooing used to influence health and well-being, as well as to literally treat illness.

We will be discussing some of the same populations also mentioned in other chapters of this handbook (e.g., those by Deter-Wolf, Robitaille, and Sialuk Jacobsen; Krutak; and Gilreath-Brown and Deter-Wolf). Our focus, however, is on tattooing as a form of “medicine” rather than strictly for its apotropaic purposes—as protective magic used to ward off evil or bad luck associated with supernatural threats to human life and social groups. Nonetheless, we will occasionally reference apotropaic tattooing practices when they are clearly connected to medicine. We define “medicine” broadly as the knowledge, practices, and systems used to treat illness and promote health and well-being. Thus we will also consider medicinal practices outside of biomedical parameters, which tend to view the body as a biological machine that is somehow disconnected from belief systems, and with a general idea of well-being that extends beyond the individual physical body. We argue that, despite the pain and injury involved, tattooing can be seen as a therapeutic and medicinal, as well as symbolic, communicative, and aesthetic practice.

Therapeutic Tattooing in the Neolithic
















The oldest evidence of therapeutic tattooing comes from the naturally preserved remains of an internationally famous mummy known as the “Iceman.” This tattooed mummy is also the most ancient and definitive indication of tattooing (Deter-Wolf et al. 2016). The presence of tattoos on the Iceman's body have been noticed since the day of the mummy's discovery, on September 19, 1991, in the Italian Alps (Spindler 1996). Many coincidences contributed to the extraordinary story of this man, whose body was preserved in a glacier for over 5,300 years. The discovery of the Iceman has given researchers a glimpse of the health conditions in Southern Europe during the Copper Age and unveiled some of the medicinal knowledge of the Iceman's people.

For instance, the Iceman provides clues as to how tattooing was administered in antiquity. Archaeologist Konrad Spindler was first to analyze the body of the Iceman when it was transferred to Innsbruck, Austria. He concluded the tattoos were intended to relieve pain, a folk remedy still being practiced in the Alps (Spindler 1996, 173). The Iceman's tattoos were once believed to have been produced by making multiple

parallel or intersecting linear incisions with a scalpel, and filling the incisions with a mixture of herbs and setting fire to them, which also had the effect of cauterizing the incisions (Capasso 1998; Dorfer et al. 1998, 1999; Sjøvold 2003; Sjøvold et al. 1995; Van der Velden et al. 1995). However, recent experimental studies suggest the tattoos on the Iceman were made via the puncture tattooing method, possibly with an awl—a tool for piercing holes in leather (Deter-Wolf, Riday, and Sialuk Jacobsen 2023; Deter-Wolf et al. 2024). While, to date, there are no plans to examine the bone awl and horn tooth found with the Iceman to see if they were used as hand-tipped tools, this new research does not contradict therapeutic tattooing hypotheses made so far. The fact that not all tattoos are placed at wounds or painful areas does not automatically imply their symbolic meaning. As the oldest evidence of tattooing, these puncture markings have been closely scrutinized. This close attention has proven valuable; because of the current dark color of the Iceman's mummified skin, many of the tattoos are not visible to the naked eye even at close range. For this reason, infrared-sensitive analogical photography has been used to detect the Iceman's tattoos (Gaber and Künzle 1995; Krutak 2012; Sjøvold 1992; Sjøvold et al. 1995).

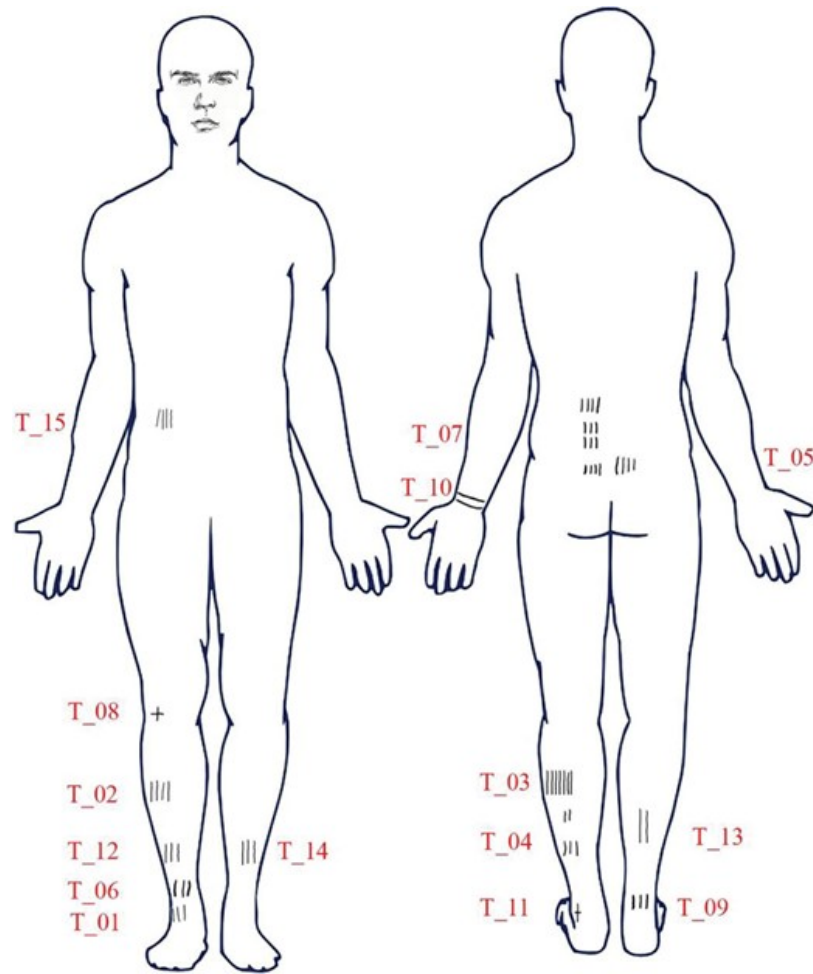
Based on their locations on the body, it was initially believed the Iceman's tattoos were the indirect results of other treatments for ailments, such as an ancient form of acupuncture, or a means to diagnose and treat other health problems (Capasso 1993, 1998; Dorfer et al. 1998, 1999). Some researchers have suggested that the tattoos could have marked the locations for treating lower back pain or degenerative joint disease in the Iceman's knees, ankle, and wrist (Dorfer et al. 1998; Kean et al. 2013). More recently, an in-depth study was carried out using 7-band hypercolorimetric multispectral imaging (HMI7) to determine the exact number and location of tattoos present on the Iceman's body (Samadelli et al. 2015). HMI7 is based on the detection of local spectral reflectance components of an acquired image. Using this technique, it was possible to identify and confirm the presence of 61 tattoos divided into 19 groups of lines on various parts of the Iceman's body as shown in Table 1 (see also Figures 1 and 2).

Table 1. Mapping of All Tattoos Present on the Iceman Body.

LABEL	POSITION	LINES	GROUPS	SIGNS	EXTENT min-max (mm)	LINE SPACING (mm)	LINE THICKNESS (mm)
T_01	right external ankle - malleolus externus dexter	3	1		17 - 20	4	3
T_02	right lower leg outside (lateral: proximal)	4	1		37	8	2
T_03	left lower leg (dorsal proximal)	7	1		34 - 38	5	2
T_04	left lower leg (dorsal distal)	5	2		13 - 20	3	1
T_05	right lower back (lumbal)	4	1		22 - 26	2	2
T_06	right lower leg outside (lateral distal)	3	1		20 - 26	2	3
T_07	left lower back (lumbal)	14	4		15 - 25	3	3
T_08	right knee inside (medial)	2	1		19 - 27	-	3
T_09	right lower leg (medial distal)	3	1		21 - 22	3	3
T_10	left wrist (dorsal)	2	1		37 - 40	8	2
T_11	left Achilles tendon (lateral)	2	1		7 - 9	-	1
T_12	right lower leg outside (lateral: centre)	3	1		20 - 23	2	1
T_13	right lower leg (dorsal medial centre)	2	1		30	2	1
T_14	left lower leg frontside (frontal medial distal)	3	1		20 - 23	4	2
T_15	right lower thoracic region	4	1		20 - 25	3	2
		61	19				

Source: ©EURAC Research-Institute for Mummy Studies / Marco Samadelli.

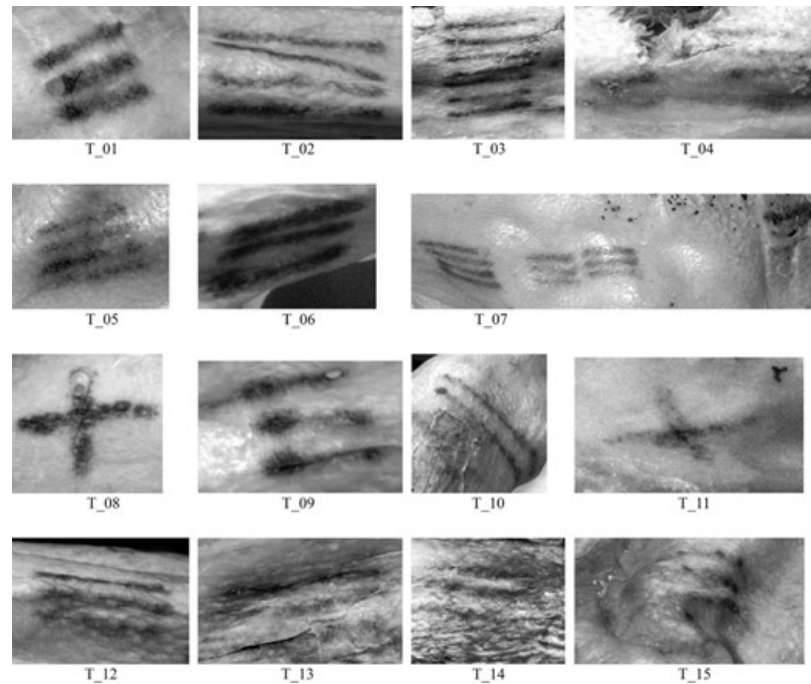
Figure 1.



Graph mapping all tattoos present on the Iceman body.

Source: ©EURAC Research-Institute for Mummy Studies /Marco Samadelli.

Figure 2.

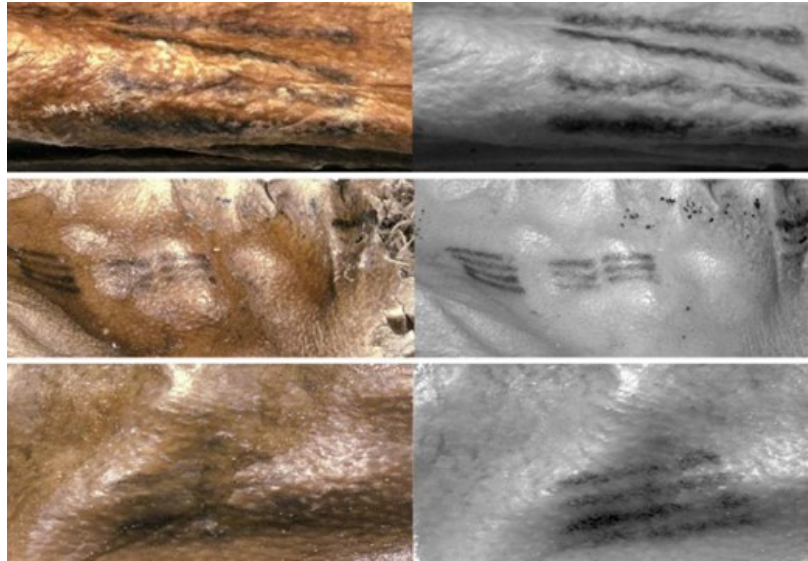


Set of tattoos on the Iceman seen through the results of the processing obtained by combining the HMI bands. Labels correspond to those reported in Figure 1 and Table 1.

Source: ©EURAC Research-Institute for Mummy Studies / Marco Samadelli.

The tattoos consist of linear markings ranging from 1 to 3 millimeters in thickness and 7 to 40 millimeters in length. The lines are parallel for each group, with spacing varying between 2 and 8 millimeters, and are mostly longitudinal with respect to the body. This execution method is common for all groups except two that are located on the knee of the right leg (T_08) (follows the numbering of Samadelli et al. 2015) and on the ankle of the left foot (T_11), respectively, where the lines form a perpendicular cross. These latter tattoos are distributed in two main groups on the lower back and lower legs. Others appear on the wrist and the abdomen. The right leg has seven groups (T_01, T_02, T_06, T_08, T_09, T_12, T_13), and the left leg has four groups (T_03, T_04, T_11, T_14; Fig. 2). Several highly visible tattoos are present in the rear right and left lumbar area (T_05, T_07; Figure 3). The longest markings are present in the tattoo around the wrist of the left hand (T_10), in which two parallel lines run 37 to 40 millimeters. The group with the largest number of parallel lines is in the left lower leg (dorsal proximal; T_03) and consists of seven parallel lines of varying length from 34 to 38 millimeters.

Figure 3.

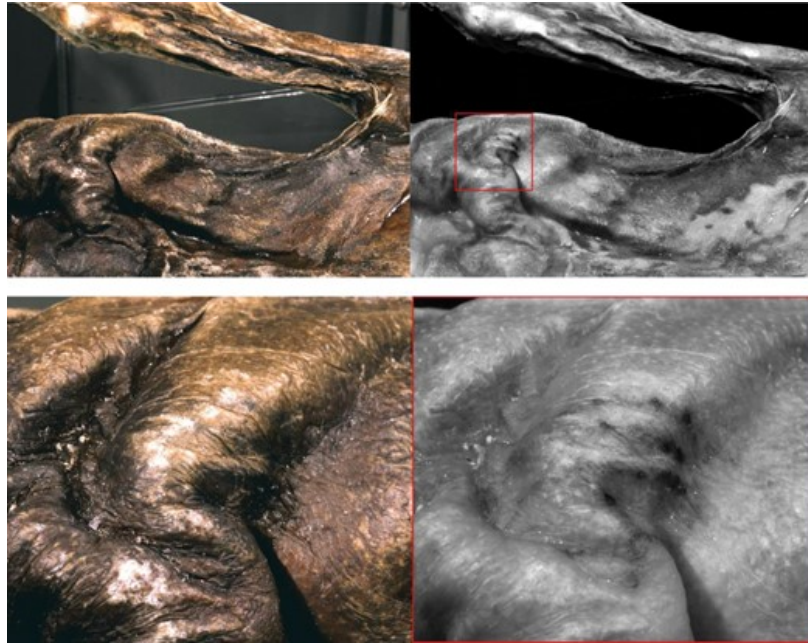


Comparison of tattoos found on the Iceman body (T_02, T_07, T_05) seen with the naked eye versus the results of the processing obtained by combining the HMI bands.

Source: ©EURAC Research-Institute for Mummy Studies / Marco Samadelli.

Most interestingly, through HMI7, researchers found an undocumented group of tattoos that could not be seen by the naked eye. This tattoo group is in the right lower thoracic region (T_15), showing four parallel lines 20 to 25 millimeters in length (Figure 4; also Fig. 1). This newly discovered set of lines represents the first tattoo detected on the frontal part of Iceman's torso and supports the therapeutic explanation for the tattoos, because the marks correspond with the detected gallbladder stones (biliary calculi), a condition that could have caused the Iceman pain in the chest area (Figure 5; Gostner et al. 2011).

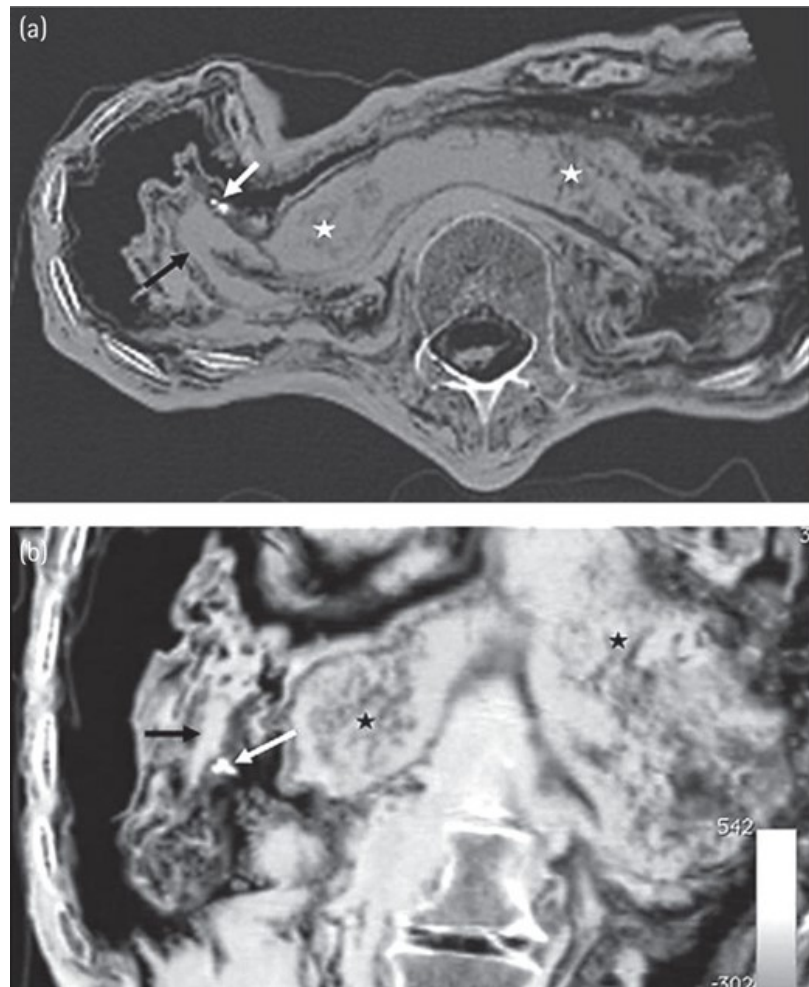
Figure 4.



Comparison of tattoo T_15 seen on the Iceman with the naked eye versus the results of the processing obtained by combining the seven HMI bands. Figures below are enlargements of figures above.

Source: ©EURAC Research-Institute for Mummy Studies / Marco Samadelli.

Figure 5.



Axial computerized tomography (CT) images of the abdomen of the Iceman. **(a)** The tubular, inhomogeneous organ is visible below the diaphragm, which can be identified as the full stomach due to its anatomical position (*stars*). **(b)** The right-view paravertebral reconstruction shows, respectively, two and three calcifications in the putative gallbladder site, which can be identified as gallstones (*white arrows*). To the right of the stomach the liver, extensively shrunken, is visible (*black arrows*).

Source: The images are of the resolution published by Gostner et al. (2011) ©*Journal of Archaeological Science*.

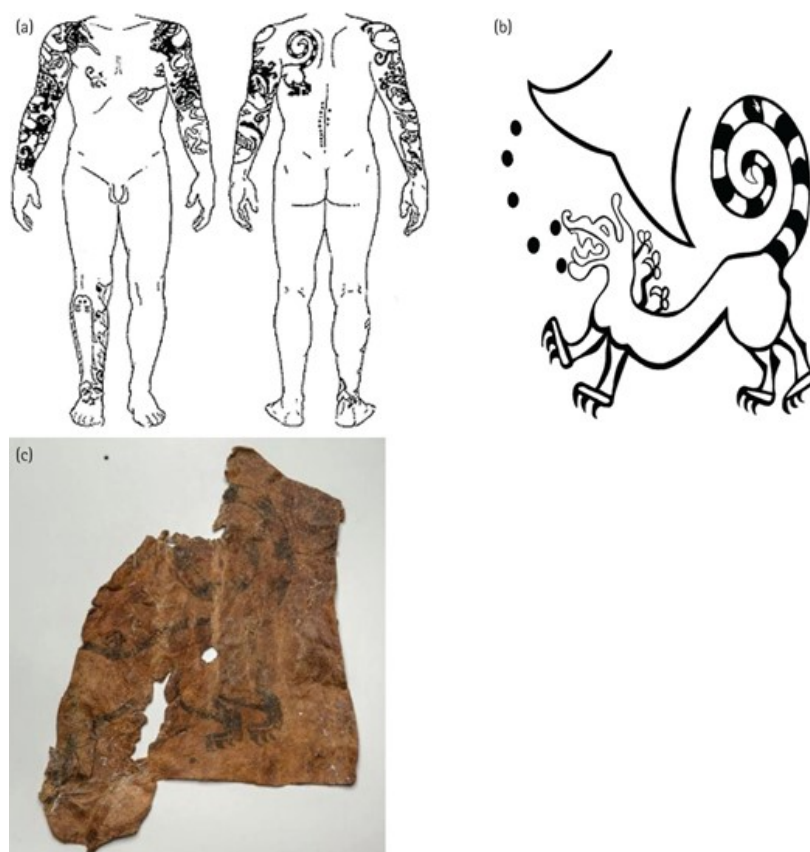
The Iceman, therefore, suffered from a variety of diseases. From the studies that have been carried out and genetic and microbiological analyses, a complete clinical profile has emerged, giving us better knowledge of the Iceman during his life and allowing us to understand the suffering that led him to search for potential therapies. He was prone to heart problems, had arterial calcifications, suffered from intestinal parasitosis (*Helicobacter pylori*), had gallbladder stones, was affected by Lyme disease, and showed spinal wear (Zink et al. 2019).

Together, the newly discovered tattoos, the previously identified tattoos located in areas where skeletal degenerations have been identified, and radiological investigations and molecular data about the Iceman's health problems at the time of his death are compatible with the hypothesis that the Iceman's tattoos were therapeutic treatments (Zink et al. 2014).

The Iceman is not the only prehistoric human with suspected therapeutic tattoos. Ukrainian Soviet archaeologist Sergei Rudenko's (1885–1969) descriptions of Pazyryk mummy tattoos appear to be the first attribution of therapeutic intentions to tattoos on mummies (Figure 6). He reported on the mummified remains of an individual from the Pazyryk culture (barrow 2), an Iron Age group found in Siberia (Rudenko

1949, 1970). Apart from the highly detailed and decorative animal tattoos he found on the mummy's arms and legs (including part of the back), Rudenko (1970) describes a series of simple, dot-like tattoos placed parallel to both sides of the spine and on the front of the right ankle and suggests that they were likely used as some form of therapeutic treatment. Rudenko's therapeutic hypothesis about the Pazyryk tattoos was based on observations of the contemporary Siberian Khanty and Yupiit populations, which practiced tattooing for alleviation of pain. Similar practices by other peoples in the region, such as the Nenets of Siberia (Middendorff 1847; Rudenko 1949), had inspired Rudenko's notion, even though the Pazyryk and these more recent peoples were separated by hundreds of years. The condition of the Pazyryk remains did not allow for exploring the underlying pathology, so the correlation with the Iceman that is so often discussed is difficult to confirm. However, Shishlina, Belkevich, and Usachuk (2013) note that some designs may have also been considered medicinal. For instance, ethnographic data from the same region indicates that snakes played a prominent role in sympathetic magic; a possible tattoo of a snake found on defleshed remains from the leg of a frozen Catacomb culture mummy (Bronze Age) had been placed over a callus caused by a fracture that may have caused the individual pain when walking.

Figure 6.



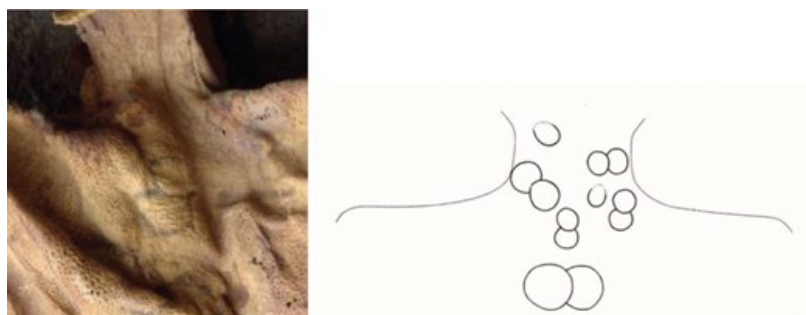
Pazyryk man (barrow 2) tattoos. (a) Drawing of Pazyryk man's tattoos front and back, including dots along spine and ankle marks (reprinted from Krutak 2019). (b) Close-up of right anterior ankle depicting dot tattoos (redrawn from Sergei I. Rudenko 1970, 262). (c) Remaining tattooed skin of Pazyryk man from upper left back with one possible dot visible (reprinted from Stepanova and Pankova 2017; Svetlana Pankova, pers. email comm., February 9, 2023).

Additionally, Pabst et al. (2010) describe two distinct types of tattoos on a 1,000-year-old mummy found in southern Peru (Figure 7). This female had decorative tattoos consisting of animals, abstract symbols, and circles on the back of the neck and lower back. The neck and back tattoos are considered to potentially have been therapeutic because they differ in several ways from the others, which have been considered more decorative. The decorative tattoos are specific designs with consistent form, located on body parts that were

likely visible to others, and appear to be pigmented by soot. The other tattoos corresponding to irregularly shaped circles are placed on the neck and on the back in areas that would likely have been covered by clothing or hair seem to have been pigmented with partly burnt plant material (Pabst et al. 2010). The locations on the body and style of these tattoos are similar to those of tattoos that have been applied to relieve pain and have no apparent aesthetic considerations, as have been documented in many places around the world by Krutak (Krutak 2013a; Piombino-Mascali and Krutak 2020).

Many mummies from Egypt have been found to have tattoos, including Middle Kingdom–period (2040–1782 BCE) mummies with tattoos associated with the protective deity Bes. These tattoos are located at the tops of thighs, suggesting protection or medicine for childbirth (Tassie 2003).

Figure 7.



Tattoos on the neck of a Chiribaya Alta mummy have been interpreted as therapeutic because of similarities to Pazyryk tattoos, but they may also simply be a different tattooing style (Figures from Krutak 2013a).

Interpretation from Aaron Deter-Wolf, personal communication, February 5, 2023.

However, therapeutic functions seem to have been attributed to any designs not considered communicative or symbolic in these few examples from antiquity. In some cases, such as that of the Iceman, the tattoos align mostly with underlying pathology, supporting the suggestion that the tattoo was intended to address pain or discomfort. In other cases, scans reveal no underlying pathology (Nystrom and Piombino-Mascali 2017).

Ethnographic Reports of Medicinal/Therapeutic Tattooing

Traveler accounts of tattooing have long reported on native tattooing used for medical and therapeutic purposes. These reports were generally vague and lacking in granular detail, so the descriptions “medical” or “therapeutic” should be considered broadly. We take a biocultural medical approach in including any tattooing purported to protect against or heal any ailment (Armelagos et al. 1992). Biocultural medical anthropology combines an ecological approach to health and disease with a focus on agency at various levels (individual, group, population, etc.). An ecological approach to health and disease “explicitly sets health, illness and disease within a system of *mutually interacting organic, inorganic and cultural environments*. These interactions are the source of options and resources for coping, as well as multiple constraints and insults” (original italics, Armelagos et al. 1992, 41). Furthermore, because of the nature of this review and the limited cultural or medical data available, we follow Piombino-Mascali and Krutak (2020) in including any cases that purport to be therapeutic, protective, or medicinal as reflections of belief and praxis, and we have leaned heavily on their published table of therapeutic tattooing around the world. In what follows, we have organized available accounts and information by geographic area, generally at the continent level, though the descriptions span large swaths of time and should in no way be considered representative of current peoples.

Oceania

The word “tattoo” derives from the Polynesian word *tatau*, used in Tahiti, Samoa, and Tonga. Although tattooing was a familiar practice, known by other terms previously, the investigations done on Captain James Cook’s (1728–1779) voyages included a closer scrutiny of cultural practices. The writings about those voyages led to increased fascination with tattooing (Douglas 2005). Because Cook’s missions were exploratory, the European crew members made particular efforts to get to know people they encountered, often living among the natives while on shore and trying to learn the native languages. Perhaps following the lead of the ship’s naturalist, Joseph Banks, who was given Indigenous tattoos in Tahiti, crew members also got tattoos, in native and European designs, applied by Tahitian artists. These expeditions were also characterized by violence, misunderstanding, strife, and exploitation, culminating in Cook’s death in Hawai’i. Nonetheless, Europeans quickly adopted tattoos and many other aspects of Pacific culture (Douglas 2005).

Within a few decades after Cook’s voyages (1768–1779), missionaries arrived in the Pacific and discouraged tattooing, which led to its eventual disappearance everywhere except the Samoan Islands by the early twentieth century (Allen 2005, 107; Mallon and Galliot 2018, 46–48), though other Pacific traditions may have persisted underground (Ellis 2008, 136–138). Nonetheless, there have been reports of medical and therapeutic tattooing being practiced and of possible therapeutic applications that have seen a resurgence among Indigenous peoples. Spennemann (2009, 120) suggests, for instance, that infection from tattooing was common among the Marshallese Islanders and other Melanesian groups, and so tattooists were often also healers. Coconut oil and *noni* (*Morinda citrifolia* L., a tropical tree whose fruit smells like cheese, which is commonly used medicinally) leaves were used to treat the extensive swelling often seen after tattooing. Infections were washed with a coconut husk solution. Infections were occasionally severe but rarely resulted in death (Spennemann 2009, 120). Maōri people of Aotearoa (New Zealand) made tattoo pigments from plants having medicinal properties (Te Awakotuku et al. 2007, 34, 39, 88). The Samoan tattooing practice is reportedly the only Pacific tattooing tradition that has been maintained without interruption (Allen 2005, 107), and contemporary Samoan *tufuga tā tatau* (master hand-tap tattooists) apply tattoos to cure goiter, gout, arthritis, carpal tunnel syndrome, and port-wine stain birthmarks.¹

Tattooing was likely brought to the Pacific during one or more of the migrations from mainland and Southeast Asia and Taiwan (Bellwood, Fox, and Tryon 1995, 288–289; Clark and Langley 2020; Green 1979; Kirch 1997). The tattooing tradition among the Ainu, the Indigenous people of Japan, is thought to have developed out of the preceding Jomon culture, approximately 10,000 years ago. Ainu tattooing was practiced by women on women, and tattoos were considered important prerequisites for marriage and entrance to the afterlife. The prominent lip tattoos were begun when women were young and added to as they grew older. The Ainu believed these tattoos repelled evil spirits from entering the mouth and causing sickness or misfortune. Other marks were placed on various body parts as charms against rheumatism, painful swellings, vision problems, and other diseases (Batchelor 1901, 20–24; Fitzhugh and Dubreuil 1999; Hitchcock 1892, 123–124; Kodama 1970, 121; Krutak 2007).

Similarly, the Indigenous Ryukyu people of Okinawa practiced tattooing until the Ryukyu Kingdom became part of Japan in 1899, which led to the restriction of Ryukyu language and cultural practices, including tattooing. Tattoos were applied by women to women and almost exclusively on the hands, though there were also applications for rheumatism, joint inflammation, neck, back, or shoulder pain (Furness 1899, 11; Glacken 1955, 236).

In the Philippines, the former headhunters of the northwestern Luzon, such as the Bontoc Igorot, Kalinga, Ifugao, and others, were heavily tattooed for both symbolic and therapeutic reasons. Although most tattoo designs commemorated achievements and events, simple marks were also placed on goiters, tumors, and varicose veins. The Kalinga were known to use centipede designs to ward off cholera. When the United

States became the colonial administrators of the Philippines, an American ban on headhunting in the early 1900s led to the disappearance of tattooing over the subsequent few decades as well, with a few exceptions (Salvador-Amores 2014). The last Kalinga warrior to wear tattoos to commemorate battle success (the victim was a Japanese soldier during World War II) also has marks on his throat to prevent goiter (Krutak and Sugguiyao 2010).

The Butbut are a Kalinga group whose tattooing practices, at least among women, have been maintained by such tattooists as the famous centenarian Whang-od Oggay, born in 1917 (Salvador-Amores 2014). Among the Butbut, women receive tattoos representing sun rays to cure goiter, other tattoos forms are said to cure back pain. The Butbut believe that the very act of tattooing is rejuvenating and get tattooed to toughen or strengthen themselves, as well as to cure infertility in women and improve male virility. In many cases, it was not the finished tattoo but the process itself that was believed to confer protection (Salvador-Amores 2014). Filipino anthropologist Analyn Salvador-Amores (2014) has likened this to the Shan Buddhists of Myanmar and Thailand, who thought of tattoos as vaccinations against supernatural agents (Tannenbaum 1987; McCabe 2002; Vanoverbergh 1929, 189).

Coastal peoples, such as the Sinagoro of Papua New Guinea, were extensively tattooed and, as with the Kalinga, the tattooing of males was linked closely to headhunting. Most tattooing declined rapidly after World War II, but ethnographers had documented some of the practices before they disappeared. These included using tattoos to treat rheumatism, sprains, and heart palpitations (Krutak 2007; Seligmann 1902, 298).

The Dayak comprise thousands of the inland peoples of Borneo, who also practiced headhunting. The Kayan, for instance, describe the balance that was necessary to appease spirits and avoid evil influences. This included the taking of heads to relieve tensions and grief, and tattoos were used to mark these accomplishments and protect the wearer and his people from various harms. In addition to these apotropaic uses of tattooing, the Kayan of Borneo, the Sarawak of Malaysia, and others also tattooed to alleviate joint sprains and muscle pain (Krutak 2007, 2013a).

Asia

Tattooing has a long history in India, which was first commented upon in the fifteenth century, though the ethnographic and historical information is spotty (Anderson 2000; Rao 1942). Some common tattoo designs among women are associated with magical ideas, including that they had healing powers. For instance, a black dot on the forehead or chin, symbolizing a mole, protected the wearer from evil. A line between the eyebrows represented the red powder or ash applied as protection from evil of all kinds. Figurative charms were also applied; for instance, spider tattoos had the power to cure leprosy. Mal Paharia women of Jharkhand thought that tattooing kept the body's organs healthy and functioning properly (Krutak 2009).

Britain's Superintendent of Ethnography Robert Russell (1873–1915) noted that many of the castes (as they were then called) used tattooing to treat pain and rheumatism, in addition to other functions. Among the many ethnic tribes of India seventy-four are designated “particularly vulnerable tribal groups” (formerly, “primitive tribal groups”), so called because they are preagricultural and preliterate (Gautam 2011). They are a subsection of the Scheduled Tribes or Castes (formerly the Lower Castes or “Untouchables”). Historically, many of these peoples were heavily tattooed. For example, the Ghasia women of Orissa and Central India, whose caste roles included cutting grass, tending horses, and acting as musicians in village festivals, were tattooed to prepare them for marriage, enhance their beauty, and treat pain (Russell 1912, 31). The Baiga, a hunter-gatherer people from Madhya Pradesh in Central India, are known to have tattooed themselves in painful areas to alleviate rheumatism and still practice this to some extent (Krutak 2009). The Baiga are tattooed by professionals from the Badna caste called *Godnaharin*, who once tattooed using a

pricking method but now use an electric tattooing machine. The pricking method was known to be extremely painful; older women used to chastise younger women who complained about the pain of tattooing, as the older women thought it preparation for the pain of intercourse. Baiga women who were interviewed in the 1990s said that their tattoos alleviated the pain from childbirth and arthritis, kept them immune to changing weather, prevented poisons from harming them, and helped them fight blood-related disorders (Krutak 2009). These protective functions appear related to the tattooing of a totem or deity that provides specific protections (Channawar 2019).

In the early twentieth century, Korathi (alternately Kaikāris, Korava in Hindu; also known as Gypsy) women from Mysore tattooed both sexes using a hand-pricking method (Krutak 2009; Rao 1942). Korathi women were heavily tattooed, as tattoos were considered a record of one's life for presentation to their deity. Untattooed people were sent to hell (Russell 1912, 302). Coconut oil was applied to the tattoo to alleviate pain, and a small amount of turmeric was added to brighten the colors of the pigment and prevent swelling. Some tattooists in India are believed to have added curative ingredients to the pigments, supporting the view that tattooing of the chest and shoulders was a way to treat the pain of rheumatism (Krutak 2009; Rubin 1988).

In neighboring Chennai (formerly Madras), tattoo artists were traveling women who went from town to town, applying symbols for luck and beauty. They also performed tattoo "operations" for muscular pain or disorders. A colonial museum administrator in India wrote about a local man who had received a tattoo of the god Hanuman at the site of the pain caused by a shoulder dislocation (Thurston 1907, 194). The belief was that tattooing a god over an affected area was a form of homage that would bring relief. However, because the tattoo was applied at the location of the pain, any reported relief could have also been produced by the physical stimulation of the tattoo needles, since acute pain is commonly used to alleviate chronic pain (Franklin et al. 2010).

Among the Gond, there were extremely specific tattoo protections, including designs to shield the foot from bruising or cuts or to give a woman strength during childbirth. The Gonds constitute one of the largest tribes in India and are among the Scheduled Castes and Tribes. Gond men and women were once heavily tattooed, but by the colonial period, the custom was dying out among men in general and in some ways among women (Russell 1912, 125). Robert Russell suggested that tattooing may originally have been a means of protecting the body against real and spiritual dangers, in the manner of then-current ornaments (1912, 125–126).

Russell (1912, 201) also noted that tattooing was used to treat rheumatism among the Halba, a caste of cultivators and farm servants. Halba tattoos were administered to women before marriage, by female tattooists belonging to the Dewar caste. Halba children who were slow to walk could be tattooed on the loins above the hips to stimulate development. Russell (1912, 201) compared tattooing to the bee sting therapy, which was popular at the time in Britain.

Ethnographic studies of tattooing among the Arab peoples of Africa and Asia were conducted by American anthropologists Winifred Smeaton Thomas (1903–1987) and Henry Field (1902–1986). They noted that most tattooing was conducted by women for various forms of protection, such as to ensure successful childbearing or a husband's continued devotion. Additionally, many tattoos were given to treat pain or illness. Among the Bakhtiari of Iran, the use of tattoos as a treatment for a tumor has been reported. The Bedouin of Iraq and Syria applied tattoos to treat sprains, headaches, wrist/hand weakness, rheumatism, toothaches, and vision problems. The Ghilzai of Afghanistan also reported tattooing for joint pain. The Kurds of Iran and Iraq tattooed to treat headaches, rheumatism, weakened wrists, and other localized pain (Field 1958; Krutak 2007; Sahai 1904, 148; Smeaton 1937, 54, 56).

Africa

During the Age of Exploration, Europeans became aware of tattooing among Africans before they encountered it in Polynesia, meaning that it was known by Europeans even before it started to be identified with the word “tattoo,” derived from *tatau* (Tahiti, Samoa, Tonga). The Portuguese began trading for decorated ivory on the West African coast in the mid-fifteenth century, and salt cellars and other ivory goods crafted in this region and period clearly depict scarified African figures (Curnow 1983, 453). Furthermore, art historian Kathy Curnow (1991, 20) suggests that the figures on a fifteenth- or sixteenth-century salt cellar from Sierra Leone depict scarified *lançados*, European males who jumped ship, married local African women, and became intermediaries in the Portuguese-African trade. The Portuguese slave traders working off the coast of West Africa would have seen thousands of scarified and tattooed faces, indicating tribal differences among the Benin, Fulani, Yoruba, and other slaves and traders working the region during that period (de Souza and Agostini 2012; Keefer 2013; Krutak 2013b; Ossai-Ugbah and Ogunrombi 2012).

Scarification with and without pigmentation has been more common in Africa than in other parts of the world. Researchers speculate that tattooing is more commonly practiced among people with lighter skin whereas scarification is more common among people with darker skin, presumably because tattoos on dark skin would be less visible, though this hypothesis has not been systematically explored (DeMello 2007, 235; Garve et al. 2017, 708). Reviews of early travelers’ accounts of tattooing and scarification in Egypt and elsewhere in Africa indicate that some types were reported to have medicinal purposes (Keimer 1948; Myers 1903).

Accounts of tattooing come largely from the nineteenth century in the form of reports to colonial agencies. Tattooing was reportedly common among the Fulani, for instance, who wore distinctive tribal marks considered important for attractiveness and identity (Bovin 2001). The Fulani are nomadic pastoralists with a deep history in northern Africa. They fled British colonial incursions into the Niger region and relocated north into the Sahel region of North Africa extending from Chad to the Sudan. Some Fulani groups became settled and urbanized, while others maintained cattle herding and traditional lifeways (Bovin 2001). Among the Fulani herding groups are the Wodaabe, who are the most heavily tattooed of the Fulani. Wodaabe means “people of the taboo” because of the many cultural prescriptions they adhere to, including traditional pastoral ways of living—and tattooing. More than seen in other Fulani groups, Wodaabe tattoos are used as charms and talismans, and others involve pigments with medicinal cures. According to American anthropologist Lars Krutak (2012, 256), some contemporary Fulani among the settled groups—called Peul in some languages—also hold beliefs in tattoos as protection against *jinn* (possessing spirits).

The Fulani use both hand-poke and pigmented cicatrix tattooing techniques. The hand-poke method involves pricking the skin with a pigmented needle (made of metal, bone, antler, cactus spine, etc.; see Robitaille et al., this volume, for more on pre-electric tattooing methods). Pigmented cicatrices are made by cutting small incisions with razor-sharp implements and rubbing pigment into the incisions. Medical and magical tattoos are made by mixing herbs and other substances with pigments. For hunting magic, charcoal from the remains of previous kills is mixed with the pigment. The Bushmen of Namibia and southern Angola make an incision between a person’s eyes to give them better sight, stamina, and power. The Kwengo Bushmen placed more tattoos on important muscles and rubbed special substances into the incisions (Fisch 1991).

The tattooing traditions among the Fulani were common in the region before colonization. The British expansion into the Niger region during the colonial era capitalized on the collapse of the Benin Empire, which had been facilitated by warfare and slave trade. The Benin Empire (1440–1897) was founded by the Bini (“Bini” is a Portuguese corruption of “Benin”) or Edo people of Southwest Nigeria, for whom an body

unmarked by either tattooing or scarification was considered polluted with symbolically clotted blood that could only be released through tattooing (Nevadomsky and Aisien 1995).

To the west of the Edo, another major ethnic-linguistic group known for their scarification-tattooing practices are the Yoruba. The Yoruba at one point received extensive pigmented cicatrix patterns, both to mark various life events and because they are considered important elements of Yoruban attractiveness. The incisions are painful precursors to life and are required before marriage to prepare women for childbirth. The Yoruba consider the ability to manage the pain of scarification preparatory and analogous to exerting self-control. Elaborate body markings thus become visible evidence of courage, fortitude, and strength. Like their neighbors, the Yoruba also practiced medicinal scarification-tattooing, mixing herbal remedies with soot or lampblack. The treatments corresponded with local ailments; for instance, short vertical marks were scarred and treated with medicinal pigment beneath the eyes of children to prevent them from trembling. Herb-infused incisions near the mouth were used to give hunters courage and improve their memory (Drewal 1988).

Many of these scarification-tattoo practices are still used and for the same reasons. In a survey of three hundred people from tribes in the South-South political region of Nigeria (including the Etsako, Ika, Edo, Ukwuani, Esan, and Ijaw) who were queried about medical markings, respondents from every tribe reported the practice of medical scarification-tattooing. Medical markings were most common among Ijaw, Edo-Benin, and Ika peoples, and the use of scarification-tattooing to treat sickness was also commonly reported among the same people (Ossai-Ugbah and Ogunrombi 2012).

The Baule are a people from Ghana and Ivory Coast who also practiced various types of scarifications before and during the colonial period, including medicinal tattooing. Three short markings between the breasts or pectoral muscles having a small dose of a local poison was generally protective and may have primed the immune system. Three marks on the arm could protect against snakes or poison. Three lines radiating from the mouth were also considered protective. In all cases, medicines were mixed with pigments or applied alone. Most scarification was applied as coming of age marks, but children could be marked to protect them if there were concerns for their health (Vogel 1988, 102–103). Among the Gonja and Dagomba women of Ghana, navel scarification and tattoos were said to be used to ward off sickness or as treatment for stomach complaints (Armitage 1924, 2, 13, 15).

In Senegal, a traditional form of tattooing unknown elsewhere is gingival tattooing, or tattooing of the gums. Thorns are tied together, and one of possible three treatments is applied with a hand-poke method to treat periodontal disease. A survey study conducted to determine the efficacy of this treatment showed that 52 percent of people with tattooed gums were free from clinically detectable gum inflammation; whereas only 40 percent of people without tattoos were without inflammation. This difference is small and the benefit may dissipate with age, as repeated tattooing leads to increased gum inflammation (Diallo et al. 1995).

In equatorial areas of Africa, tattooing was once common among the Fang, a forest-dwelling people living across regions of today's southern Cameroon, northern Gabon, and Equatorial Guinea, where they may have moved as the Fulani and other groups created geopolitical pressures through other migrations. Like other nearby peoples, the Fang wore designs all over their bodies and faces that were created by rubbing pigment into incisions. Many of the Fang designs carried apotropaic power or protection and healing attributes, such as tiny linear cuts at the temples or on the arms of children to eliminate a variety of afflictions (Sabater and Sabater 1992).

In Mozambique, various tribes used facial tattooing as marks of identity, but they also viewed tattoos as evidence of strength or of having been made strong through the duress and susceptibility to infection of the tattooing and scarification process. As American historian Heidi Gengenbach (2003) notes,

being tattooed means giving up one's blood and allowing it to freely fall on the ground, which makes one vulnerable to the supernatural, physical, and social threats of all kinds. However, blood shed to obtain *tinhlanga* brings valuable rewards; new bonds of kinship (a kind of "blood sisterhood"); proof of nerve and bravery; and, ironically, a kind of dually regendered prestige, for if tattooing contributes to the making of girls into women, it does so in part by mimicking the battlefield heroics of men. (119)

The Amhara are the dominant contemporary people of Ethiopia, whose ancestors are Indigenous Hamitic people, highlighting past migrations of Semitic people of the Middle East into the region. Christianity has also exerted a significant influence, which is visible in the tattooing. Amharic art, including tattoos, integrates Christian imagery but also talismanic elements to ward off evil and disease. For instance, people may wear a cross tattoo as well as other marks placed on the neck to prevent goiter. Both the Christian and non-Christian tattoos may also be considered necessary for beauty, as has been described for other cultures (Young 1967, 11). Similar patterns of tattooing have been noted among Arab peoples of Egypt, Tunisia, and outside Africa (Field 1958; Smeaton 1937, 54, 56).

The Makonde are an ethnic group spread across Mozambique, Tanzania, and Kenya whose tattoo artists also sometimes serve as traditional healers. Throughout Mozambique, such healers make two small incisions and rub herbs into them as treatments. Many of these incisions come to resemble scarification or pigmented cicatrices. For Makonde, up until the early 1960s, facial tattooing was so important an aspect of cultural identity and marker of courage that young people without the tattoos were not considered marriageable (Krutak 2008).

Madagascar is the fourth largest island in the world and the closest in proximity to the continent of Africa, though the earliest human migration to the island appears to have come from Southeast Asia. Tattooing was disappearing from Madagascar in the 1950s when it was being documented, so even on the island, the extent of the practice is unknown. Madagascar has approximately eighteen ethnic groups, the lowest status of which are the later immigrants from the African continent. It may be due to this migration relationship that Malagasy tattooing practices appear to have been like those among the Makonde and other groups in nearby Mozambique. This is the case with the Antandroy of the southernmost region of Madagascar, who put a scorpion tail shape on the outer edges of eyebrows to protect against eye diseases. This should not imply that tattooing diffused to Madagascar with these latter migrants, as the Tanala of the forested areas of southeast Madagascar also wore similar tattoos. The Tanala area was the first region of Madagascar settled by humans, and it has seen repeated replacements during periods of conflict. Perhaps internecine warfare makes protection against envy and social ills more important than physical ailments, as the Tanala wore forearm chevron tattoos for physical protection from evildoers (Decary 1935).

North America

Tattoos have been widely used as protection, both spiritual and physical, and in ways that could be deemed medicinal in North America, as Krutak (2014) discusses in his book-length treatment (see Krutak, this volume, for more information on Native North American tattooing). For instance, Jesuit writers suggested that the Native Huron people of Eastern North America used both body paint and tattooing to “harden” the body as protection against winter cold (Bressani 1899, 250; Jouveney 1896, 279). Among the Iroquois of the northeastern region of the current United States, women were rarely tattooed but sometimes received them to alleviate toothache or rheumatism pain (Lafitau [1724] 1977, 35). The Chippewa of the Northern Woodlands put tattoos over pained areas to treat various types of pain. These had no specific designs but looked like blueberries. Tattoos were administered using a hand-poking method and pigments that may have included herbal remedies (Hilger [1951] 1992, 93). The Menominee and Meskawaki of the Great Lakes also tattooed to alleviate aches and pains (Hilger 1960, 52). Another report notes the Menominee also got Thunderbird tattoos with various herbs mixed in the pigment and that tattoo needles were said to be a gift to humans of the Thunderbirds (Krutak 2014; Skinner 1921, 134–135).

Among the Yavapai and Apache of the Southwest region of the current United States, women were tattooed with a stick figure of a child or similar design to induce conception, while women the Wukchumni of California and Akimiel O’odham of Arizona had their faces tattooed to preserve their youthful appearance (Corbusier 1886, 280–281; Gayton 1948, 69; Gifford 1936, 276; Hrdlička 1902, n.p.; Krutak 2014, 133; Russell 1908, 162). Through the Native American West, tattooing was used for treatment of tuberculosis, arthritis, and other chronic pains. The Yuki also reportedly tattooed to alleviate the pain of rheumatism (Foster 1944; Skoggard 2003). Others report that the Yuki and Tuolumne Miwok tattooed sites of chronic pain with a pigment of charred white sage (Barrett and Gifford 1933, 224; Essene 1937, 59; Krutak 2014, 135; Merriam 1966, 349). American anthropologist Edwin M. Loeb (1894–1922) noted self-tattooing among the Pomo to treat rheumatism of the knees (1926, 158).

Likewise, Arctic and Subarctic peoples such as the Ojibwe had similar practices, using tattooing to treat rheumatism and muscle aches. The pigments are believed to have been medicinal, as the ingredients were kept secret. The knowledge about how to apply such tattoos was typically the province of women, who either dipped the needles in a medicinal substance and then pricked the skin or applied the medicine to the skin and then pricked the area (Hilger [1951] 1992, 93). The Nlaka’pamux and other groups of the Subarctic Plateau region sometimes instructed sick people to consult their guardian spirits in dreams about what and where to tattoo themselves for a cure (Lantis 1984, 174). Among the St. Lawrence Yupiget, tattooing was first documented by English explorer Martin Frobisher (1535–1594) in 1576 (Krutak 2000). According to Yupiget sources, the origin of tattooing was associated with the creation of the sun and moon and sickness with the loss of the soul. Thus, tattooing carried great power (Krutak 1999, 2000). At death, souls were believed to linger and to have malignant intent, entering the living through the body’s joints, but the elements of the tattoo had specific apotropaic powers to prevent this. For instance, during funerary rituals, when the pallbearers and others were near the dead and at risk of spiritual attack, protective dots were tattooed at the joints. The ink was a mixture of lampblack and urine, combined with lubricating seal oil and applied by passing coated whale sinew (substances abhorred by evil, according to Yupiget informants) beneath the skin with a sewing needle. We note that the tattooing of joints was also common practice among the Yupiget as a treatment for joint pain. Furthermore, the Yupiget practiced therapeutic bleeding and believed the bleeding that took place during tattooing was beneficial (Krutak 1999, 2000). Other Alaskan Native groups such as the Alutiiq of Ugashik and Egegik, the Aleut, and the Chukchi also tattooed joints during their puberty rituals, which were believed to be protective against joint diseases (H.D. Anderson and Eells 1935, 175; Krutak 2012; 2014, 46–54; Laughlin 1951, 117; 1980, 104–105; Sverdrup 1978). Ingalik Athabaskan tattooers placed heart-shaped designs over the heart to cure heart disease. Dakelh women of British Columbia got marks on their arms and legs to make them stronger (Jenness 1946, 54; Krutak 2014,

49; Morice 1893, 182; Osgood 1940, 73; 1936, 99). Tattooing among the Inuit, a group of related peoples spread across northernmost North America, was primarily the domain of women, but men were sometimes tattooed as part of shamans' curing ceremonies (de Cocola and King [1954] 1986). One Copper Inuit woman warned that "if one is afraid of being tattooed one will have much worse pains when the child is coming" (Jenness 1946, 53). The Tetlit Gwich'in also tattooed the faces of people with facial paralysis, which they claimed helped restore sensation (Krutak 2014, 49; Osgood 1936, 99). For more on Inuit tattooing, see Sialuk Jacobsen, this volume.

Historical Accounts of Medical Tattooing

In 1891, the first electric tattoo machine was patented, making tattooing widely available for biomedical applications. By the early twentieth century, feminist movements, women's socialization into a "beauty culture," and the Industrial Revolution had combined to create a consumer class and society, leading to the development of aesthetic surgical procedures. These methods incorporated tattooing as a lucrative practice into the US and European medical systems (Vassileva and Hristakieva 2007). The medical specialties of plastic and aesthetic surgery would emerge after World War I, and postoperative tattooing after reconstructive surgeries to improve the appearance of soldiers wounded in the trenches became a part of it (Byars 1945). Tattoo artists of the so-called Golden Age, as the period between the world wars has been termed, reported tattooing some people repeatedly at the sites of particular ailments and giving old sailors ink-less tattoos so that they could gain the benefits of the vibrating needles on rheumatoid joints (Parry [1933] 2006, 137).

Medical tattooing with red cinnabar, the toxic mineral mercury sulfide that has been a component of traditional medicines for thousands of years, was popularized during the late 1930s and 40s because of its efficacy in treating cutaneous syphilis-like skin lesions and severe genital itching (Liu et al. 2008; Hollander 1938; Turell 1940). By the mid- to late twentieth century, medical tattooing was being widely practiced in the United States and Europe, for a variety of procedures including in the treatment of port-wine stains (a type of birthmark) and corneal opacities/scarring; as a novel method in the field of endoscopic tattooing to mark colorectal polyps for removal; nipple and areolar reconstruction in burn patients; and as permanent eyeliner (Angres 1984a, 1984b; Bunchman et al. 1974; Sauntry and Knudtson 1958; Vassileva and Hristakieva 2007).

Medical Tattooing Today

Medical tattooing is now commonly referred to as micropigmentation and dermatography.

Micropigmentation is the term used in the US literature to describe cosmetic tattooing and permanent makeup; whereas *dermatography* is used in Europe to describe tattooing to correct cosmetically disabling disorders (Vassileva and Hristakieva 2007). These techniques are used in a range of medical disciplines and conditions—such as hyper- or depigmentation from congenital defects, traumas, and skin diseases (e.g., vitiligo, piebaldism, halo nevus, postburn scars, alopecia areata, and syringomata). Dermatography is also a common postoperative technique used in plastic, reconstructive, and craniomaxillofacial surgery to improve aesthetics in individuals with unilateral and bilateral cleft lip and palate bald spots. Additionally, dermatography is used for nipple-areola complex reconstruction after mastectomies for breast cancer, congenital abnormalities, posttraumatic deformations, and breast surgery complications (Van der Velden et al. 2001). As in endoscopic tattooing—a safe, minimally invasive procedure that has become the gold standard for locating small colorectal tumors—medical tattoos are also commonly used in radiation oncology to mark sites of repeated radiation treatments (Washington and Leaver 1996; Yang et al. 2017).

Recently, there have been some interesting developments for the future of medical tattooing. Electrochemical biosensors inserted in the skin with a tattooing machine have been developed for the noninvasive, real-time monitoring of lactate in sweat. Similar intradermal tattoo biosensors have also been developed for colorimetric metabolite detection, which may eventually be used to manage acid-base homeostasis, diabetes, and liver failure in point-of-care settings. Measurements from these dermal tattoo biosensors can be obtained noninvasively and displayed in real-time with a smartphone diagnostic report (Jia et al. 2013; Jiang et al. 2020). While tattoos have obvious medicolegal importance in the identification of individuals (Mallon and Russell 1999), they can also be applied to give useful medical and biologic information about an individual. The *Blutgruppentätowierung* that were applied to the arms of a significant fraction of the Waffen SS during the Second World War is an example that combines both purposes, because tattooing the blood group was meant to make transfusions faster and safer in the event of war injuries and since the end of the war has also been used to identify SS criminals. More recently, medical-alert tattoos have been developed to inform care workers about an individual's health conditions, such as diabetes, as well as their resuscitation instructions and organ donor status (Kluger and Aldasouqi 2013).

Butterfield et al. (2020) have extended the application of tattooing in biomedicine by engineering the first type of nanoencapsulated dye to work successfully in living human tissue. This semipermanent ink can detect dangerous levels of ultraviolet light exposure, providing visual cues to decrease sun exposure and thereby prevent skin cancer. Such “solar freckles” (2020, 13621) are photochromic, intensifying in color when activated, and can remain functional for months. Butterfield et al. (2020) have also developed similar inks for smart tattoos that can detect other forms of harmful radiation. They suggest these tattoos could replace personal dosimeters, wearable devices that detect radiation exposure, which could increase compliance in environmental and occupational health and safety settings.

Tattooing and Trauma

Outside the medicalized use of tattooing to mark or mask sites of disease or enhance certain bodily features, tattoos are also used in a personal way in healing from various traumatic experiences. Trauma is “an overwhelming experience of sudden, or catastrophic events, in which the response to the event occurs in the often delayed, and uncontrolled repetitive occurrence of hallucinations and other intrusive phenomena” (Caruth 1991, 181). Researchers theorize that when a person experiences a traumatic event, they are unable to fully take in, let alone describe, what has happened to them. Essentially, traumatic experiences can cause breaks or gaps in one's consciousness that lead to feelings of stress and anxiety. In trying to fill these “gaps,” people often engage in acts that simulate or repeat the trauma as means of making sense of the experiences or to create stories that help with healing (Caruth 1991). The process of being tattooed can be a form of storytelling that enables people to return creatively and symbolically to their traumas, which helps them heal and survive (Sarnecki 2001).

Recently, there has been an explosion of academic interest in the healing potential of tattooing for survivors of trauma. For example, Crompton et al. (2021) explore personal accounts of tattooing by trauma survivors. They draw on psychological and cross-cultural perspectives, to suggest that the process of tattooing may be both a way of coping with the experience and a cultural practice of meaning-making. Similarly, Buckle and Dwyer (2021) investigate the increasing popularity of getting a memorial tattoo as an active response to loss and a visual expression of grief after the death of a loved one. They propose that memorial tattoos serve as embodied processes of meaning-making during experiences and expressions of grief. Reid-de Jong and Bruce (2020) explore postmastectomy tattoos as part of a social movement promoting self-expression, embodied healing, and transformation. Postmastectomy tattoos provide an alternative way to heal from the trauma of experiencing breast cancer and a mastectomy, while also challenging the hegemonic, patriarchal ideals of female beauty (Reid-de Jong and Bruce 2020). Maxwell and colleagues (2020) report on the tattoo

motivations for survivors of sexual trauma and also suggest tattooing as a nontraditional form of healing and means of resisting hegemonic and patriarchal control. Alter-Muri (2020) suggests tattooing's art therapy potential to promote healing, explore identity, and help clients open themselves up to the therapeutic process by having them share their "tattoo stories" or the meaning behind or experience of getting each tattoo.

Immune and Endocrine Responses to Tattooing

Biological studies of tattooing have mostly focused on the associated health risks, neglecting the potential benefits (Lynn and Medeiros 2017). However, across cultures, tattooing is commonly viewed as an important sign of adulthood or maturity, because tattoos indicate toughness or the ability to withstand pain and hardship, and many peoples believe the tattoos make them biologically stronger (Krutak 2015). Based on their Six Cultures Study of Child Development, anthropologist-psychologists John and Beatrice Whiting and their colleagues found associations between a variety of stressors experienced during childhood and adult physiology. Ethnographic and animal studies confirm that these early developmental exposures seem adaptive in preparing a more robust phenotype for the respective environment. Their findings suggest that early exposures to intense stressors would be adaptive in unstable or insecure environments (Landauer and Whiting 1964; Levine 1960). Even in our contemporary hygienic context tattooing, where tattoo-related medical complications are increasingly rare, getting a tattoo may still involve a developmental or competitive inclination to prepare for potential danger. Carmen, Guitar, and Dillon (2012) refer to this as the "upping the ante" hypothesis, which suggests that people get tattooed to show their ability to endure pain.

The results of ethnologic studies predicting that tattooing rates should be higher in areas of greater environmental hardships (natural disasters, wars, etc.), because tattoos may serve as signs of toughness and group commitment, have been inconclusive (Ludvico and Kurland 1995; Singh 1993). However, more recent tests of this inoculation hypothesis have found that tattooing boosts the immune system in a way that may be protective against other dermal injury (Lynn, Dominguez, and Decaro 2016; Lynn et al. 2020, 2022, 2023). In these studies, the authors tested for allostatic adjustment to tattoo stress. "Allostasis" refers to the dynamism of homeostatic mechanisms and set points that are known to change over the life course and in response to some environmental factors (Goldstein and McEwen 2002). Novel stressors stimulate the stress response (fight-or-flight-or-freeze), but the endocrine and immune systems adjust to familiar stressors based on the risk assessment (welcoming eustress and avoiding distress). The bodies of people getting their first tattoo or of relative tattoo novices produce more cortisol (stress hormone) in response to the tattooing process (via either fear or pain) and experience immunosuppression. This is consistent with stress theory, because the stress response suppresses systems that are not immediately needed for survival (Sapolsky 2002). However, those with relatively more tattoo experience show elevated immune response to tattooing, notwithstanding the production of stress hormone. Together, these reactions suggest that people with more tattoos have become physiologically habituated to the dermal stress of tattooing (Lynn, Dominguez, and Decaro 2016; Lynn et al. 2020, 2022, 2023). These quicker responses may make the process easier and the tattoo heal faster and look better, though these latter predictions have not been tested. These findings support the folk belief that tattoos make people more resilient, though it is still unclear whether tattooing increases protection in a clinically significant way.

A complementary hypothesis is that quickly and attractively healed tattoos send signals about the underlying health or biological fitness of the wearer (Koziel, Kretschmer, and Pawlowski 2010; Sosis, Kress, and Boster 2007; Osu et al. 2021). These models place tattooing, scarification, and other means of purposeful stress within the theoretical paradigm of evolutionary medicine, an emerging field that integrates evolutionary explanations for modern disease and disorders into biomedicine.

Dermatological Risks of Tattooing

Tattooing does not come without potentially unwanted or even harmful effects. Getting a tattoo means choosing to deliberately injure one's skin and can lead to medical complications, especially concerning the integumentary system. While there are no sources describing the complications that were experienced in the past, it is likely that the array of setbacks identified by contemporary medicine and dermatology applies to past practices as well; this is why we report them here.

Many studies have explored the dermatological risks associated with tattooing, reporting on everything from mild complaints to infectious complications, and even life-threatening hazards.² Serup, Hutter Carlson, and Sepehri (2015) define tattoo "complaints" as generally mild experiences that do not prompt medical attention; whereas tattoo "complications" are more serious adverse events requiring medical attention and treatment. Several studies report that tattoo complaints are extremely common, itching and swelling being the most likely symptoms, followed by sun-related problems, especially in connection with dark tattoos because they absorb more light (Klügl et al. 2010).

Serup and Hutton Carlsen (2014) categorize tattoo complications as "noninfectious," "infectious," or "life-threatening." Allergic reactions are the most frequently reported non-infectious tattoo complications; they are caused by haptens, or small molecules that form in the skin as the ink breaks down over a longer period, not by a specific allergen in the ink itself. Serup and colleagues further distinguish noninfectious tattoo complications by local reaction patterns and general conditions and associations. Local response patterns include nonallergic papulo-nodular, allergic plaque-like, allergic excessive hyperkeratotic, allergic neurosensory, and allergic ulcero-necrotic reactions; permanent lymphophatic staining; and scar patterns. Allergic papulo-nodular reactions cause thickening and elevations and are associated mainly with black tattoos, needle trauma, or the insertion of too much ink. Allergic plaque-like reactions also cause thickening and elevation but are associated with colored tattoos, particularly those done with red, blue, and green inks. Allergic ulcero-necrotic reactions indicate an intense allergy to red inks resulting in aggressive inflammation, tissue death, and skin ulcers, which can lead to autoimmunity affecting nontattooed skin. Allergic excessive hyperkeratotic reactions occur with inflammation, thickening, and elevation due to red inks. Allergic neurosensory reactions are characterized by severe itching, discomfort, and pain and are more common on the wrists and forearms. These reactions are very uncommon, but when they occur, they can reduce a person's quality of life to the point that the surgical removal of the tattoo may be recommended. Permanent lymphophatic staining is caused when excess ink is taken up by the lymph nodes; it can lead to significant swelling and tenderness, as well as damage to the lymphatic system. Scar patterns tend to be more common on the chest, shoulders, and upper arms, the severity of which depends on the skills of the tattoo artists and the quality of their tools and inks.³

General conditions and associations that can lead to tattoo complications include tattoo-provoked illness, existing skin disease and tattoo reaction, and psychosocial disability (Serup, Hutter Carlsen, and Sepehri 2015). Tattoo-provoked illness occurs when new or existing skin problems are induced by the tattooing process. For instance, tattooing can trigger the release of histamine, which can cause an urticarial reaction, or a general redness and itchiness that may be persistent and require medical attention. Eczema can also be caused by a new allergy that develops after being tattooed, and it can be severe in some cases. Life-threatening allergic reactions can occur when latex (natural rubber) gloves are used by the tattoo artist and latex proteins become embedded in the skin during needling, which carries the risk of an anaphylactic reaction with future latex exposure. Although individuals with existing skin diseases should be cautious when getting a tattoo, most noninfectious skin diseases are not affected by tattooing. Psoriasis is a notable exception that can flare up after the mechanical trauma of getting a tattoo. Psychosocial disability still occurs among those who permanently mark themselves, despite the increasing popularity and acceptance of tattooing. Stigmatization and prejudice, especially against those with highly visible or controversial tattoos,

can negatively affect an individual's employment opportunities or even physical safety. Many tattoos simply cannot be removed, and the negative psychological effects carrying an unwanted permanent mark should not be underestimated.

Infectious tattoo complications may be caused by a range of microorganisms (e.g., bacterial, fungal, and viral) that are introduced into the body during the application of the tattoo or the healing phase (Serup, Hutter Carlsen, and Sepehri 2015). These microorganisms can come from many different sources, including the environment in which the tattooing takes place, the tattooed person themselves, the tattoo artist, the needles or tools used to apply the tattoo, and the ink or contaminated water used to dilute it. Around 10 percent of new, "sterile" tattoo inks may be contaminated with harmful bacteria. Despite these potential contaminants, tattooing is not associated with high risk of bacterial infection, particularly when proper hygiene practices are followed before, during, and after the tattooing. Although modern hygiene practices help to reduce the risk of tattoo-associated infection, there continues to be a special risk related to antibiotic-resistant staphylococci and *E. coli*, as well as Hepatitis B and C. It should be noted that there have been cases of death resulting from post-tattooing infection in the past. However, today, death is rare and most infections are successfully treated with antibiotics.

Life-threatening hazards associated with tattooing are all but a distant memory in industrialized regions of the world. Standard health and hygiene practices, in addition to vaccines, antibiotics, etc., have made tattooing relatively safe for most people. However, there are certain individuals for whom tattooing is contraindicated, including those with chronic skin disorders, pigmented lesions of the skin, heart disease, immunosuppressive disorders and treatments, blood-clotting disorders, and those who are pregnant or breastfeeding (Kluger 2015). Concerns over carcinogenic pigments and the risk of cancer from tattooing are largely overstated in the literature (Kluger 2019; Sabbioni and Hauri 2016).

Social Behavior of Contemporary Tattooed Individuals

Just as the biomedical research on tattooing has focused more on the negative aspects than the potential benefits, psychological research has tended to focus on tattoos as markers of deviance and other socially undesirable traits, as well as associating them with harmful behavioral choices. It is important to note that the psychological research on tattooing has largely been conducted using convenience samples of college students and other Western, educated, industrialized, rich, and democratic (WEIRD) samples. This approach limits our understanding of tattooing as a culturally diverse human practice.

Today, a desire to express or enhance one's sexual attractiveness is a common motivation for choosing to get a tattoo (Wohlrab, Stahl, and Kappeler 2007). Instead of viewing this choice as an expression of openness to experience, many studies are devoted to finding a connection between tattooing and promiscuity, drug and alcohol use, sexual orientation, and risky sexual behavior (Heywood et al. 2012; Koch et al. 2005; Laumann and Derick 2006; Nowosielski et al. 2012; Owens et al. 2023; Swami et al. 2012). However, as Swami et al. (2012) note, simply having a tattoo does not account for these correlations, as openness to experience presupposes getting a first tattoo (Swami et al. 2012). Tattooed individuals should also not be labeled as an at-risk group for sexually transmitted infections (Nowosielski et al. 2012). A study by Heywood et al. (2012) showed no difference in the presence of sexually transmitted infections among a representative sample of men and women with and without tattoos. Similarly, Nowosielski et al. (2012) found no significant associations between tattoos and sexual orientation, risky sexual behavior, or history of sexual abuse. However, as noted above, body modifications can be powerful therapeutic outlets for people who have experienced trauma and abuse.

Conclusion

In this chapter, we have reviewed how tattooing has been used across cultures for medicinal and therapeutic purposes from ancient to contemporary times. Our earliest evidence of tattooing comes from the naturally and serendipitously preserved remains of the Iceman. Many of the Iceman's tattoos are simple lines and dots placed over known sites of injury or disease. The placement of these tattoos and the fact that they do not seem to be decorative in nature suggest a therapeutic role, directly, as a specific medicinal treatment or diagnostic tool for other therapies. The Iceman's tattoos, along with similar marks on other mummies found around the world, suggest that ancient forms of tattooing may have been developed across cultures to help heal the body, besides carrying powerful symbolic and cultural messages about the wearer. This idea of the ancient roots of therapeutic tattooing has also been well documented in historical and ethnographic sources that describe tattoos being used for physical and spiritual protection that can cure or prevent various ailments (see also Renaut, this volume).

We have also described the increasing popularity of tattoos across cultures and social classes as a means of modifying the body, creating a body that is both socially intelligible and uniquely human. Despite this, much of the scientific research on tattooing and tattoo wearers has tended to focus on the risks associated with being tattooed, neglecting the possible benefits. Historically, this "science" of tattooing has helped to reinforce stigmatizing views of people with tattoos, which can have serious adverse impacts on their lives far beyond the health risks associated with getting inked (about prejudice, see Cilli et al., this volume). However, current trends in psychology suggest that researchers are moving away from these outdated perspectives toward more complex social psychological approaches to tattooing. Instead of perpetuating antiquated perspectives that view tattooing as inherently deviant, immoral, or harmful, we call for tattoo researchers across disciplines to take the cultural and potential therapeutic significance of tattooing seriously. Given the evidence, tattooing, in all its diverse forms, should be investigated for what it is: a prosocial practice with the potential to heal, physically, emotionally, and spiritually.

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References

Allen, Tricia. 2005. *Tattoo Traditions of Hawai'i*. Honolulu, Hawai'i: Mutual Pub.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Alter-Muri, Simone. 2020. "The Body as Canvas: Motivations, Meanings, and Therapeutic Implications of Tattoos." *Art Therapy* 37 (3): 139–146.

[Google Scholar](#) [WorldCat](#)

Anderson, Clare. 2000. "Godna: Inscribing Indian Convicts in the Nineteenth Century." In *Written on the Body: The Tattoo in European and American History*, edited by Jane Caplan, 102. Princeton, NJ: Princeton University Press.

Anderson, Hobson Dewey, and Walter Crosby Eells. 1935. *Alaska Natives; A Survey of Their Sociological and Educational Status*. Stanford, CA: Stanford University Press.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Angres, Giora G. 1984a. "Angres Permalid-Liner Method: A New Surgical Procedure." *Annals of Ophthalmology* 16 (2): 145–148.

[Google Scholar](#) [WorldCat](#)

Angres, Giora G. 1984b. "Eye-Liner Implants: A New Cosmetic Procedure." *Plastic and Reconstructive Surgery* 73 (5): 833–836.

[Google Scholar](#) [WorldCat](#)

Armelagos, George J., Thomas Leatherman, Mary Ryan, and Lynn Sibley. 1992. "Biocultural Synthesis in *Medical Anthropology*." *Medical Anthropology* 14 (1): 35–52.

Armitage, Cecil Hamilton. 1924. *The Tribal Markings and Marks of Adornment of the Natives of the Northern Territories of the Gold Coast Colony*. London: Harrison and Sons.

Barrett, Samuel Alfred, and Edward Winslow Gifford. 1933. *Miwok Material Culture*. Yosemite National Park, CA: Yosemite Natural History Association.

Batchelor, John. 1901. *The Ainu and Their Folk-lore*. London: Religious Tract Society.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Bellwood, Peter, James J. Fox, and Darrell Tryon. 1995. "The Austronesians in History: Common Origins and Diverse Transformations." In *Austronesians: Historical and Comparative Perspectives*, edited by Peter Bellwood, James J. Fox, and Darrell Tryon, 1–16. Canberra: Australian National University Department of Anthropology.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Bovin, Mette. 2001. *Nomads Who Cultivate Beauty: Wodaabe Dances and Visual Arts in Niger*. Uppsala, Sweden: Nordic Africa Institute.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Bressani, Francesco Giuseppe. 1899. "A Brief Account of Certain Missions of the Fathers of the Society of Jesus in New France." In *The Jesuit Relations and Allied Documents: Travels and Explorations of the Jesuit Missionaries in New France, 1610–1791*, edited by Reuben Gold Thwaites, 203. Cleveland, OH: Burrows Brothers.

Buckle, Jennifer L., and Sonya Corbin Dwyer. 2021. "Embodied Meaning Making: Memorial Tattoos as a Visual Expression of Grief." *Death Studies* 47 (1): 1–9.

[Google Scholar](#) [WorldCat](#)

Bunchman, Herbert H., II, Duane L. Larson, Ted T. Huang, and Stephen R. Lewis. 1974. "Nipple and Areola Reconstruction in the Burned Breast: The 'Double Bubble' Technique." *Plastic and Reconstructive Surgery* 54 (5): 531–536.

[Google Scholar](#) [WorldCat](#)

Butterfield, Jesse L., Sean P. Keyser, Karan V. Dikshit, Hyejin Kwon, Maranke I. Koster, and Carson J. Bruns. 2020. "Solar Freckles: Long-Term Photochromic Tattoos for Intradermal Ultraviolet Radiometry." *ACS Nano* 14 (10): 13619–13628.

[Google Scholar](#) [WorldCat](#)

Byars, Louis T. 1945. "Tattooing of Free Skin Grafts and Pedicle Flaps." *Annals of Surgery* 121 (5): 644.

[Google Scholar](#) [WorldCat](#)

Capasso, Luigi. 1993. "A Preliminary Report on the Tattoos of the Val Senales Mummy (Tyrol, Neolithic)." *Journal of Paleopathology* 5:173–182.

[Google Scholar](#) [WorldCat](#)

Capasso, Luigi. 1998. "5300 Years Ago, the Ice Man Used Natural Laxatives and Antibiotics." *The Lancet* 352 (9143): 1864.

[Google Scholar](#) [WorldCat](#)

Carmen, Rachael A., Amanda E. Guitar, and Haley M. Dillon. 2012. "Ultimate Answers to Proximate Questions: The Evolutionary Motivations behind Tattoos and Body Piercings in Popular Culture." *Review of General Psychology* 16 (2): 134.

<https://doi.org/10.1037/a0027908>.

[Google Scholar](#) [WorldCat](#)

Caruth, Cathy. 1991. "Unclaimed Experience: Trauma and the Possibility of History." *Yale French Studies* 79:181–192.

[Google Scholar](#) [WorldCat](#)

Channawar, Sonali N. 2019. "Bhaigas: Tattooing an Integral Part of Tribal Tradition and Culture of Chhattisgarh." *Journal of Emerging Technologies and Innovative Research* 6 (3): 571–573.

[Google Scholar](#) [WorldCat](#)

Clark, Geoffrey, and Michelle C. Langley. 2020. "Ancient Tattooing in Polynesia." *Journal of Island and Coastal Archaeology* 15 (3): 407–420. <https://doi.org/10.1080/15564894.2018.1561558>.

[Google Scholar](#) [WorldCat](#)

Corbusier, William F. 1886. "The Apache-Yumas and Apache-Mojaves." *American Antiquarian and Oriental Journal (1880–1914)* 8 (5): 276.

[Google Scholar](#) [WorldCat](#)

Crompton, Laura, Galia Plotkin Amrami, Noga Tsur, and Zahava Solomon. 2021. "Tattoos in the Wake of Trauma: Transforming Personal Stories of Suffering into Public Stories of Coping." *Deviant Behavior* 42 (10): 1242–1255.

[Google Scholar](#) [WorldCat](#)

Curnow, Kathy. 1983. "The Afro-Portuguese Ivories: Classification and Stylistic Analysis of a Hybrid Art Form (Sierra Leone, Benin)." 2 vols. PhD diss., Indiana University.

Curnow, Kathy. 1991. "Oberlin's Sierra Leonean Saltcellar: Documenting a Bicultural Dialogue." *Allen Memorial Art Museum Bulletin* 44 (2): 13–23.

[Google Scholar](#) [WorldCat](#)

de Coccola, Raymond, and Paul King. (1954) 1986. *The Incredible Eskimo: Life among the Barren Land Eskimo*. Surrey, CAN: Hancock House.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

de Souza, Marcos André Torres, and Camilla Agostini. 2012. "Body Marks, Pots, and Pipes: Some Correlations between African Scarifications and Pottery Decoration in Eighteenth-and Nineteenth-Century Brazil." *Historical Archaeology* 46:102–123.

[Google Scholar](#) [WorldCat](#)

Decary, Raymond. 1935. "Les tatouages chez les indigènes de Madagascar." *Journal des Africanistes* 5 (1): 1–39.

[Google Scholar](#) [WorldCat](#)

DeMello, Margo. 2007. *Encyclopedia of Body Adornment*. Westport, CT: Greenwood Press.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Deter-Wolf, Aaron, Danny Riday, and Maya Sialuk Jacobsen. 2023. "Experimental Tattooing and Analysis of Preserved Skin Markings on Human Mummies." Experimental Archaeology Conference, Torun, Poland, May 13.

Deter-Wolf, Aaron, Benoît Robitaille, Lars Krutak, and Sébastien Galliot. 2016. "The World's Oldest Tattoos." *Journal of Archaeological Science: Reports* 5:19. <https://doi.org/10.1016/j.jasrep.2015.11.007>.

[Google Scholar](#) [WorldCat](#)

Deter-Wolf, Aaron, Benoît Robitaille, Daniel Riday, A. Burlot, and Maya Sialuk Jacobsen. 2024. "Chalcolithic Tattooing: Historical and Experimental Evaluation of the Tyrolean Iceman's Body Markings." *European Journal of Archaeology*, 1–22.

<https://doi.org/10.1017/eea.2024.5>.

[Google Scholar](#) [WorldCat](#)

Diallo, P. D., A. M. Diallo-Seck, M. Sembène, M. N. D. Ngom-Ndoye, J. L. Moreau, and A. Diene. 1995. "Le tatouage gingival au Sénégal: Le 'pimpi.' Incidence sur le parodonte du carbone." *Odonto-Stomatologie Tropicale* 71:4–6.

[Google Scholar](#) [WorldCat](#)

Dorfer, Leopold, Maximilian Moser, Frank Bahr, Konrad Spindler, Eduard Egarter-Vigl, S. Giullen, et al. 1999. "A Medical Report from the Stone Age?" *Lancet* 354 (9183): 1023. [https://doi.org/10.1016/S0140-6736\(98\)12242-0](https://doi.org/10.1016/S0140-6736(98)12242-0).

[Google Scholar](#) [WorldCat](#)

Dorfer, Leopold, Maximilian Moser, Konrad Spindler, Frank Bahr, Eduard Egarter-Vigl, and Gottfried Dohr. 1998. "5200-Year-Old Acupuncture in Central Europe?" *Science* 282 (5387): 242.

[Google Scholar](#) [WorldCat](#)

Douglas, Bronwen. 2005. "Cureous Figures: European Voyagers and Tatau/Tattoo in Polynesia, 1595–1800." In *Tattoo: Bodies, Art and Exchange in the Pacific and the West*, edited by Nicholas Thomas, Anna Cole, and Bronwen Douglas, 33–52. Durham, NC: Duke University Press.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Drewal, Henry John. 1988. "Beauty and Being: Aesthetics and Ontology in Yoruba Body Art." In *Marks of Civilization: Artistic Transformations of the Human Body*, edited by Arnold Rubin, 83–96. Los Angeles: University of California, Los Angeles, Museum of Cultural History.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Ellis, Juniper. 2008. *Tattooing the World: Pacific Designs in Print and Skin*. New York: Columbia University Press.

Essene, Frank. 1937. "Culture Element Distributions: XXI." *Anthropological Records* 8:1–97.

[Google Scholar](#) [WorldCat](#)

Field, Henry. 1958. "Body Marking in Southwestern Asia." *Papers of the Peabody Museum of Archaeology and Ethnology*.

Fisch, Maria. 1991. "Tattoos and Cicatrizations among the Namibian Peoples." *Journal-Namibia Scientific Society* 43:49–69.

[Google Scholar](#) [WorldCat](#)

Fitzhugh, William W., and Chisato O. Dubreuil. 1999. *Ainu: Spirit of a Northern People*. Washington DC: Arctic Studies Center.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Foster, George McClelland. 1944. *A Summary of Yuki Culture*. Berkeley: University of California Press.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Fouquet, Daniel Marie. 1898. "Le tatouage médical en Égypte dans l'antiquité et à l'époque actuelle." *Archives d'Anthropologie Criminelle* 13: 1–10.

[Google Scholar](#) [WorldCat](#)

Franklin, Joseph C., Elenda T. Hessel, Rachel V. Aaron, Michael S. Arthur, Nicole Heilbron, and Mitchell J. Prinstein. 2010. "The Functions of Nonsuicidal Self-Injury: Support for Cognitive–Affective Regulation and Opponent Processes from a Novel Psychophysiological Paradigm." *Journal of Abnormal Psychology* 119 (4): 850.

[Google Scholar](#) [WorldCat](#)

Furness, William Henry. 1899. *Life in the Luchu Islands (Japan)*. Philadelphia: University of Pennsylvania.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Gaber, O., and T. Karl-Heinz Künzel. 1995. "Sjælvold, The Tattoos of the Iceman from the Clinical-Anatomical Point of View." *Berichte des naturwissenschaftlichen-medizinischen Verein Innsbruck* 82: 347–354.

[Google Scholar](#) [WorldCat](#)

Garve, Roland, Miriam Garve, Jens C. Türp, Julius N. Fobil, and Christian G. Meyer. 2017. "Scarification in Sub-Saharan Africa: Social Skin, Remedy and Medical Import." *Tropical Medicine & International Health* 22 (6): 708–715.

[Google Scholar](#) [WorldCat](#)

Gautam, Rajesh K. 2011. *Baigas: The Hunter Gatherers of Central India*. New Delhi: Readworthy.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Gayton, Anna Hadwick. 1948. *Yokuts and Western Mono Ethnography: I: Tulare Lake, Southern Valley, and Central Foothill Yokuts*. *Anthropological Records* 10 (1): 1–142.

[Google Scholar](#) [WorldCat](#)

Gengenbach, Heidi. 2003. "Boundaries of Beauty: Tattooed Secrets of Women's History in Magude District, Southern Mozambique." *Journal of Women's History* 14 (4): 106–141.

[Google Scholar](#) [WorldCat](#)

Gifford, Edward Winslow. 1936. *Northeastern and Western Yavapai*. Berkeley: University of California Press.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Glacken, Clarence J. 1955. *The Great Loochoo: A Study of Okinawan Village Life*. Berkeley: University of California Press.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Goldstein, David S., and Bruce McEwen. 2002. "Allostasis, Homeostats, and the Nature of Stress." *Stress* 5 (1): 55–58.

Gostner, Paul, Patrizia Pernter, Giampietro Bonatti, Angela Graefen, and Albert R Zink. 2011. "New Radiological Insights into the Life and Death of the Tyrolean Iceman." *Journal of Archaeological Science* 38 (12): 3425–3431.

[Google Scholar](#) [WorldCat](#)

Green, Roger C. 1979. "Early Lapita Art from Polynesia and Island Melanesia: Continuities in Ceramic, Barkcloth, and Tattoo Decorations." In *Exploring the Visual Art of Oceania*, edited by S. M. Mead. Honolulu: University of Hawai'i Press. 13–31.***

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Heywood, Wendy, Kent Patrick, Anthony M. A. Smith, Judy M. Simpson, Marian K. Pitts, Juliet Richters, et al. 2012. "Who Gets Tattoos? Demographic and Behavioral Correlates of Ever Being Tattooed in a Representative Sample of Men and Women." *Annals of Epidemiology* 22 (1): 51–56.

[Google Scholar](#) [WorldCat](#)

Hilger, Mary Inez. (1951) 1992. *Chippewa Child Life and Its Cultural Background*. St. Paul: Minnesota Historical Society Press.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Hilger, Mary Inez. 1960. "Some Early Customs of the Menomini Indians." *Journal de la Société des américanistes* 49:45–68.

[Google Scholar](#) [WorldCat](#)

Hitchcock, Rymyn. 1892. *The Ainos of Yezo, Japan*. Washington, DC: US Government Printing Office.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Høgsberg, T., Katrina Hutton Carlsen, and Jørgen Serup. 2013. "High Prevalence of Minor Symptoms in Tattoos among a Young Population Tattooed with Carbon Black and Organic Pigments." *Journal of the European Academy of Dermatology and Venereology* 27 (7): 846–852.

[Google Scholar](#) [WorldCat](#)

Hollander, Edward. 1938. "Treatment of Pruritus Ani by Tattoo with Mercuric Sulfide." *Archives of Dermatology and Syphilology* 38 (3): 337–339.

[Google Scholar](#) [WorldCat](#)

Hrdlička, Aleš. 1902. "Title." Aleš Hrdlička Papers, Box 77, National Anthropological Archives, Smithsonian Institution.

Hutton Carlsen, Katrina, and Jørgen Serup. 2014. "Photosensitivity and Photodynamic Events in Black, Red and Blue Tattoos Are Common: A 'Beach Study.'" *Journal of the European Academy of Dermatology and Venereology* 28 (2): 231–237.

[Google Scholar](#) [WorldCat](#)

Jenness, Diamond. 1946. *The Material Culture of the Copper Eskimos*. Ottawa, CAN: King's Printer.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Jia, Wenzhao, Amay J. Bhandodkar, Gabriela Valdés-Ramírez, Joshua R. Windmiller, Zhanjun Yang, Julian Ramírez, et al. 2013. "Electrochemical Tattoo Biosensors for Real-Time Noninvasive Lactate Monitoring in Human Perspiration." *Analytical Chemistry* 85 (14): 6553–6560.

[Google Scholar](#) [WorldCat](#)

Jiang, Nan, Ali K. Yetisen, Nico Linhart, Krzysztof Flisikowski, Jie Dong, Xingchen Dong, et al. 2020. "Fluorescent Dermal Tattoo Biosensors for Electrolyte Analysis." *Sensors and Actuators B: Chemical* 320:128378.

[Google Scholar](#) [WorldCat](#)

Jouveney, Joseph. 1896. "Concerning the Country and Manners of the Canadians or the Savages of New France." In *The Jesuit Relations and Allied Documents: Travels and Explorations of the Jesuit Missionaries in New France, 1610–1791*, edited by Reuben Gold Thwaites, 239. Cleveland, OH: Burrows Brothers.

Kean, Walter F., Shannon Tocchio, Mary Kean, and K. D. Rainsford. 2013. "The Musculoskeletal Abnormalities of the Similaun Iceman ('Ötzi'): Clues to Chronic Pain and Possible Treatments." *Inflammopharmacology* 21 (1): 11–20.

[Google Scholar](#) [WorldCat](#)

Keefer, Katrina H. B. 2013. "Scarification and Identity in the Liberated Africans Department Register, 1814–1815." *Canadian Journal of African Studies/La Revue canadienne des études africaines* 47 (3): 537–553.

[Google Scholar](#) [WorldCat](#)

Keimer, Ludwig. 1948. "Remarques sur le tatouage dans l'Égypte ancienne." *Mémoires de l'Institut d'Égypte* vol. 53, 1–15. Le Caire: L'institut Français d'Archéologie Orientale.

[Google Scholar](#) [WorldCat](#)

Kirch, Patrick Vinton. 1997. *The Lapita Peoples: Ancestors of the Oceanic World*. The Peoples of South-East Asia and the Pacific. Oxford: Blackwell.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Kluger, Nicolas. 2015. "Contraindications for Tattooing." In *Tattooed Skin and Health*, edited by Jørgen Serup, Nicolas Kluger, and Wolfgang Bäuml, 76–87. Basel, Switzerland: Karger.

Kluger, Nicolas. 2019. "Tattoo Reactions Associated with Targeted Therapies and Immune Checkpoint Inhibitors for Advanced Cancers: A Brief Review." *Dermatology* 235 (6): 522–524. <https://doi.org/10.1159/000501590>.

[Google Scholar](#)
[WorldCat](#)

Kluger, Nicolas, and Saleh Aldasouqi. 2013. "A New Purpose for Tattoos: Medical Alert Tattoos." *La Presse Médicale* 42 (2): 134–137.

[Google Scholar](#)
[WorldCat](#)

Klühl, Ines, Karl-Anton Hiller, Michael Landthaler, and Wolfgang Bäuml. 2010. "Incidence of Health Problems Associated with Tattooed Skin: A Nation-Wide Survey in German-Speaking Countries." *Dermatology* 221 (1): 43–50.

[Google Scholar](#)
[WorldCat](#)

Koch, Jerome R., Alden E. Roberts, Myrna L. Armstrong, and Donna C. Owen. 2005. "College Students, Tattoos, and Sexual Activity." *Psychological Reports* 97 (3): 887–890.

[Google Scholar](#)
[WorldCat](#)

Kodama, Sakuzaemon. 1970. "Ainu: Historical and Anthropological Studies." *Hokkaido University Medical Library Series* 3:1–295.

[Google Scholar](#)
[WorldCat](#)

Koziel, Slawomir, Weronika Kretschmer, and Boguslaw Pawlowski. 2010. "Tattoo and Piercing as Signals of Biological Quality." *Evolution and Human Behavior* 31 (3): 187–192.

[Google Scholar](#)
[WorldCat](#)

Krutak, Lars. 1999. "St. Lawrence Island Joint-Tattooing: Spiritual/Medicinal Functions and Inter-continental Possibilities." *Études/Inuit/Studies* 23 (1–2): 229.

[Google Scholar](#)
[WorldCat](#)

Krutak, Lars. 2000. "Tattoos of the Hunter-Gatherers of the Arctic." Lars Krutak: Tattoo Anthropologist. Accessed January 5. <http://www.larskrutak.com/articles/Arctic/index.html>.

[WorldCat](#)

Krutak, Lars. 2007. *The Tattooing Arts of Tribal Women*. London: Desert Hearts.

[Google Scholar](#)
[Google Preview](#)
[WorldCat](#)
[COPAC](#)

Krutak, Lars. 2008. "Dinembo: Forbidden Tattoos of the Makonde of Mozambique." *Skin & Ink*, November 12–17.

Krutak, Lars. 2009. "India: Land of Eternal Ink." Lars Krutak: Tattoo Anthropologist. Last modified May 10, 2022. Accessed January 2. <https://www.larskrutak.com/india-land-of-eternal-ink/>.

Krutak, Lars. 2012. *Spiritual Skin: Magical Tattoos and Scarification; Wisdom, Healing, Shamanic Power, Protection*. Aschaffenburg, Germany: Edition Reuss.

[Google Scholar](#)
[Google Preview](#)
[WorldCat](#)
[COPAC](#)

Krutak, Lars. 2013a. "The Power to Cure: A Brief History of Therapeutic Tattooing." In D. P. Casa and C. Witt (eds.) *Tattoos and Body Modifications in Antiquity: Proceedings of the Sessions at the EAA Annual Meetings in The Hague and Oslo, 2010/11*, 27–34. Zürich: Chronos.

[Google Scholar](#)
[Google Preview](#)
[WorldCat](#)
[COPAC](#)

Krutak, Lars. 2013b. "Scarification and Tattoo in Benin: The Bétamarribé Tribe of the Atakora Mountains." Lars Krutak: Tattoo Anthropologist. Last Modified May 13. Accessed January 2, 2023. <https://www.larskrutak.com/scarification-and-tattooing-in-benin-the-betamarribé-tribe-of-the-atakora-mountains/>.

Krutak, Lars. 2014. *Tattoo Traditions of Native North America: Ancient and Contemporary Expressions of Identity*. Edam,

Netherlands: LM Publishers.

Krutak, Lars. 2015. "The Cultural Heritage of Tattooing: A Brief History." In Serup, Kluger and Bäumler, *Tattooed Skin and Health*, 1–5.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Krutak, Lars. 2019. "Therapeutic Tattooing in the Arctic: Ethnographic, Archaeological, and Ontological Frameworks of Analysis." *International Journal of Paleopathology* 25:99–109. <https://doi.org/10.1016/j.ijpp.2018.05.003>.

[Google Scholar](#) [WorldCat](#)

Krutak, Lars, and Natividad Sugguiyao. 2010. *Kalinga Tattoo: Ancient and Modern Expressions of the Tribal*. Aschaffenburg, Germany: Edition Reuss.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Lafitau, Joseph-Francois. (1724) 1977. *Customs of the American Indians Compared with Customs of Primitive Times*. Vol. 1. Translated by William Nelson Fenton and Elizabeth L. Moore. Toronto: Champlain Society.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Landauer, Thomas K., and John W. M. Whiting. 1964. "Infantile Stimulation and Adult Stature of Human Males." *American Anthropologist* 66 (5): 1007. <https://doi.org/10.1525/aa.1964.66.5.02a00020>.

[Google Scholar](#) [WorldCat](#)

Lantis, Margaret. 1984. "Aleut." In *Handbook of North American Indians*, vol. 5: *Arctic*, edited by David Damas. Washington, DC: Smithsonian Institution.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Laughlin, William S. 1951. "Aleut Health Problems from the Viewpoint of an Anthropologist." In *Proceedings of the Alaska Science Conference of the National Academy of Sciences*, National Research Council. *Bulletin of the National Research Council*, 116–117. Washington, DC: National Academy of Sciences.

Laughlin, William S. 1980. *Aleuts, Survivors of the Bering Land Bridge*. New York: Holt, Rinehart, and Winston.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Laumann, Anne E., and Amy J. Derick. 2006. "Tattoos and Body Piercings in the United States: A National Data Set." *Journal of the American Academy of Dermatology* 55 (3): 413–421.

[Google Scholar](#) [WorldCat](#)

Levine, Seymour. 1960. "Stimulation in Infancy." *Scientific American* 202 (5): 80–87.

[Google Scholar](#) [WorldCat](#)

Liu, Jie, Jing-Zheng Shi, Li-Mei Yu, Robert A. Goyer, and Michael P. Waalkes. 2008. "Mercury in Traditional Medicines: Is Cinnabar Toxicologically Similar to Common Mercurials?" *Experimental Biology and Medicine* 233 (7): 810–817.

[Google Scholar](#) [WorldCat](#)

Loeb, Edwin Meyer. 1926. *Pomo Folkways*. Berkeley: University of California Press.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Ludvico, L. R., and J. A. Kurland. 1995. "Symbolic or Not-so-Symbolic Wounds: The Behavioral Ecology of Human Scarification." *Ethology and Sociobiology* 16 (2): 155. [https://doi.org/10.1016/0162-3095\(94\)00075-i](https://doi.org/10.1016/0162-3095(94)00075-i).

[Google Scholar](#) [WorldCat](#)

Lynn, Christopher D., Johnna T. Dominguez, and Jason A. Decaro. 2016. "Tattooing to 'Toughen up': Tattoo Experience and Secretory Immunoglobulin A." *American Journal of Human Biology* 28:603–609. <https://doi.org/10.1002/ajhb.22847>.

[Google Scholar](#) [WorldCat](#)

Lynn, Christopher D., Michaela Howells, David Herdrich, Joseph Ioane, Duffy Hudson, and Su'a Tupuola U Fitiao. 2020. "The Evolutionary Adaptation of Body Art: Tattooing as Costly Honest Signaling of Enhanced Immune Response in American Samoa." *American Journal of Human Biology* 32 (4): Article e23347.

[Google Scholar](#) [WorldCat](#)

Lynn, Christopher D., Michaela E. Howells, Michael P. Muehlenbein, Tomasz Nowak, Jeffrey Gassen, and Alexandria Henderson. 2023. "Tattooing as a Phenotypic Gambit." *American Journal of Biological Anthropology* 182 (1): 7–11.

<https://doi.org/10.1002/ajpa.24741>.

[Google Scholar](#) [WorldCat](#)

Lynn, Christopher D., Michaela E. Howells, Michael P. Muehlenbein, Holly Wood, Grey W. Caballero, Tomasz J. Nowak, et al. 2022. "Psychoneuroimmunology and Tattooing." *Adaptive Human Behavior and Physiology* 8:355–369. <https://doi.org/10.1007/s40750-022-00202-x>.

[Google Scholar](#) [WorldCat](#)

Lynn, Christopher D., and Cassandra A. Medeiros. 2017. "Tattooing Commitment, Quality, and Football in Southeastern North America." In *Evolution Education in the American South*, edited by Christopher D. Lynn, Amanda L. Glaze, William A. Evans and Laura K. Reed, 263–280. New York: Palgrave Macmillan.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Mallon, Sean, and Sebastien Galliot. 2018. *Tatau: A History of Samoan Tattooing*. Honolulu: University of Hawai'i Press.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Mallon, William K., and Marie A. Russell. 1999. "Clinical and Forensic Significance of Tattoos." *Advanced Emergency Nursing Journal* 21 (3): 21–29.

[Google Scholar](#) [WorldCat](#)

Maxwell, December, Johanna Thomas, and Shaun A. Thomas. 2020. "Cathartic Ink: A Qualitative Examination of Tattoo Motivations for Survivors of Sexual Trauma." *Deviant Behavior* 41 (3): 348–365.

[Google Scholar](#) [WorldCat](#)

McCabe, Michael. 2002. *Tattoos of Indochina: Magic, Devotion, and Protection; Thailand, Cambodia, and Laos*. Atglen, PA: Schiffer.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

McElroy, Ann, and Patricia K. Townsend. 2004. *Medical Anthropology in Ecological Perspective*. 4th ed. Boulder, CO: Westview Press.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Merriam, Clinton Hart. 1966. *Ethnographic Notes on California Indian Tribes*. Berkeley: University of California Archaeological Research Facility.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Middendorff, Alexander Theodor von. 1847. "Reise in den äussersten Norden und Osten Sibiriens während der Jahre 1843 und 1844 mit Allerhöchster Genehmigung auf Veranstaltung der Kaiserlichen Akademie der Wissenschaften zu St. Petersburg ausgeführt und in Verbindung mit vielen Gelehrten, (Vol. 1)." St. Petersburg: Buchdr. Der K. Akademie der Wissenschaften.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Moe, Iefata. 1989. "Samoan Navel Tattoo." In *Modern Primitives: An Investigation of Contemporary Adornment and Ritual*, edited by Vale Vale and Andrea Juno, 117. San Francisco, CA: RE/Search Publications.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Morice, Adrien G. 1893. *Notes Archaeological, Industrial and Sociological, on the Western Dénés: With an Ethnographical Sketch of the Same*. Toronto, Canada: The Canadian Institute.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Myers, Charles S. 1903. "Contributions to Egyptian Anthropology: Tatuing." *Journal of the Anthropological Institute of Great Britain and Ireland* 33:82–89.

[Google Scholar](#) [WorldCat](#)

Nevadomsky, Joseph, and Ekhaguosa Aisien. 1995. "The Clothing of Political Identity: Costume and Scarification in the Benin Kingdom." *African Arts* 28 (1): 62.

[Google Scholar](#) [WorldCat](#)

Nowosielski, Krzysztof, Adam Sipiński, Ilona Kuczerawy, Danuta Kozłowska-Rup, and Violetta Skrzypulec-Plinta. 2012. "Tattoos, Piercing, and Sexual Behaviors in Young Adults." *Journal of Sexual Medicine* 9 (9): 2307–2314.

[Google Scholar](#) [WorldCat](#)

Nystrom, Kenneth, and Dario Piombino-Masali. 2017. "Mummy Studies and the Soft Tissue Evidence of Care." In *New Developments in the Bioarchaeology of Care*, edited by L. Tilley and A. A. Schrenk, 199–218. Switzerland: Springer.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Osgood, Cornelius. 1936. *Contributions to the Ethnography of the Kutchin*. Yale University Publications in Anthropology 14. New Haven, CT: Yale University Press.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Osgood, Cornelius. 1940. *Ingalik Material Culture*. Yale University Publications in Anthropology 22. New Haven, CT: Yale University Press.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Ossai-Ugbah, Ngozi Blessing, and Samuel Adewale Ogunrombi. 2012. "Information Dissemination through Body Markings: A Survey of Selected Tribes in the South-South Geo-political Zone of Nigeria." *Journal of Educational and Social Research* 2 (2): 251–251.

[Google Scholar](#) [WorldCat](#)

Osu, Tinisha, Julia Lechler-Lombardi, Amy Butler, Miles Newman, Karolina Miłkowska, Andrzej Galbarczyk, et al. 2021. "Fluctuating Asymmetry of Finger Lengths, Digit Ratio (2D:4D), and Tattoos: A Pre-registered Replication and Extension of Koziel et al. (2010)." *Early Human Development* 152: Article 105273. <https://doi.org/10.1016/j.earlhumdev.2020.105273>.

[Google Scholar](#) [WorldCat](#)

Owens, Rebecca, Steven Filoromo, Lauren Landgraf, Christopher Lynn, and Michael Smetana. 2023. "Deviance as an Historical Artifact: A Scoping Review of Psychological Studies of Body Modification." *Humanities and Social Sciences Communications* 10 (33). <https://doi.org/10.1057/s41599-023-01511-6>.

[Google Scholar](#) [WorldCat](#)

Pabst, Maria Anna, Ilse Letofsky-Papst, Maximilian Moser, Konrad Spindler, Elisabeth Bock, Peter Wilhelm, et al. 2010. "Different Staining Substances Were Used in Decorative and Therapeutic Tattoos in a 1000-Year-Old Peruvian Mummy." *Journal of Archaeological Science* 37 (12): 3256. <https://doi.org/10.1016/j.jas.2010.07.026>.

[Google Scholar](#) [WorldCat](#)

Parkman, Francis. 1867. *The Jesuits in North America in the Seventeenth Century*. Little, Brown.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Parry, Albert. (1933) 2006. *Tattoo: Secrets of a Strange Art*. Mineola, NY: Dover.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Piombino-Masali, Dario, and Lars Krutak. 2020. "Therapeutic Tattoos and Ancient Mummies: The Case of the Iceman." In *Purposeful Pain*, edited by S. G. Sheridan and L. A. Gregoricka, 119–136. Switzerland: Springer.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Rao, C. Hayavadana. 1942. "Note on Tattooing in India and Burma." *Anthropos* 37/40 (1–3): 175–179.

[Google Scholar](#) [WorldCat](#)

Reid-de Jong, Victoria, and Anne Bruce. 2020. "Mastectomy Tattoos: An Emerging Alternative for Reclaiming Self." *Nursing Forum* 55 (4): 695–702.

[Google Scholar](#) [WorldCat](#)

Rubin, Arnold. 1988. "Tattoo Trends in Gujarat." In Rubin, *Marks of Civilization*, 141–153.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Rudenko, Sergei I. 1949. "The Most Ancient 'Scythian' Tattoo." *Sovetskaia Etnografiia* [Soviet ethnography] 3:133–143.

[WorldCat](#)

Rudenko, Sergei I. 1970. *Frozen Tombs of Siberia; the Pazyryk Burials of Iron Age Horsemen*. Translated by M. W. Thompson. Berkeley & Los Angeles: University of California Press.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Russell, Frank. 1908. *The Pima Indians*. Washington, DC: US Government Printing Office.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Russell, Robert Vane. 1912. *The Tribes and Castes of the Central Provinces of India*. Vol. 3. London: MacMillan.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Sabater, I. P., J. Jordi, and I. C. Oriol Sabater. 1992. *Els Tatuatges dels Fang de L'Àfrica occidental; art, simbolisme i biologia en una manifestació artística poc coneguda*. Barcelona: Adjuntament de Barcelona. Treballs del Museu Etnològic/1.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Sabbioni, Gabriele, and Urs Hauri. 2016. "Carcinogenic Tattoos?" *Epidemiology, Biostatistics, and Public Health* 13 (4): e12018-1–e12018-3.

[Google Scholar](#) [WorldCat](#)

Sahai, G. 1904. "Female Tattooing amongst Ghilzais." *Indian Antiquary* 33:147–148.

[Google Scholar](#) [WorldCat](#)

Salvador-Amores, Analyn. 2014. *Tapping Ink, Tattooing Identities: Tradition and Modernity in Contemporary Kalinga Society, North Luzon, Philippines*. Honolulu: University of Hawai'i Press.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Samadelli, Marco, Marcello Melis, Matteo Miccoli, Eduard Egarter-Vigl, and Albert R Zink. 2015. "Complete Mapping of the Tattoos of the 5300-year-old Tyrolean Iceman." *Journal of Cultural Heritage* 16 (5): 753–758.

[Google Scholar](#) [WorldCat](#)

Sapolsky, Robert M. 2002. "Endocrinology of the Stress-Response." In *Behavioral Endocrinology*, edited by Jill B. Becker, S. Marc Breedlove, David Crews, and Margaret M. McCarthy, 409. Cambridge, MA: MIT Press.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Sarnecki, Judith Holland. 2001. "Trauma and Tattoo." *Anthropology of Consciousness* 12 (2): 35.

<https://doi.org/10.1525/ac.2001.12.2.35>.

[Google Scholar](#) [WorldCat](#)

Sauntry, J. P., and K. P. Knudtson. 1958. "A Technique for Marking the Mucosa of the Gastrointestinal Tract after Polypectomy." *Cancer* 11 (3): 607–610.

[Google Scholar](#) [WorldCat](#)

Scotch, Norman A. 1963. "Medical Anthropology." *Biennial Review of Anthropology* 3:30–68.

[Google Scholar](#) [WorldCat](#)

Seligmann, C. G. 1902. "The Medicine, Surgery, and Midwifery of the Sinaugolo." *Journal of the Anthropological Institute of Great Britain and Ireland* 32:297–304. <https://doi.org/10.2307/2842822>.

[Google Scholar](#) [WorldCat](#)

Serup, Jørgen, and Katrina Hutton Carlsen. 2014. "Patch Test Study of 90 Patients with Tattoo Reactions: Negative Outcome of Allergy Patch Test to Baseline Batteries and Culprit Inks Suggests Allergen(s) Are Generated in the Skin through Haptenization." *Contact Dermatitis* 71 (5): 255–263.

[Google Scholar](#) [WorldCat](#)

Serup, Jørgen, Katrina Hutton Carlsen, and Mitra Sepehri. 2015. "Tattoo Complaints and Complications: Diagnosis and Clinical Spectrum." In Serup, Kluger, and Bäuml, *Tattooed Skin and Health*, 48–60.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Shishlina, Natalia I., E. V. Belkevich, and A. N. Usachuk. 2013. "Bronze Age Tattoos: Sympathetic Magic or Decoration." In *Tattoos and Body Modifications in Antiquity: Proceedings of the Sessions at the EAA Annual Meetings in The Hague and Oslo, 2010/11*, edited by D. P. Casa and C. Witt, 67–74. Zürich: Chronos.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Singh, D. 1993. "Adaptive Significance of Female Physical Attractiveness: Role of Waist-to-Hip Ratio." *Journal of Personality and Social Psychology* 65 (2): 293.

[Google Scholar](#) [WorldCat](#)

Sjøvold, Torstein. 1992. "The Stone Age Man from the Austrian-Italian Alps. Discovery, Description and Current Research." *Collegium Antropologicum* 16 (1): 1–12.

[Google Scholar](#) [WorldCat](#)

Sjøvold, Torstein. 2003. "The Location of the Iceman Tattoos." In *La mummia dell'Età del Rame*, edited by A. Fleckinger, 111–122. Bolzano, Italy: Folio Verlag.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Sjøvold, Torstein, Wolfram Bernhard, Othmar Gaber, Karl-Heinz Künzel, Werner Platzer, and Hans Unterdorfer. 1995. "Verteilung und Größe der Tätowierungen am Eismann vom Hauslabjoch." In *Der Mann im Eis*, edited by Konrad Spindler, Elisabeth Rastbichler-Zissernig, Harald Wilfing, Dieter zur Nedden, and Hans Nothdurfter, 279–286. Vienna: Springer Vienna.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Skinner, Alanson. 1921. *Material Culture of the Menomini*. Vol. 20. New York: Museum of the American Indian, Heye Foundation.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Skoggard, Ian A. 2003. *Culture Summary: Yuki*. New Haven, CT: Human Relations Area Files.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Smeaton, Winifred. 1937. "Tattooing among the Arabs of Iraq." *American Anthropologist* 39 (1): 53–61.

[Google Scholar](#) [WorldCat](#)

Sosis, Richard, Howard C. Kress, and James S. Boster. 2007. "Scars for War: Evaluating Alternative Signaling Explanations for Cross-Cultural Variance in Ritual Costs." *Evolution and Human Behavior* 28 (4): 234–247.

[Google Scholar](#) [WorldCat](#)

Spennemann, Dirk. 2009. *Tattooing in the Marshall Islands*. Honolulu, Hawaii: Bess Press.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Spindler, Konrad. 1996. *The Man in the Ice: The Discovery of a 5,000-Year-Old Body Reveals the Secrets of the Stone Age*. New York City: Harmony Books.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Stepanova, Elena V., and Svetlana Pankova. 2017. "Personal Appearance." In *Scythians: Warriors of Ancient Siberia*, edited by S. T. J. Simpson and Svetlana Pankova, 88–151. London, United Kingdom: Thames and Hudson.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Sverdrup, Harald Ulrik. 1978. *Among the Tundra People*. La Jolla: University of California, San Diego.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Swami, Viren, Jakob Pietschnig, Bianca Bertl, Ingo W. Nader, Stefan Stieger, and Martin Voracek. 2012. "Personality Differences between Tattooed and Non-tattooed Individuals." *Psychological Reports* 111 (1): 97–106.

<https://doi.org/10.2466/09.07.21.Pr0.111.4.97-106>.

[Google Scholar](#) [WorldCat](#)

Tannenbaum, Nicola. 1987. "Tattoos: Invulnerability and Power in Shan Cosmology." *American Ethnologist* 14 (4): 693–711.

[Google Scholar](#) [WorldCat](#)

Tassie, Geoffrey. 2003. "Identifying the Practice of Tattooing in Ancient Egypt and Nubia." *Papers from the Institute of Archaeology* 14: 85–101.

[Google Scholar](#) [WorldCat](#)

Te Awekotuku, Ngahuia, Linda Waimarie Nikora, Mohi Robert Rua, Rolinda Karapu, and Becky Nunes. 2007. *Mau Moko: The World of Maori Tattoo*. Honolulu: University of Hawai'i Press.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Thurston, Edgar. 1907. *Ethnographic Notes in Southern India*. Madras: Superintendent, Government Press.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Turell, Robert. 1940. "Tattooing (Puncturation) with Mercury Sulfide and Other Chemicals for the Treatment of Pruritus Ani and Perine: Further Investigations." *Journal of Investigative Dermatology* 3 (4): 289–297.

[Google Scholar](#) [WorldCat](#)

van der Velden, Eddy, Leo den Dulk, Henk Leenders, Koert Dingemans, Marius van der Bergh Weerman, Sebastiaan van der Putte, et al. 1995. "The Decorated Body of the Man from Hauslabjoch." In *Der Mann im Eis*, K. Spindler, E. Rastbichler-Zissernig, H. Wilfig, D. zur Nedda, and H. Nothdurfter, 275–278. New York: Springer.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

van der Velden, E. M., J. Defrancq, O. E. Ijsselmuiden, A. M. Baruchin, and H. J. Hulsebosch. 2001. "Dermatography: A Review of 15 Years of Clinical Applications in Surgery." *International Journal of Cosmetic Surgery and Aesthetic Dermatology* 3 (2): 151–159.

[Google Scholar](#) [WorldCat](#)

Vanoverbergh, Morice. 1929. "Dress and Adornment in the Mountain Province of Luzon, Philippine Islands." *Catholic Anthropological Conference* 1 (5): 181–242.

[Google Scholar](#) [WorldCat](#)

Vassileva, Snezhina, and Evgeniya Hristakieva. 2007. "Medical Applications of Tattooing." *Clinics in Dermatology* 25 (4): 367–374.

[Google Scholar](#) [WorldCat](#)

Vogel, Susan. 1988. "Baule Scarification: The Mark of Civilization." In Rubin, *Marks of Civilization*, 97–105.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Washington, Charles M., and Dennis T. Leaver. 1996. *Principles and Practice of Radiation Therapy: Introduction to Radiation Therapy*. St. Louis, MO: Mosby.

[Google Scholar](#) [Google Preview](#) [WorldCat](#) [COPAC](#)

Wohlrab, Silke, Jutta Stahl, and Peter M. Kappeler. 2007. "Modifying the Body: Motivations for Getting Tattooed and Pierced." *Body Image* 4 (1): 87. <https://doi.org/10.1016/j.bodyim.2006.12.001>.

Yang, Mei, Daniel Pepe, Christopher M. Schlachta, and Nawar A. Alkhamesi. 2017. "Endoscopic Tattoo: The Importance and Need for Standardised Guidelines and Protocol." *Journal of the Royal Society of Medicine* 110 (7): 287–291.

<https://doi.org/10.1177/0141076817712244>.

[Google Scholar](#) [WorldCat](#)

Young, Allan. 1967. "Varieties of Amhara Graphic Art." *Expedition* 9 (4): 2.

[Google Scholar](#) [WorldCat](#)

Zink, Albert, Marco Samadelli, Paul Gostner, and Dario Piombino-Mascali. 2019. "Possible Evidence for Care and Treatment in the Tyrolean Iceman." *International Journal of Paleopathology* 25:110–117. <https://doi.org/10.1016/j.ijpp.2018.07.006>.

[Google Scholar](#) [WorldCat](#)

Zink, Albert, L. Samuel Wann, Randall C. Thompson, Andreas Keller, Frank Maixner, Adel H. Allam, et al. 2014. "Genomic Correlates of Atherosclerosis in Ancient Humans." *Global Heart* 9 (2): 203–209.

[Google Scholar](#) [WorldCat](#)

Notes

- 1 According to the Samoan and Tongan cultural tattoo practitioners interviewed by Christopher Lynn in Honolulu, Hawaii, American Samoa, and Samoa in 2017, 2019, and 2022. A Samoan informant from New Zealand sent photos of her grandmother's hand tattoo, which had been administered to treat pain. The woman's daughter and granddaughter got replicas of the tattoo to commemorate their relative and culture. The tattoos on babies are symbolic, because an inkless tattoo implement is waived over the baby, but families have stated that the birthmark disappears. One Samoan informant interviewed in Hawaii in 2022 indicated she had received a Samoan hand tattoo to treat carpal tunnel syndrome and that the treatment was successful.
- 2 This section is based on the following works of Jørgen Serup and colleagues, except where otherwise indicated: Serup, Hutter Carlsen, and Sepehri (2015); Høgsberg, Hutton Carlsen, and Serup (2013); Hutton Carlsen and Serup (2014); Kluger (2015); and Serup and Hutton Carlsen (2014).
- 3 Most contemporary tattoo inks are made of pigments suspended in a carrier solution (water, ethanol etc.) Pigments are often made of metal salts.