UNIVERSITY OF MINNESOTA

Twin Cities Campus

Division of Environmental Health Sciences
School of Public Health

1260 Mayo Memorial Building
420 Delaware Street S.E.
Mayo Mail Code 807
Minneapolis, MN 55455

612-626-0900
Fax: 612-626-4837

Committee Chairs, Representative Robert Bierman,
Representative Jeff Backer
Cc: Representative Perez-Vega, Representative Samakab Hussein

Re: SF 1885-0

April 5, 2025

Dear Representative Bierman and Backer,

I am providing this letter to express the strong support of SF 1885-0: A bill for an act relating to health; appropriating money to the Beautywell Project, on behalf of Dr. Trân Huỳnh and myself. Dr. Huỳnh and I are Associate Professors at the University of Minnesota School of Public Health, in the Division of Environmental Health Sciences. Our research includes the community engaged research project with our community partner Beautywell, to build healthier work and home environments for immigrant-owned beauty salon owners and workers. The sale and use of skin lightening products in this community is common, and too often leads to toxic mercury exposures among an already vulnerable population due to skin lightening product contamination. Indeed, recent testing conducted by our team of beauty products (e.g., shampoo, conditioner, hair color) that are sold in Minnesota, revealed the presence of mercury in several of them.

This legislation will provide funds needed to raise awareness of the serious health hazards associated with skin lightening products and products contaminated with skin lightening chemicals like mercury. Awareness of the harms caused by these chemicals, and presence of them in beauty products is a first and critical step towards reducing the availability of mercury-containing products and the risks to the women and children who would otherwise unknowingly be exposed.

We therefore issue our support for this bill in the strongest terms.

Sincerely,

Susan Arnold

Susan Arnold, PhD, MSOH, CIH

Associate Professor
Director, Exposure Science & Sustainability Institute
Director, Midwest Center for Occupational Health and Safety
University of Minnesota School of Public Health

Trân Huỳnh, PhD, MPH, CIH

Associate Professor
Outreach Director, Midwest Center for Occupational Health and Safety
University of Minnesota School of Public Health

Health Advisory: Mercury-containing Skin Lightening Product Associated with Acute Health Effects

Minnesota Department of Health, Tue Jan 14 11:00 CST 2020

Action Steps:

Local and tribal health departments: Please forward to hospitals, clinics, emergency departments, urgent care centers and convenience clinics in your jurisdiction.

Hospitals and clinics: Please distribute to primary care and OB-GYN providers and dermatologists in these facilities.

Health care providers:

- Ask patients who may be at risk for using skin lightening products because of cultural or medical reasons about these products, which may contain mercury.
- Consider inorganic mercury exposure from skin lightening products when conducting workup for differential diagnoses of renal, dermatologic and neurological diseases.
- Contact Minnesota Poison Control at 1-800-222-1222 with any questions about evaluating for mercury exposure or whether to obtain urine mercury levels.

Background

A case of acute renal, dermatologic and neurological health effects has been reported in a Minnesota woman who used a skin lightening product containing mercury. She was initially evaluated for lower-extremity edema and nephrotic range proteinuria, and was diagnosed with membranous nephropathy after a biopsy. Dermatologic symptoms included progressive painful, maculopapular, pinkish/red, eczema-like rash on exposed face and neck skin. The patient has reported progressive and marked fatigue, insomnia, depression, anxiety, irritability and apathy.

The patient reported use of a skin lightening product called Nunn Care Crema Limpiadora for one year. She ordered the product online through Walmart Marketplace and Amazon. She stopped using the product after learning of the association between membranous nephropathy and inorganic mercury. The product was tested and found to have high mercury content.

Multiple urine tests have confirmed elevated levels of urine mercury. Levels have trended downward since discontinuation of the skin lightening product.

Clinical Presentation and Evaluation

Signs and symptoms of exposure to inorganic mercury in skin lightening products include:

- Rash
- Hypertension, edema, uremia (due to tubular and glomerular renal injury), nephrotic syndrome
- Paresthesia, anxiety, irritability, tremors, memory loss, depression, weight loss, fatigue

Screening for inorganic mercury is completed through urine collection, ideally collected with use of a preservative. In the general population, normal urine mercury levels should be <5 micrograms/liter. Anything higher indicates likely exposure to inorganic mercury. At levels >25 mcg/L, symptoms may be present though are unlikely, and a toxicologist or environmental specialist should be consulted. At levels >100 mcg/L, acute health effects are possible, and a toxicologist should be consulted as soon as possible through Minnesota Poison Control.

Removing the source of exposure is the most effective treatment. Some patients may require supportive care. Severe mercury poisoning can be treated with chelation after careful assessment of risk/benefit. Chelation treatment of asymptomatic or mildly symptomatic patients is unlikely to benefit patients, and may be harmful. Consultation with a medical toxicologist at Minnesota Poison Control is highly recommended before initiating chelation.

Patient Education

People use skin lightening products for a variety of reasons including skin bleaching, melasma, age or sun spot reduction, morphea, dysmorphia and other medical/personal reasons. Examples of skin lightening products include creams, powders and soaps. Some contain mercury (or other chemicals such as hydroquinone or steroids). Use of a product containing mercury exposes everyone in the home to mercury vapor in the air. Mercury can also be spread through household items (towels, clothing) that come in contact with the products.

Skin lightening is commonly practiced around the world, with deep roots in colorism that places higher value and privilege of light-skinned people over dark-skinned people. It is important to address the social stigma that comes with darker skin and encourage everyone to love their skin. The Minnesota Family Environmental Exposure Tracking (MN FEET) study found that using skin lightening products may be putting women from some Minnesota communities – Hmong, Latina and East African women, among other groups – in danger of high mercury levels.

Patients are advised that skin product ingredient lists are often not complete. The safest course of action is to discontinue use of all skin lightening products not used at the direction of a dermatologist. If they are using a product that is lightening their skin, it is probably unsafe. If patients are currently using a skin lightening product:

- Stop using the product now. If you have been using a product with mercury in it, your body will naturally get rid of the mercury over time.
- Do not throw the product in the trash or dispose of it in the toilet or sink. If it has mercury in it, it can harm others if it gets into the environment.
- Take the product to a household hazardous waste site. You can find the nearest site in the phone book or on the website of the Minnesota Pollution Control Agency (search for household hazardous waste).
- If you have concerns about your skin, see a dermatologist.

Further Information

- MDH Skin Lightening Products Found to Contain Mercury

Pictures of tested products and patient-friendly, short informational sheets in English, Spanish, Hmong, Somali, Oromo and Karen.

- MDH Mercury
  More background information and resources on mercury.
- MN FEET program: Birth disparities and prenatal mercury exposure
  October 2019 article in Minnesota Physician.

Questions or Concerns

- Questions about evaluating for mercury exposure or whether to obtain urine mercury levels: Minnesota Poison Control at 1-800-222-1222
- Urine mercury testing at MDH: Jessica Nelson at 651-201-3610 or jessica.nelson@state.mn.us
- Skin lightening product outreach and education at MDH: Michelle Gin at 651-201-4825 or michelle.gin@state.mn.us

A copy of this HAN is available at: MDH Health Alert Network

The content of this message is intended for public health and health care personnel and response partners who have a need to know the information to perform their duties.

MERCURY EXPOSURE FROM SKIN-LIGHTENING PRODUCTS

Using skin-lightening products is not safe. Most skin-lightening products contain toxic chemicals including mercury. Many skin-lightening products tested in Minne-sota and nationwide contained mercury levels that exceeded the current FDA threshold of 1 part per million (ppm).

Mercury and other chemicals in skin-lightening products can damage your health.

MERCURY IS TOXIC AND CAN HARM YOUR HEALTH:

- It can cause kidney damage.
- It can harm your brain and nervous system.
- It can pass from the mother's milk while breastfeeding causing harm to the baby's brain development.
- Pregnant women and women of childbearing age should avoid exposure to mercury. Unborn babies, infants, and children can be harmed by small amounts of mercury.
- Prenatal exposure to mercury may cause neurological harm in children.

SOME OF THE SKIN-LIGHTENING PROJECTS THAT CONTAIN HIGH LEVELS OF MERCURY

WHAT TO DO?

- If you use products that have mercury in it, stop using it now. Your body will naturally get rid of the mercury.
- For skin problems, consult with your dermatologist.
- Read the skin-lightening products labels. Do not use products that contain mercury and other toxic chemicals.
- Homes tested showed high levels of mercury in the air from skin-lightening products. Do not use mercury products at home.
- Embrace your own beauty and avoid chemical exposures.

Do not throw skin-lightening products in the trash. Take it to a hazardous waste site. For help, contact us via www.thebeautywell.org, 612-250-4263.

www.thebeautywell.org

For more information contact: Amira Adawe
amira.adawe@thebeautywell.org

Healthy Babies Bright Futures

BW BEAUTYWELL

THE BEAUTYWELL PROJECT

MERCURY FACT SHEET

for Business Owners

Skin lightening creams & soaps have mercury in them. Mercury is dangerous and bad for people's health.

WHAT IS MERCURY?

Mercury is a toxic metal in skin lightening products.

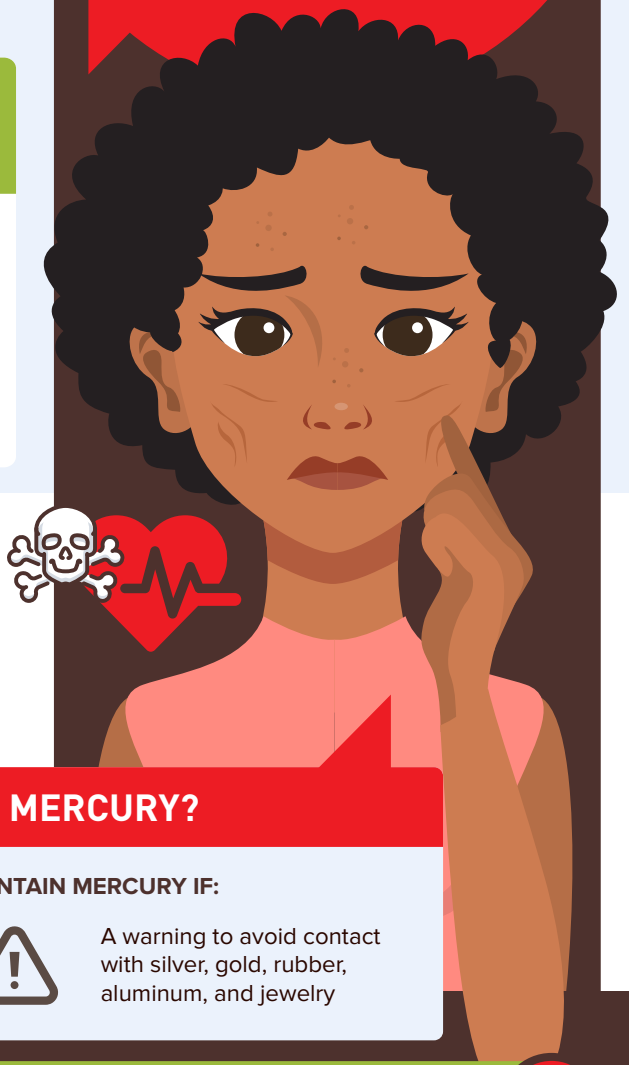
WHY SHOULD I BE WORRIED ABOUT MERCURY?

Mercury is toxic, which means it is bad for your health. Mercury exposure causes:

- Skin rashes, discoloration, scars
- Anxiety, depression, psychosis
- Kidney damage
- In children: **brain, vision, and hearing damage**

Mercury in open skin lightening products can also harm other people in the home or store.

- A child who touches their mother's skin
- A family member who eats food from the fridge where the product is kept
- A family member who breathes the air
- A baby who is being breastfed
- A baby before it is born from their pregnant mother



WHAT PRODUCTS CONTAIN MERCURY?

- Creams
- Lotions and Soaps used for skin lightening
- Skin Brightening
- Skin Whitening
- Dark Spots
- Age Spots
- Blemishes
- Freckles
- and Acne have been found to contain mercury.

HOW DO I KNOW IF A PRODUCT CONTAINS MERCURY?

THE INGREDIENT LIST SAYS

"mercury," "mercurous chloride," "calomel," "mercuric," or "mercurio."

PRODUCTS MAY CONTAIN MERCURY IF:

No ingredient list or no label

A warning to avoid contact with silver, gold, rubber, aluminum, and jewelry

WHAT SHOULD I DO WITH PRODUCTS IN MY STORE THAT CONTAIN MERCURY?

Do not sell them and do not throw them in the trash! It is illegal to sell cosmetics with mercury in them in Minnesota. Mercury is also very bad for the environment.

BRING THE PRODUCTS TO YOUR LOCAL HOUSEHOLD HAZARDOUS WASTE DROPOFF PLACE. IT'S FREE!

- Hennepin County: 1400 W 96th St, Bloomington, MN 55431 or 8100 Jefferson Hwy, Brooklyn Park, MN 55445
- Ramsey County: Bay West, 5 Empire Dr, St Paul, MN 55103

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QUESTIONS OR NEED HELP? CONTACT AMIRA ADAWE AT THE BEAUTYWELL PROJECT!

612-250-4263 amira.adawe@thebeautywell.org www.thebeautywell.org

STEROID EXPOSURE FROM SKIN-LIGHTENING PRODUCTS

Research has found harmful ingredients in skin-lightening products, including steroids. Steroids are toxic and harmful, especially when used for long periods of time. Some products contain steroids in doses 1,000 times higher than recommended.

Steroids and other chemicals in skin-lightening products can damage your health. Skin-lightening products are used by women and men.

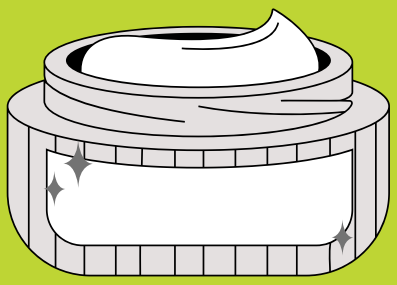
STEROIDS ARE A RISK TO YOUR HEALTH AND DEPEND ON:

- How often the product is applied
- How long you apply the product
- Where you apply the product
- Use during pregnancy and/or breastfeeding

SOME SKIN-LIGHTENING PRODUCTS CONTAIN HIGH LEVELS OF STEROIDS THAT ARE HAMFUL TO YOUR HEALTH

STEROIDS CAN HARM YOUR HEALTH:

- It can cause skin damage: acne, thinning of the skin, rash, painful sores & skin infections
- It can become addictive
- It can cause hypertension
- It can cause elevated blood sugar
- It can decrease the body's natural steroid production



WHAT TO DO?

Many skin-lightening product's ingredient label does not list all ingredients in the product. Avoid all skin-lightening products

- If you use products that have steriods in it, consult with your doctor
- Read the skin-lightening products labels. Do not use products that contain corticosteroids, specifcally clobetasol
- Embrace your own beauty and avoid chemcial exposure from skin-lightening products

Do not throw skin-lightening products in the trash. Take it to a hazardous waste site. for help, contact us via www.thebeautywell.org, 612-250-4263

www.thebeautywell.org

For more information contact: Amira Adawe
amira.adawe@beautywell.org

BW BEAUTYWELL

State of California—Health and Human Services Agency
California Department of Public Health

SUSAN FANELLI
Acting Director

GAVIN NEWSOM
Governor

v.8/2019

Health Alert

Mercury Poisoning Linked to Use of Skin-Lightening Creams from Mexico

Certain skin-lightening or acne creams from Mexico have caused multiple cases of mercury poisoning throughout California. Cream users purchased the products on the street in California cities through informal networks of friends or they brought them into the United States (US) from Mexico. These non-commercial creams are used for lightening the skin, fading freckles, blemishes, and age spots, and treating acne. Products usually come in plastic containers that either have no label or have hand-made labels (see photos on page 3). The poisoning cases have included several children and babies who were not cream users but who were exposed to mercury through contact with family members who used the products. The California Department of Public Health's Food and Drug Laboratory found creams to contain very high levels of mercury, up to 210,000 parts per million (ppm) or 21 percent. It is illegal to sell skin cream products in the US that have 1 ppm or more of mercury.

Signs and Symptoms of Mercury Poisoning

Because signs and symptoms associated with mercury poisoning are non-specific in nature, cases may go undiagnosed for weeks or months, and misdiagnosis has led to clinical treatments that did not address the underlying poisoning.

General Signs and Symptoms	Children with prolonged exposure
• Difficulty concentrating, memory loss • Nervousness, irritability, anxiety • Depression, insomnia • Headaches • Weight loss, fatigue	• Pink hands and feet • Desquamation of the skin • Excessive salivation or thirst, gingivitis • Irritability, anorexia • Poor muscle tone, leg cramps • Hypertension, rash
Neuromuscular Effects	**Renal Effects**
• Tremors, paresthesias • Numbness or tingling in hands, feet, or around the lips • Weakness in the extremities	• Proteinuria • Nephrotic syndrome • Renal tubular acidosis

The California Department of Public Health (CDPH) asks medical providers to consider mercury poisoning in their workup of patients with the above signs and symptoms.

Patients who use these creams and have symptoms of mercury poisoning should have their blood and urine tested for mercury. Providers should urge patients to stop using unlabeled or hand-labeled products immediately. Because homes of skin cream users can become contaminated, other family members should be assessed for mercury poisoning. Any cases of mercury poisoning should be reported to the local public health or environmental health authorities, as well as to Poison Control (1-800-222-1222), who can provide advice about whether chelation therapy may be needed.

Examples of Cases in California

1. A Sacramento woman is currently in the hospital in a semi-comatose state after using a Pond's-labeled skin cream tainted with methylmercury. This is the first reported case of methylmercury poisoning of this type linked to a skin cream in the United States. The woman obtained the skin cream through an informal network that imported the cream from Mexico. This type of cream is used by consumers as a skin lightener and to remove spots and wrinkles. The mercury was not added by the Pond's manufacturer, but by a third party after purchase. Please see the Sacramento County News Release for more information (https://www.saccounty.net/news/latest-news/Pages/Tainted-Skin-Cream-Results-in-Mercury-Poisoning.aspx).

2. In 2014, following two hospitalizations, a 20-month-old baby was diagnosed with mercury poisoning. The baby exhibited hypertension, refusal to walk, irritability, difficulty sleeping and required a nasogastric tube for poor appetite. The baby's mother used a skin-lightening cream from Mexico. The baby was most likely exposed to mercury through physical contact with the mother or from contact with contaminated household items. The cream used by the mother contained 38,000 ppm of mercury and the baby's mercury urine level was 52 µg/g creatinine. Through contact tracking of friends who also used the cream, an additional six households with 40 individuals, half of whom were children, were found to be exposed to mercury. Many of the family's personal belongings were discarded because they were contaminated with mercury.

3. In 2013, following several emergency room visits, consultations with a neurologist, and a week-long hospitalization, a 16-year-old was admitted to a pediatric intensive care unit for almost a month after using a homemade cream from Mexico for acne. His symptoms progressed rapidly from weakness in his legs to involuntary muscle twitching. Later he developed severe back pain; diffuse and visible fasciculations of the extremities, tongue, and lips; unsteady gait; delirium; agitation; sleep disturbances; diaphoresis; persistent tachycardia; and hypertension. A renal sonogram revealed inflammation. The adolescent's mercury urine level was 144 µg/g creatinine from a spot urine and 208 µg/g creatinine from a 24-hour urine. The creams he used contained from 96,000 ppm to 210,000 ppm of mercury. He had only been using the acne cream twice a day for about six weeks before the

onset of symptoms. Eleven family members were affected by mercury exposure, and almost all furniture and personal belongings were disposed of.

4. In 2010, a 39-year-old Latino woman and her four-year-old child were found to have elevated urine mercury levels after participating in a health study. The woman had 482 µg/g creatinine of mercury in urine and the four-year-old child had 107 µg/g creatinine. A clinical examination showed that the woman experienced mild to moderate symptoms of mercury toxicity, including numbness and tingling in her hands and lips, dizziness, forgetfulness, headaches, depression, irritability, and anxiety. The four-year-old appeared to be developing normally with no clinical symptoms of mercury toxicity. The woman had used a skin-lightening cream from Mexico for three years to fade freckles and age spots but her child did not use the cream. An additional twenty one friends and family were assessed for mercury poisoning and five homes were inspected for contamination. The creams used contained between 20,000 ppm and 57,000 ppm of mercury in the form of mercurous chloride.

Sources of these products

All California cases have resulted from use of skin creams originating in Mexico. In some cases, the skin creams were purchased in either Jalisco or Michoacan, Mexico, and then brought into the US. In other cases, the products were sold on the street in California cities, or through informal networks of friends. In two cases, a pharmacy in Mexico adulterated a commercial skin cream by adding powder and oil containing vitamins and other ingredients that included mercury; this product was then carried into California. In nearly all the cases, the skin creams were shared with family and friends and often used by adolescents for acne. See additional photos of Face Creams Containing Mercury purchased in California.

Examples of non-commercial and commercial skin-lightening or acne creams found in CA

Creams come in all types of containers

Unlabeled creams collected in 2010

Unlabeled cream used by index case in 2013

Cream collected in 2014 with hand-made label

Pond's cream adulterated in Mexico in 2010.

Pond's cream adulterated in Mexico in 2019. Cream is particularly toxic due to the organic mercury content.

Mercury Absorption and Toxicity

The CDPH Environmental Health Laboratory identified inorganic mercury in the form of mercurous chloride (also known as calomel) found in most of the creams tested. This is different from organic mercury (methylmercury), which is found in the cream from 2019, but is usually found seafood. Inorganic mercury in skin cream is absorbed following application to the skin; it is retained in the body and toxic levels can develop gradually with prolonged use. Among young children, contact with adult cream users' skin, contaminated air and household items contribute to exposure via dermal absorption, inhalation and hand-to-mouth behavior. Breastfeeding could also contribute to exposure. The target organs for toxic effects are the central nervous system and kidneys. Organic mercury, such as that found in the 2019 cream usually Most inorganic mercury is excreted in the urine. The biological half-life is about 45-60 days.

However, in patients with mercury urine levels > 5 µg/g creatinine, testing for urinary mercury should be repeated every couple of months to confirm that levels are declining until the urine level is below 5 µg/g creatinine. If levels are not dropping accordingly, contamination of the home or continued cream use should be suspected.

Home Contamination

The mercury from these creams can easily spread from the skin of the affected user to clothing and bedding, and on to surfaces and furniture throughout the home where the creams are

used. From these surfaces, through mechanisms that are poorly understood, some of the mercury gets into the air in the home. As a result, until the home is assessed and decontaminated, every person in the home where these products are used is at risk for mercury poisoning.

Medical Testing

The most accurate method to confirm exposure to inorganic mercury is a urine test. A first morning void has up to an 85% correlation with a 24-hour collection, which is the most accurate test. The 95th percentile of urine mercury concentrations from the nationally representative National Health and Nutrition Examination Survey was 2.09 µg/g creatinine[1] (n=2865). Occupational studies have demonstrated non-specific symptoms when urine mercury levels are between 25-50 µg/L, renal tubular effects and changes in plasma enzymes at 50 µg/L, and objective tremor at 100 µg/L. However, in non-occupational cases in California, severity of symptoms of mercury poisoning do not correlate well with urinary mercury levels. Some individuals appear to be more sensitive than others to the development of symptoms associated with mercury exposure.

Renal function tests, including a urinalysis, creatinine, BUN, urine microglobulin, and microalbuminuria, should be performed in individuals with elevated urine mercury levels.

Mercury may also be measured in whole blood. However, blood mercury levels are not accurate indicators of inorganic mercury exposure. Total mercury in blood is normally less than 6 µg/L. Elevated blood mercury levels should be followed up with urine tests as described above.

Choose a laboratory to conduct repeated urinary mercury monitoring with detection limits below 5 µg/L. Laboratory normal values may not reflect a health protective level and we therefore recommend monitoring patients until urinary mercury levels fall below 5 µg/g creatinine or 5 µg/L .

Medical Treatment and Follow Up

Mild to moderate symptoms may resolve over a period of months without therapy. Since skin-lightening or acne creams are commonly used throughout the world, it is often difficult for affected patients to believe that these products can be harmful to their health or the health of their children. When signs and symptoms of neurologic or renal impairment are present, chelation therapy may be considered. Chelation should only be performed in consultation with medical toxicologists with expertise in heavy metals. Contact Poison Control

[1] Urine mercury may be reported as the mass of the metal per volume of urine (ie, mcg/L) or as the mass of the metal per gram of creatinine (ie, mcg/g creatinine). Adjustment for creatinine, which reduces the impact of variation in urine flow rate, can be of value in comparing serial measurements obtained in the same individual (eg, workplace biomonitoring) or in evaluating dose-response trends in small population studies. However, when one is assessing a "creatinine-corrected" result, the urine concentration of the metal (Hg/L) and of creatinine (g creatinine/L) should also be reviewed individually. Kosnett, Michael J, "Mercury" (http://www.accessmedicine.com)

(1-800-222-1222) or the Pediatric Environmental Health Specialty Unit (PEHSU) to be linked with a specialist at www.pehsu.net or at 1-888- 347-2632.

Disposal

Any skin cream product that is suspected to contain mercury must be disposed of as household hazardous waste. The face cream container should be labeled "contains mercury," placed in a sealed plastic bag, and disposed of at local household hazardous waste collection facilities. A listing of local household hazard waste collection facilities can be found at the California Department of Toxic Substances Control website: https://dtsc.ca.gov/managing-hazardous-waste/. Poison Control can also be consulted on how to dispose of these creams.

Commercial Skin-lightening or Acne Creams

Elevated levels of mercury have also been found in commercial skin-lightening or acne creams, germicidal soaps, and other products that have been imported to the US from China, Mexico, the Dominican Republic, and other countries. Users of these products often purchase them abroad or at ethnic markets in California and other states. In 2013, CDPH identified several mercury-containing skin creams sold in Oakland, San Francisco and San Jose. These products came primarily from China and tested as high as 29,000 ppm of mercury. In 1995-1996, 104 people in four southwestern states, including California, were found to have levels of mercury over 20 µg/L in urine from using a mercury-containing commercial skin cream product from Mexico. In some of these products, "mercury," "mercurio," or "calomel" (mercurous chloride) was listed on the label, but it is most often absent.

For Further Information

- CDPH, Environmental Health Investigations Branch's mercury in skin creams page: or call 510-620-3620. A general public one-page flyer is available in Spanish and English to download from this link.

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EDITED BY
Gian Marco Ghiggeri,
Giannina Gaslini Institute (IRCCS), Italy

REVIEWED BY
Keith Dana Thomsen,
Washington River Protection Solutions, United States
Sandeep Kondakala,
National Center for Toxicological Research (FDA), United States

*CORRESPONDENCE
Yuhua Tang
✉ drtang2024@163.com

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Diverse clinical manifestations and prognosis in a couple's mercury poisoning caused by skin-lightening creams: two case reports and literature review

Huixia Ji[1], Ye Chen[1], Dandan Liu[1], Tongzhou Zhou[2] and Yuhua Tang[1]*

[1]Department of Occupational Disease, Nanjing Prevention and Treatment Center for Occupational Diseases, Nanjing, China, [2]Department of Clinical Laboratory, Nanjing Prevention and Treatment Center for Occupational Diseases, Nanjing, China

Skin exposure to mercury-containing creams occurs most commonly in young and middle-aged women and, in a few cases, in men. This article presents the symptoms and prognosis of a couple who developed mercury poisoning after cosmetic use of similar duration and dosage. Case 1 is a 33-year-old man who developed nephrotic syndrome after using skin-lightening creams containing mercury over 9 months. Renal puncture pathology indicated membranous nephropathy. During the course of the illness, the patient intermittently took Chinese medicine. Approximately 4 months later, the patient developed pulmonary thrombosis and lower extremity venous thrombosis as a result of fatigue driving and had to undergo thrombolysis and filter implantation. A urine mercury level of 65.4 μg/g·creatinine was detected in the patient. The urine protein level remained positive 8 months after mercury removal. Case 2 is a 30-year-old woman, the wife of case 1, who used the same creams for 9 months with her husband and had a urine mercury level of 80 μg/g·creatinine. The patient experienced sleep disturbances, fatigue, and irritability. In Case 2, neurasthenia symptoms were relieved following mercury removal, and no other complications were observed. There have been very few reports regarding male patients developing nephrotic syndrome as a consequence of using cosmetics that contain mercury. However, clinicians should not neglect this cause when dealing with newly diagnosed male patients with nephrotic syndrome. The treatment and prognosis of male patients are less well established, and changes in their condition must be closely monitored.

KEYWORDS

mercury poisoning, nephrotic syndrome, mercury removal therapy, prognosis, case report

1 Introduction

Mercury poisoning occurs as a result of exposure to mercury or its compounds through the respiratory tract, digestive system, or skin. The symptoms associated with mercury poisoning can range from mild allergic reactions to severe impairments of the nervous and renal systems (1). It has been reported that cosmetics account for approximately 70% of cases of mercury poisoning (2). Mercury (II) salts promote skin lightening by inhibiting tyrosinase, an enzyme crucial for melanogenesis, thereby reducing melanin synthesis. According to the World Health Organization, skin-whitening products should not contain more than one part

per million (ppm) of mercury (3). However, skin-lightening cosmetics containing excessive levels of mercury remain widely available in numerous regions globally. Consequently, these products are a frequent cause of chronic mercury poisoning among women (4, 5).

It has been observed that the nervous system and kidneys are the organ systems most significantly impacted by chronic mercury poisoning. Chronic mercury poisoning exhibits diverse clinical symptoms, which are governed by the specific chemical forms, exposure doses, and individual susceptibility (6).

In recent years, the majority of studies have focused on the potential risks that mercury-containing cosmetics may pose to female patients. However, there is a significant lack of reports concerning mercury poisoning in males resulting from skin-lightening cosmetics. This article presents the clinical features of mercury poisoning observed in two young married couples who exhibited markedly different clinical symptoms, disease progression, and prognoses after using mercury-containing skin-lightening products at comparable doses and duration.

2 Case presentation

2.1 Case 1

A 33-year-old man weighing 90 kg, who had smoked 20 cigarettes a day for more than 10 years, had no family history of autoimmune disease and reported no proteinuria on previous medical examinations. Over the last 10 years, the patient has been employed as a hairdresser. Since January 2023, the patient has been using skin-lightening lotions and creams on alternate days for 9 months, which he bought from a beauty salon.

In September 2023, the patient developed edema of both lower limbs and foamy urine. Urinalysis revealed protein 2+, blood biochemical tests revealed albumin at 35 g/L, and creatinine levels were within normal limits in the initial hospital. After hospitalization, the patient underwent a renal puncture biopsy. The results showed that the patient had stage II membranous nephropathy, PLA2R and THSD7A were both negative (as shown in Figure 1).

He was then referred to the outpatient clinic of a teaching hospital in the provincial capital city, where he was prescribed valsartan and Chinese medicine without hormone therapy or immunosuppression. Initially, the patient took Chinese medicine intermittently but then stopped taking it.

The patient often worked overtime and stayed late because of his schedule. In January 2024 the patient developed chest tightness, cough, and hemoptysis after a 20-h long-distance drive. In February 2024 the patient was admitted to a local hospital for treatment. CTA of the pulmonary arteries showed multiple pulmonary embolisms in both the main trunk and branches of the bilateral pulmonary arteries. Pre-operative angiography revealed thrombosis-like manifestations in the right calf deep vein, popliteal vein, superficial femoral vein, common femoral vein, and the middle and distal segments of the right iliac vein. The deep vein of the left calf was not visualized, the left popliteal vein had a double-track sign, and the left superficial femoral vein had no middle or distal segments. Blood biochemistry analysis revealed an albumin level of 13 g/L. The patient underwent inferior vena cava filter placement, mechanical thrombectomy for the pulmonary artery thrombus, and contact thrombolysis with thrombolytic catheter placement. The patient underwent thrombolysis and anticoagulation therapy.

In March 2024 his condition was re-evaluated at a teaching hospital in the provincial capital. The serum albumin level was 28.8 g/L, the creatinine level was 83.6 μmol/L, and antiphospholipase A2 receptor antibodies (anti-PLA2R) were found to be negative. Additionally, the urine protein level was measured at 16.04 g/24 h. This patient's treatment regimen includes calcitriol capsules 0.25 μg once daily, atorvastatin calcium 20 mg once daily, valsartan 80 mg once daily, rivaroxaban 20 mg once daily, tacrolimus 1 mg twice daily, and prednisolone acetate 10 mg twice daily. The patient was advised to undergo urinary mercury testing.

The patient underwent a urinary mercury test at our outpatient clinic on 8 March 2024, revealing a level of 65.4 μg/g·Cr (normal < 4 μg/g·Cr). In April 2024 on admission to our department, the patient still had foamy urine and edema of the right lower limb. The patient's temperature was 36.7°C, his heart rate was 110 bmp (later reduced to 80 bmp), and his blood pressure was 124/73 mm Hg. Physical examination revealed no rash, white nail stripes (Mees' lines), scaling

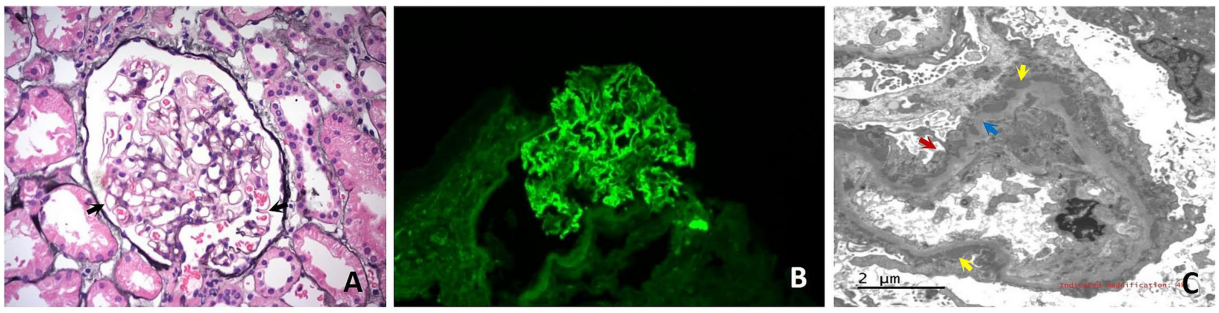

FIGURE 1
Histological images from the renal biopsy of Case 1. **(A)** Light microscopy shows glomerulus with the stiff capillary loops, thickening of basement membranes and formation of spikes (black arrows) (PASM × 400). **(B)** Immunofluorescence microscopy shows Immunoglobulin G deposits as fine granules along the capillary loops (×400); **(C)** Electron microscopy shows glomerular basement membrane irregularly thickened and diffuse fusion of podocyte foot processes (red arrows). Electron-dense deposits are noted beneath the epithelium (yellow arrows). Hyperplastic changes of the basement membrane are observed around some of the electron-dense deposits (blue arrows).

TABLE 1 Symptoms, blood biochemical test results (before mercury removal treatment) and treatment of Case 1 and Case 2.

	Case 1	Case 2
Symptoms	Edema of lower limbs and foamy urine	Insomnia, fatigue, and irritability
Albumin, g/L	29.5 (40.0–55.0)	46.3 (40.0–55.0)
Globulin, g/L	20.2 (20.0–40.0)	29.2 (20.0–40.0)
Alanine aminotransferase, U/L	23 (9–15)	8 (7–40)
Aspartate aminotransferase, U/L	15 (15–40)	10 (13–35)
Total cholesterol, mmol/L	9.16 (<5.18)	4.47 (2.80–6.00)
Triglyceride, mmol/L	1.72 (<1.7)	1.94 (0.50–1.70)
Creatinine, umol/L	80 (57–97)	39.4 (41.0–73.0)
Urea, mmol/L	6.58 (2.8–7.2)	2.71 (2.60–7.50)
Uric acid, umol/L	445 (208–428)	278.6 (200.0–420.0)
Mercury removal treatment	IM, DMPS 0.25 g × 3 day, 3 weeks	IVP, DMPS 0.25 g × 3 day, 3 weeks

In both case 1 and case 2, the blood tests were conducted in different hospitals; therefore, the normal ranges for each indicator varied.

of the hands or feet, or discoloration of the gums (mercury lines). Mild pitting edema of the right lower limb is observed. No abnormalities were observed upon neurological examination. Upon admission, routine blood tests revealed the following results: white blood cell count of 11.8×10^9/L, neutrophil count of 67.8%, red blood cell count of 5.53×10^{12}/L, hemoglobin level of 167/L, and platelet count of 275×10^9/L. Urine analysis showed a protein level of 3+ and microalbumin levels ≥150 mg/L. The biochemical profile of the blood indicated a glutamyl transpeptidase level of 119 U/L, total protein concentration of 49.7 g/L, albumin concentration of 29.5 g/L, total cholesterol level at 9.16 mmol/L, triglyceride level at 1.72 mmol/L, HDL (high-density lipoprotein) at 4.22 mmol/L, LDL (low-density lipoprotein) at 5.58 mmol/L, glucose level at 5.22 mmol/L, urea concentration at 6.58 mmol/L, creatinine concentration at 80 μmol / L, and uric acid concentration at 445 μmol/L.

The patient was administered three courses of chelation therapy with 2,3-dimercaptopropane-1-sulphonate (DMPS) 0.25 g once daily for three consecutive days, followed by a 4-day interval. In the first course of treatment, the urinary mercury levels were 960 μg /24 h, 630 μg /24 h, and 319.8 μg /24 h, respectively. In the second course of treatment, the urinary mercury levels were 828 μg /24 h, 239.2 μg /24 h, 168 μg /24 h, respectively. In the third course of treatment, the urinary mercury levels were 171 μg /24 h, 184.5 μg /24 h, 84 μg /24 h, respectively. There were no adverse reactions during treatment.

Two weeks after the mercury removal, the patient's right lower extremity was edema-free. Repeat the blood biochemistry test: glutamyl transpeptidase 95 U/L, total protein 39.8 g/L, albumin 23.6 g/L, total cholesterol 7.65 mmol/L, triglycerides 2.05 mmol/L, HDL 2.96 mmol/L, LDL 4.47 mmol/L, glucose 3.94 mmol/L, urea 5.71 mmol/L, creatinine 78 μmol/L, uric acid 421 μmol/L. Urine routine: protein 3+, microalbumin ≥150 mg/L. In May 2024 the removal of the lower extremity venous filter was conducted. In September 2024, the patient's liver function was reexamined: glutamyl transpeptidase 35 U/L, total protein 64 g/L, and albumin 37 g/L. In December 9, 2024, the patient's urine test indicated: protein 2+.

A sample of the patient's cream was sent to a laboratory for testing, which showed mercury levels exceeding the upper limit of normal by 10,000 times.

2.2 Case 2

The wife of Case 1, a 30-year-old woman used the same skin-lightening cosmetics as in Case 1, with the same frequency and duration. Several months after using mercury-containing cosmetics, the patient complained of insomnia, fatigue, and irritability. Due to elevated urinary mercury levels in Case 1, Case 2 presented to our outpatient clinic in March 2024. She was advised to undergo hospitalization for mercury removal due to a urine mercury level of 80 μg/g·Cr. The patient underwent mercury removal at the general hospital where she worked. Urine protein levels were negative before treatment. Blood biochemistry revealed an albumin level of 46.3 g/L and a triglyceride level of 1.94 mmol/L. Detailed blood biochemical parameters are presented in Table 1. The treatment plan consisted of daily administration of DMPS 0.25 g plus 0.9% sodium chloride solution 500 mL intravenously for three consecutive days, followed by a four-day break, and a week later, for three courses. In the first course of treatment, the urinary mercury concentration levels were 141.7 μg/g·Cr, 88 μg/g·Cr, and 3352.3 μg/g·Cr, respectively. In the second course of treatment, the urinary mercury levels were 3312.3 μg/g·Cr, 2003.4 μg/g·Cr, 1198.6 μg/g·Cr, respectively. In the third course of treatment, the urinary mercury levels were 686.7 μg/g·Cr, 676.2 μg/g·Cr. There were no adverse reactions during treatment. After mercury removal treatment, her fatigue and insomnia improved.

The medical history for case 1 and case 2 can be seen in Figure 2. Blood biochemical test results before mercury removal treatment of Case 1 and Case 2 were shown in Table 1. Figure 3 presents the total urinary mercury levels and concentrations collected daily for Case 1 and Case 2 throughout the mercury removal period. During the treatment of Case 1, the 24-h urinary mercury excretion was assessed after each mercury removal procedure performed in our hospital. During the treatment course of Case 2, mercury was removed in another hospital, and the concentration of urinary mercury was assessed following each procedure. During the third treatment course, Case 2 failed to provide a urine specimen the third intravenous infusion of DMPS. Upon a one-month follow-up of Case 2, the patient reported complete recovery of her health.

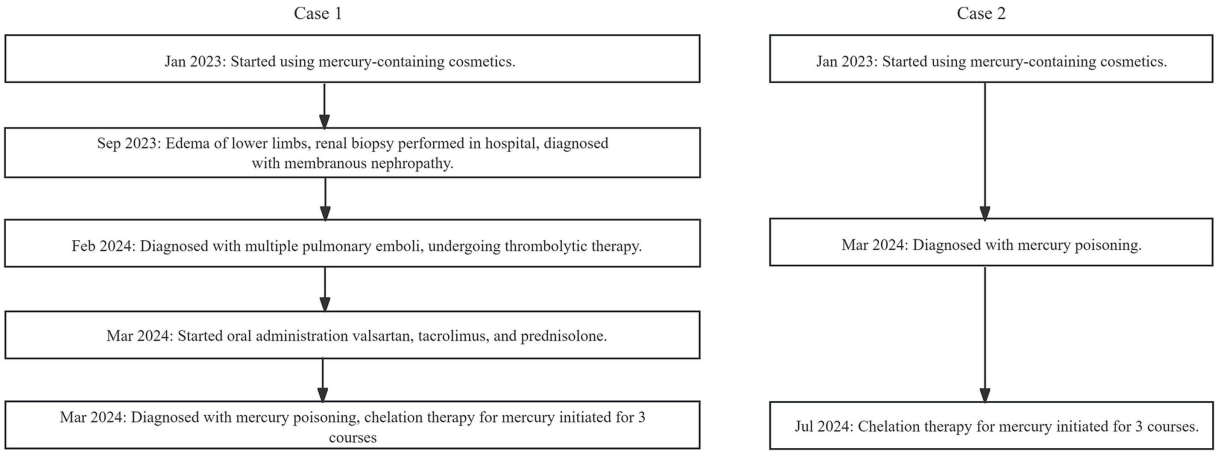

FIGURE 2
Flowchat of Case 1 and Case 2's medical history.

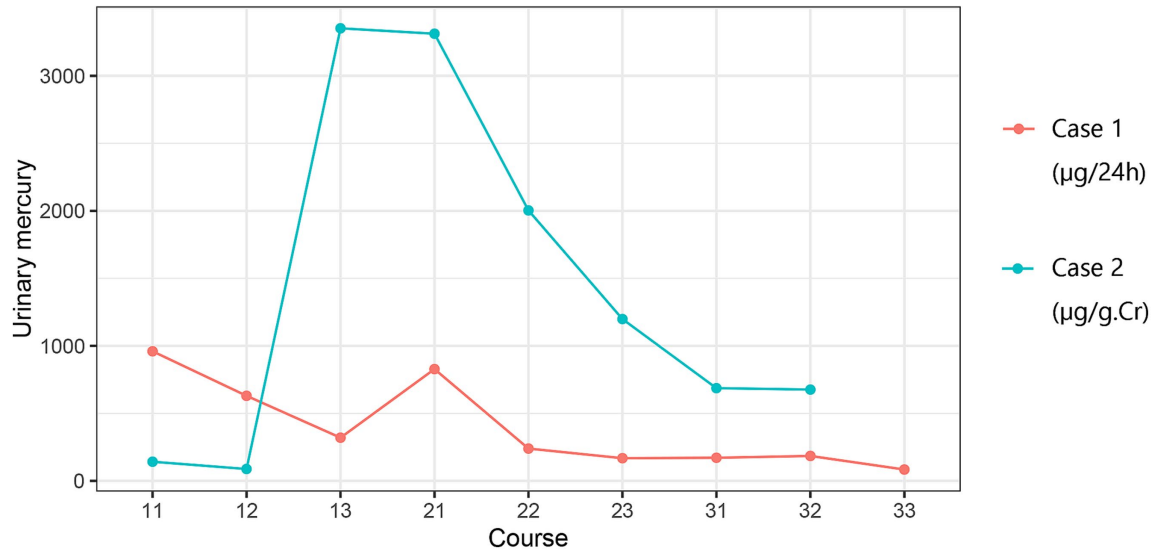

FIGURE 3
Results of mercury removal in Case 1 and Case 2. Course: 11: Week 1, Day 1; 12: Week 1, Day 2....

3 Discussion

Recently, cosmetic products containing excessive mercury have led to increased organ damage, particularly in the kidneys and nervous system (5, 7), owing to the desire for whitening. However, it is not certain whether male patients will have the same clinical characteristics and prognosis as female patients, as most patients in the current literature who have suffered mercury poisoning after using skin-lightening cosmetics are female (4). In this study, the symptoms of individuals exposed to similar levels of mercury varied considerably. The male patient suffered nephrotic syndrome, pulmonary embolism, and lower limb thrombosis, whereas the female patient experienced only mild symptoms of neurasthenia.

The skin absorption rate is related to the mercury concentration and skin hydration status. Skin absorption is influenced by the skin's integrity and the solubility of cosmetic carriers in lipids. Following absorption, inorganic mercury was distributed throughout all tissues. Due to the lipid solubility of mercury, it is readily permeable through the membrane and barrier of alveolar cells. Furthermore, it can permeate the blood–brain barrier and traverses the placenta by means of diffusion. A high concentration of mercury is present in the brain and kidneys. Within the kidneys, the concentration of mercury attains the highest level.

An expanding body of research has demonstrated that mercury, particularly in its inorganic divalent form, is linked to the development of autoimmune diseases (8). Activated T cells lead to the polyclonal activation of B cells, resulting in immune complex nephritis, such as membranous nephropathy, minimal change disease, or focal segmental glomerulosclerosis (9, 10). In Case 1, the mercury-related membranous nephropathy was caused by the use of skin-lightening cosmetics. Mercury-induced nephropathy remains inadequately understood. Upon the combination of mercury with proteins, haptens

are generated, leading to the immune system's production of antigen–antibody complexes. After infiltrating the glomerular basement membrane, these complexes induce glomerular lesions. In addition to exerting detrimental effects on the immune system, mercury can enhance the production of autoantibodies, inhibit T lymphocyte function, and trigger autoimmune disorders.

When a patient is diagnosed with mercury-related nephropathy, it is imperative that, in addition to mercury removal, comprehensive tests are performed, including renal puncture pathology, blood cholesterol, anti-M-type phospholipase A2 receptor (PLA2R), anti-thrombospondin type 1 domain 7 A receptor (THSD7A), and renal tubular function analysis. High levels of PLA2R and THSD7A expression have been observed in the kidneys of patients with idiopathic membranous nephropathy (IMN) and are associated with a poor prognosis (11, 12). THSD7A and PLA2R were not detected in the tissues of Case 1, suggesting a distinct immunological difference between mercury poisoning nephropathy and IMN. However, the patient failed to adhere to the recommended treatment, stopped taking the medication on his own, stayed up late, and drove fatigue for long periods, resulting in pulmonary embolism and lower-limb thrombosis. Therefore, patients with this type of nephrotic syndrome who are at risk of hypercoagulation should be closely monitored, and appropriate measures should be taken to prevent hypercoagulation.

Despite the poor permeability of the blood–brain barrier to mercury, prolonged exposure and slow elimination can lead to the accumulation of mercury ions in the central nervous system and cause neurotoxicity (8). When mercury ions interact with thiol groups, they lead to the formation of thiols. The thiol groups present in the brain play a crucial role in maintaining redox balance. Consequently, this reaction may disrupt cellular metabolism by inactivating thiolases. Furthermore, both *in vitro* and *in vivo* studies have demonstrated that exposure to mercury can induce oxidative stress (OS) (13), promote the generation of reactive oxygen species (ROS), and the depletion of glutathione (GSH) (14). As in Case 2, mercury damage to the central nervous system can manifest as insomnia, fatigue, weakness, mood swings, and other non-specific symptoms. The symptoms in Case 2 were significantly alleviated following mercury removal treatment.

Mercury poisoning should be treated with thiol-containing chelating agents. DMPS injections are the most commonly prescribed treatment. Both Cases 1 and 2 were treated with DMPS for mercury removal. The urinary mercury levels of both the husband and wife decreased after three courses of treatment.

The conditions and prognoses of patients with mercury-related nephropathy have also been studied. Mercury poisoning causes nephrotic syndrome, which is characterized by proteinuria, hypoproteinaemia, and hyperlipidemia but is less commonly caused by reduced renal function. Most mercury-related nephropathy cases have a good prognosis, with remission times ranging from 1 to 48 months and a median remission time of approximately 3 months. There was almost no recurrence after the mercury removal (6, 15). However, it is essential to note that most of these reports relate to young and middle-aged female patients, and there are relatively few reports on nephropathy in men who have used cosmetics containing mercury. After 8 months of follow-up, the urine protein in Case 1 remained positive for mercury-related nephropathy.

Men exhibit a higher susceptibility to occupational mercury poisoning, primarily due to their exposure to mercury vapor via the respiratory system in workplace environments (16, 17). Women are more likely to suffer from mercury poisoning due to the use of mercury-containing cosmetics. However, it remains unclear whether men are also at risk for mercury poisoning or related kidney disease from these products (18). Due to an irregular lifestyle and prolonged periods of staying up late, Case 1 discussed in this article may have a higher likelihood of developing kidney disease compared to mercury-poisoned individuals who maintain healthy working and resting habits. The rapid elevation in Ca2+ levels induced by testosterone induces calcium overload in cells, which contributes to mercury poisoning-induced kidney damage (19). Case 1 is a man who smoked for 10 years. Smoking also increases the risk of proteinuria (20). Smoking reduces nitric oxide (NO), which attenuates endothelial cell-dependent vasodilation and promotes intimal cell hyperplasia, leading to endothelial dysfunction and chronic kidney disease (21).

Additionally, high cholesterol levels contribute to poor prognosis in patients with membranous nephropathy. As plasma cholesterol concentrations increase, the cholesterol content in red blood cell membranes also increases, resulting in a decrease in fluidity, hindering oxygen diffusion, reducing the ability of red blood cells to load and release oxygen, and causing renal hypoxia. Another consequence of hypercholesterolemia is lipid deposition in the renal arteries, which can lead to a reduction in renal artery capacity and increased renal stress (22). At the time of hospital admission, Case 1's plasma total cholesterol level was 9.16 mmol/L. Two weeks after receiving the mercury removal therapy, this level dropped to 7.65 mmol/L, indicating his health had improved.

Mercury-containing cosmetics were manufactured and used in Europe, Southeast Asia, Africa, the Mediterranean, and other regions from 2000 to 2022, whether purchased online or offline and recommended by friends and relatives, promoting the widespread use of whitening products and leading to mercury poisoning (23). Michael et al. reported that a 17-month-old female toddler developed hypertension, irritability, constipation, appetite loss, and leg pain after mercury exposure. The urinary mercury level was 243 mcg/g creatinine. The urinary mercury levels of her mother and grandmother after mercury exposure were 197 mcg/g creatinine and 222 mcg/g creatinine, respectively (normal 35 mcg/g creatinine). Still, they did not show any clinical symptoms. This suggests that individuals respond differently to exposure (24).

This study had some limitations. Case 2 was unable to undergo mercury removal treatment at our hospital due to work-related reasons, which led to a variation in the normal range of biochemical test results between Case 1 and Case 2. DMPS was injected intramuscularly in Case 1 and intravenously in Case 2. Although the treatment doses were the same, the different administration methods may have resulted in different mercury removal outcomes. As Case 2 only provided the urine concentration following mercury removal treatment, without providing the corresponding urine volume, it is not feasible to determine the amount of mercury excreted. Furthermore, patient 2 failed to provide a urine sample after the third injection of mercury removal in the third course of treatment.

Patients suspected of having mercury poisoning often require a multidisciplinary team that involves toxicologists and public health officials. To facilitate early recovery for patients affected by mercury poisoning, clinicians should strive to gain a comprehensive understanding of the clinical manifestations associated with this condition. Early identification and diagnosis are essential, as well as the removal of exposure sources and the implementation of chelation therapy. Furthermore, providing timely health education to patients is vital in managing their recovery effectively.

4 Conclusion

Generally, Nephrotic Syndrome caused by mercury-containing cosmetics have a better prognosis. Most of the research subjects reported in the literature on mercury poisoning caused by the use of skin-lightening creams are female patients. Whether male and female patients share similar clinical characteristics remains unknown. Some patients have a prolonged course of illness due to a lack of knowledge regarding mercury poisoning and heavy metal toxicity testing. Male patients may seek medical advice, but clinicians may overlook the possibility that mercury-containing cosmetics contribute to a range of complications. To reduce the number of misdiagnoses, it is imperative that the public is educated about mercury poisoning, including cosmetic use and occupational exposure. The significance of public health education in promoting the early detection of mercury poisoning cannot be overstated. Enhanced monitoring of mercury levels in cosmetics is crucial for mitigating mercury-related health risks and improving cosmetic safety.

Data availability statement

The datasets featured in this article are not readily accessible due to personal privacy. For inquiries regarding access to these datasets, please contact jihuixia1990@163.com.

Ethics statement

The studies involving humans were approved by Nanjing Prevention and Treatment Center for Occupational Diseases Ethics Committee. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

HJ: Conceptualization, Data curation, Formal analysis, Investigation, Supervision, Writing – original draft, Writing – review & editing. YC: Supervision, Writing – original draft, Writing – review & editing. DL: Methodology, Resources, Visualization, Writing – original draft, Writing – review & editing. TZ: Validation, Writing – review & editing. YT: Supervision, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declare that no Gen AI was used in the creation of this manuscript.

Publisher's note

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