

Belt Buckles—Increasing Awareness of Nickel Exposure in Children: A Case Report

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Children, especially those with atopic dermatitis, are at risk for nickel sensitization and subsequent dermatitis from metal-containing objects, namely belt buckles. We describe allergic contact dermatitis in 12 children with peri-umbilical nickel dermatitis (with and without generalized involvement) caused by dimethylglyoxime-positive belt buckles. The patients' symptoms resolved with avoidance of the nickel-containing products.

Nickel allergic contact dermatitis (Ni-ACD) has become increasingly recognized in the pediatric population, with prevalence rates in patch-tested populations of ~25% throughout the last decade.^{1,2} Nickel is one of the most common causes of allergic contact dermatitis in children.

In the literature, nickel exposure in children has been linked to a wide range of materials and accessory sources, with ear piercing being highly contributory.³ However, increasing numbers of pediatric cases of nickel dermatitis occur in children who have no piercings.⁴ Of note, Silverberg et al found that in a series of patients with a reported personal history of umbilical or wrist dermatitis or a family history of Ni-ACD, all had a positive reaction to a nickel patch test.⁵ Given the move of major manufacturers to remove nickel from jean snaps,⁶ the importance of peri-umbilical dermatitis may be overlooked, underscoring the pivotal sensitization role of any skin contact with a metal belt buckle.⁷

CASES

Twelve patients with clinically apparent nickel dermatitis (peri-umbilical with or without generalized involvement) were evaluated. The age

ranged from 9 to 15 years old, mean age 12.5 years; the group included 5 males and 7 females. Information on race was available for 10 patients: 5 were white non-Hispanic, 4 were Hispanic, and 1 was Asian. Atopic dermatitis history was present in 9 patients (75%). Family history of contact dermatitis or atopic triad was not available (Table 1). Clinically, Ni-ACD presents hours to days after initial exposure; it may be confined to the site of contact or be generalized and extend outside the area of exposure. Visually the skin often has an erythematous base with overlying pruritic papules and, at times, vesicles. Chronic Ni-ACD may show lichenified and hyperpigmented plaques.

Of the 12 patients evaluated, 11 proved positive for nickel allergy on confirmatory patch testing. Patch testing was deferred by one patient due to difficulty in accessing medical care. Of the 11 total pairs of pants tested (each from an individual patient), none of the jean snaps tested positive for nickel with the dimethylglyoxime (DMG) test (Dormer Laboratories Chemo-Nickel Test, Chemotechnique Diagnostics, Malmö, Sweden), whereas DMG testing on patients' belt buckles unequivocally pointed to the source.

abstract

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TABLE 1 Demographics of Pediatric Nickel Dermatitis Cases (*n* = 12)

Category	Value
Mean age, years (range)	12.5 (9 to 15)
Gender	
Male	5 (42)
Female	7 (58)
Race ^a	
White, non-Hispanic	5 (42)
Hispanic	4 (33)
Asian	1 (8)
Location of nickel dermatitis	
Generalized	8 (67)
Peri-umbilical only	1 (8)
Other ^b	3 (25)
Concurrent atopic dermatitis	9 (75)

Values are expressed as *n* (%) unless stated otherwise.

^a Race information missing for 2 cases.

^b Other includes torso, legs, ear, and axilla.

Patients were instructed to specifically avoid contact with their nickel-containing belt buckles by simply switching to brass buckles. Ten patients (83%) who adhered to instructions and replaced their belt buckles had dramatic resolution of their dermatitis within a time range of 1 to 5 weeks, depending on the severity of the reaction, with more widespread reactions taking more time to resolve. Two patients were lost to follow-up.

DISCUSSION

Ni-ACD is a significant pediatric health concern. Notably, individuals with a history of atopic dermatitis (AD) appear to be more susceptible to developing nickel allergy; this is not surprising, considering that filaggrin null mutations have been shown to be positively associated with nickel sensitization.^{8,9} This fact advances the importance of contact allergy testing in children with recalcitrant or widespread severe AD, because such situations may indicate the presence of underlying or superimposed ACD.¹⁰ Additionally, recognizing the risks of Ni-ACD associated with piercing may justify preemptive avoidance of nickel among patients with AD, to decrease sensitization and morbidity.

In the 1990s, metal clothing clasps and snaps became a recognized

source of nickel sensitization.¹¹ In 2012, a European group led by Thyssen tested a total of 701 belts purchased in China and the United States for their metal content and found that 60% (China) and 55.7% (United States) released nickel.¹² With such widespread presence of nickel in metal items, it became popular for the public to engage in the practice of painting nickel sources with varnishes (eg, nail polish) to create a barrier between the skin and metal.⁶ Buckles may be coated with clear varnish, but this is not recommended since it is difficult to determine when transparent polish is worn away, in which case it gives a false sense of security that can lead to ongoing and inadvertent contact. The preferred approach to prevention, therefore, should be to DMG test buckles before purchase to ensure they are nickel free (Fig 1).

The DMG test, first described by Feigl¹³ in 1958 and modified by Fisher¹⁴ in 1973, consists of a 1% dimethylglyoxime in alcohol with 10% ammonium hydroxide. The solution is applied to a cotton-tipped applicator and rubbed on the surface of the metallic object in question. If nickel is present at a concentration as low as 1:10 000 on a solid surface and 10 ppm in a liquid, a pink precipitate will form (the greater the nickel content, the greater the intensity of the pink color-change indicator observed). The DMG test varies in sensitivity, as it is dependent

on the nickel concentration in the metal being tested.¹⁵ A recent European study assessed DMG sensitivity and specificity on 96 metallic products with resulting 59.3% sensitivity and 97.5% specificity.¹⁶ The test is able to detect a content >10 μg (0.44 $\mu\text{g}/\text{cm}$) of released nickel in objects. However, because objects with nickel content of as low as 0.05 μg have been reported to cause ACD,¹⁷ the DMG test is not a failsafe measure. The consumer should try to use nickel-free alternatives when possible.

Sensitization is lifelong, and thus it is important to recognize that development of nickel contact allergy as a child could potentially limit choice of clothing worn, jewelry adorned, razors used, electronics bought, instruments played, or occupation chosen, because highly allergic individuals require stringent avoidance of all nickel substances.¹⁸ Of note, body habitus and clothing style may have an impact on sensitization, as exposure of extraneous abdominal tissue to metal via low-waist jeans may yield a higher surface area for nickel contact. Additionally, a medical history of nickel allergy increases the risk for future disabling hand dermatitis,¹⁹ which has a staggering annual societal per-patient cost of \$9575 US.²⁰

The overall cost associated with nickel dermatitis is significant for both the consumer and the health care system, at an estimated \$100 million per year.²¹ Given the economic burden of this diagnosis, population-based measures to limit nickel content in products with significant exposure to skin are reasonably warranted. Two decades ago, the European Union followed Denmark's example by initiating a Nickel Directive: national legislation that limited nickel within goods, and specifically earring posts. This intervention resulted in significantly decreased nickel sensitization rates, leading to a savings of >\$20 billion in health care dollars.^{21–23} Efforts



FIGURE 1 Belt buckle with “nickel-free” label. Made in the United States.

toward a similar legislative change in the United States are underway.

Collaboration among medical professionals, manufacturers, and legislators is key to the success of lowering this disease burden. The knowledge gap within the clothing industry regarding Ni-ACD is evidenced by the high levels of nickel in products that release this allergen and cause dermatitis in vulnerable children. Some companies have emerged as leaders by voluntarily removing nickel from their products. For example, companies that have already implemented nickel restrictions in their jean snaps include Levi Strauss & Co. and the VF Corporation (including Lee, Rock & Republic, Wrangler, and 7 for All Mankind).²⁴ Additionally, Walmart has recently declared a goal to initiate safer clothing lines with limited nickel content for children.¹²

Clinicians often make the diagnosis of nickel allergy in the pediatric population based on clinical presentation and history without confirmatory patch testing. In recent years, detection and reporting of nickel allergy in children has been on the rise.² It is important to continue considering metallic-appearing accessories as potential nickel exposure sources and, whenever possible, recommending avoidance of prolonged skin contact to metal with nickel-releasing content. This is particularly true in the 20% of the pediatric population with AD, because they are more susceptible to Ni-ACD. Overall, as harmless as a belt buckle may appear to be, it can be a significant sensitizer in the pediatric population at risk for Ni-ACD.

ABBREVIATIONS

ACD: allergic contact dermatitis
AD: atopic dermatitis
DMG: dimethylglyoxime
Ni-ACD: nickel allergic contact dermatitis

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