

# P-Phenylenediamine in Black Henna Temporary Tattoos: A Pediatric Problem Despite Prohibition

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**Abstract:** Para-phenylenediamine (PPD) is a known strong sensitizer and allergen. It has been directly associated with severe allergic contact dermatitis reactions and systemic toxicities. While PPD is permitted in hair-dye with restriction, it is prohibited for direct use on skin. Unfortunately, skin application continues through temporary tattoos with black henna dyes, because these products are unregulated by the US Food and Drug Administration. Policy change, and parent and child-oriented educational campaigns are necessary to build knowledge of this serious issue.

**Key words:** Allergic contact dermatitis, p-Phenylenediamine, PPD, Pediatric, Henna, Temporary tattoos.

## INTRODUCTION

The unregulated use of p-phenylenediamine (PPD) in temporary tattoos endangers children worldwide. Temporary black henna tattoos are frequently applied on children and young adults at holiday and vacation venues with harmful consequences [1]. Temporary black henna tattoos are readily available from a number of sources including, and not limited to, resorts, beaches, cruise ships, ethnic marketplaces, beauty parlors, kiosks in shopping malls, festivals, street fairs, amusement parks, and cultural celebrations. Black henna tattoos are primarily applied by individuals who have little or no training. There is minimal oversight from local or state authorities, since the Food and Drug Administration (FDA) does not regulate the practices of individual vendors/artisans. Moreover, vendors may be unaware of the contents of the products they are applying, and since temporary tattoo adverse reactions are usually delayed (Type IV Hypersensitivity), they may not be aware that such events even occur.

Severe reactions to black henna tattoos have been reported in a Dutch boy who later developed erythema exsudativum multiforme minor, a 30-month old toddler vacationing in Hawaii, Indian children who have post-black henna leukoderma,

and Israeli children using temporary "Black Henna" hair coloring products during religious celebrations [1-4]. Systemic toxicity and reports of fatality after black henna use have been reported in several African countries where PPD is widely used in traditional ceremonies and familial celebrations, and is unfortunately not regulated [5,6]. A case in which a French girl developed a severe erythematous-vesicular reaction to black henna, prompted the European Union to increase legislation to protect the public and inform them about the dangers of black henna [7].

The natural reddish-brown henna powder is derived from the *Lawsonia inermis* plant leaf and is commonly used in Asia and Africa for body-decorating, a process known as *mehndi*. Little toxicity has been associated with red henna use [8]. In an attempt to speed the drying and decorating process, secondary ingredients (such as PPD) are often added to the natural henna dye [9]. PPD is a highly sensitizing oxidizer, and its use on the skin can result in severe allergic contact dermatitis (ACD), post inflammatory pigment alteration, scarring, and life-long sensitization [6]. (See Figures 1 and 2). Skin pigment changes have been frequently reported as notable side effects of PPD's use in children [10-12]. For example, Neri *et al.* described multiple cases of hypopigmentation at the site of prior temporary tattoos in children [12]. In children with skin types IV and V, hyperpigmentation following black henna tattoo reactions have

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**Figure 1:** Photograph of the arm of a 16-year-old girl with ACD due to black henna tattoo [37].

been observed to last more than two years (author's unpublished observation, SEJ).



**Figure 2:** Photograph of ACD on a child's arm after application of a dragon-shaped temporary tattoo [28].

PPD-sensitized individuals can demonstrate cross-reactivity to a number of products containing azo dyes, which are commonly used in leather and textile manufacturing, as well as in some medications (eg: brompheniramine, doxepin, diphenhydramine, hydroxyzine, and chlorpheniramine). Notable widespread ACD has been reported following exposure to azo dyes in individuals previously sensitized to PPD [14, 15]. Black rubber mix, an antioxidant additive used in the manufacture of tires and other rubber-containing products, also contains PPD, and therefore exposure to a wet-suit containing rubber could potentially cause a reaction in PPD-sensitized individuals [16]. Other para-amino compounds, including sulfa medications and ben-

zocaine anesthetics confer a cross-reactivity risk to PPD in reportedly 6% and 7.5% of cases, respectively [17]. Indirect PPD exposure through secondary contact with another person's dyed hair (wife to husband and mother to child) has been reported to induce a "connubial" dermatitis [18-20]. Over the last 15 years, as the use of PPD-containing products such as hair dye and temporary tattoos has become more widespread, especially in younger populations, there is a greater possibility of a lifetime of sensitization with significant ramifications. For example, a 15 year old girl was recently reported to have developed an angioedema-like reaction after her first hair dye exposure, she was believed to have been sensitized to PPD by a black henna tattoo [21].

The popularization of temporary tattoos at fairs, beaches, and tourist attractions in the US has brought PPD's regulation, or lack thereof, to light [22]. PPD was first used in the early 20th century as a hair dye due to its ability to permanently pigment the hair. The first reported cases of serious adverse reactions associated with PPD were noted in the literature during the 1930's, prompting the first US legislation targeting the additive [20,23]. The Food, Drug, and Cosmetic Act of 1938 prohibited the use of PPD in retail goods applied directly to the skin, while continuing to allow its use in hair dye products [24]. Although retail hair dye manufacturers recommend an allergy test (application of the hair dye product to the skin for 24-48 hours prior to product use) in order to identify sensitization, the specificity and sensitivity

of these tests is not known, as many patients may not seek medical attention if they do get a reaction. Furthermore, instructions often vary, and it is unclear how many consumers follow through with the testing [25]. In addition, hair dyes are not “intended” for use among children under 16-years of age, yet the growing popularity of hair dying among teenagers sets the stage for early sensitization [26].

Temporary tattoos were excluded from the 1967 Fair Packaging and Labeling Act (FPLA), which requires the declaration of all ingredients in retail cosmetic products [27]. Temporary tattoos are classified as products used “exclusively by professionals” (technicians at salons or tattoo booths), and as such, are not regulated under the FPLA restrictions [28]. Therefore, the face painting and hand design “artists” at vacation venues could be utilizing PPD-infused skin products, which were directly prohibited for retail sales by the 76-year-old Food, Drug and Cosmetic Act. Furthermore, unbeknownst to the consumer, levels of PPD in black henna tattoos as high as 29.5% have been reported, while the maximum permitted concentration of PPD in hair dye is 6% [29-31]. The FDA has issued import alerts in order to escalate confiscation of unregulated black henna products at international commercial shipping stations; nevertheless, “not every shipment is inspected and many problematic items pass through” [32].

In Canada, all retail and professional cosmetic products used on the skin are prohibited from including any PPD additives, while the European Union has only restricted PPD’s concentration in hair dye products [33]. Most other countries have not implemented any regulation of PPD within henna products, which translates to an international problem with continued need for vigilance and intervention [34].

Despite prohibition, PPD has remained a popular additive in skin-surface cosmetics and artistic products such as temporary tattoos. Hundreds of case reports of allergic contact dermatitis associated with skin-application of PPD are reported [6]. Although hair dye-use remains the leading source

of PPD sensitization, black henna tattoo-use is rising throughout the world, especially among the pediatric population due to its popularity, low cost, and painless application [6]. Denmark, reported increased use of black henna among youth, and an overall increase in the exposure to black henna tattoos [6]. In the US, such data are currently unavailable (personal communication, Food and Drug Administration hotline, 2014 May 12). In 2001, however, alarming case reports of severe bullous reactions from temporary tattoos prompted the FDA to launch a safety and regulation website and a reporting hotline, to alert consumers about the dangers (MedWatch, 1-800-332-1088) [6,28,35].

Analysis of published PPD patch test data suggests that PPD-sensitization continues to be a prevalent and clinically relevant global problem for children [6,36]. Given the popularization of black henna tattoos among children and adolescents, we suggest an amendment to the current US FPLA policy to mandate accurate ingredient labeling for all cosmetic products, and the prohibition of all PPD-laced henna tattoos. Since PPD-sensitization is a global public health issue, educational programs for both minors and parents are needed to establish lasting impressions and build knowledge about the dangers of PPD and black henna tattoos.

## REFERENCES

- [1] Jacob SE, Brod BA. Paraphenylenediamine in black henna tattoos: sensitization of toddlers indicates a clear need for legislative action. *J Clin Aesthet Dermatol* 2011; 4: 46-7.
- [2] den Ottolander JP, Greebe RJ. A boy with a skin lesion after a henna tattoo. *Neth J Med* 2011; 155: A2796.
- [3] Bajaj AK, Saraswat A, Srivastav PK. Chemical leucoderma: Indian scenario, prognosis, and treatment. *Indian J of Dermatol* 2010; 55: 250-4.
- [4] Glatstein MM, Rimon A, Danino D, Scolnik D. Severe allergic contact dermatitis from temporary “black henna” coloring of the hair during religious cultural celebrations: three different cases, same history. *Am J Ther* 2014 (epub ahead of print).
- [5] D’Arcy PF. Fatalities with the use of henna dye. *Pharmacy Int* 1982; 3: 217-8.

- [6] de Groot AC. Side-effects of henna and semi-permanent 'black henna' tattoos: a full review. *Contact Dermatitis* 2013; 69: 1-25.
- [7] Lamchahab FZ, Guerrouj B, Benomar S, *et al.* Henna symbolic tattoo and real dermatitis. *Arch Pediatr* 2011; 18: 653-6.
- [8] Polat M, Dikilitas M, Oztas P, Alli N. Allergic contact dermatitis to pure henna. *Dermatol Online J* 2009; 15: 15.
- [9] Blair J, Brodell RT, Nedorost ST. Dermatitis associated with henna tattoo. "Safe" alternative to permanent tattoos carries risk. *Postgrad Med* 2004; 116: 63-5.
- [10] Matulich J, Sullivan J. A temporary henna tattoo causing hair and clothing dye allergy. *Contact Dermatitis* 2005; 53: 33-6.
- [11] Onder M. Temporary holiday "tattoos" may cause lifelong allergic contact dermatitis when henna is mixed with PPD. *J Cosmet Dermatol* 2003; 2: 126-30.
- [12] Neri I, Guareschi E, Savoia F, Patrizi A. Childhood allergic contact dermatitis from henna tattoo. *Pediatr Dermatol* 2002; 19: 503-5.
- [13] Swerlick RA, Campbell CF. Medication dyes as a source of drug allergy. *J Drugs Dermatol* 2013; 12: 99-102.
- [14] Rogkakou A, Guerra L, Scordamaglia A, Canonica GW, Passalacqua G. Severe skin reaction due to excipients of an oral iron treatment. *Allergy* 2007; 62: 334-5.
- [15] McEnery-Stonelake M, Silvestri DL. Contact allergens in oral antihistamines. *Dermatitis* 2014; 25: 83-8.
- [16] Nicholas PP, Luxeder AM, Brooks LA, Hammes PA. *Kirk-Othmer encyclopedia of chemical technology*. 3<sup>rd</sup> ed. New York: Wiley Interscience; 1978.
- [17] LaBerge L, Pratt M, Fong B, Gavigan G. A 10-year review of p-phenylenediamine allergy and related para-amino compounds at the Ottawa Patch Test Clinic. *Dermatitis* 2011; 22: 332-4.
- [18] Lopez IE, Turrentine JE, Cruz PD Jr. Clues to diagnosis of connubial contact dermatitis to paraphenylenediamine. *Dermatitis* 2014; 25: 32-3.
- [19] Gass JK, Todd PM. PPD: is this a connubial dermatitis? *Contact Dermatitis* 2006; 55: 309.
- [20] National Research Council. *Science, medicine, and animals*. Washington: The National Academy Press; 2004; [cited 2014 May 29].
- [21] Haluk Akar H1, Adatepe S2, Tahan F3, Solmaz I4. Hair dyes and temporary tattoos are a real hazard for adolescents? *Eur Ann Allergy Clin Immunol*. 2014 Jan; 46(1):35-7.
- [22] Jacob SE, Zapolanski T, Chayavichitsilp P, Connelly EA, Eichenfield LF. P-Phenylenediamine in black henna tattoos: a practice in need of policy in children. *Arch Pediat Adol Med* 2008; 162: 790-2.
- [23] Meadows M. A century of ensuring safe foods and cosmetics. *FDA Consumer* 2006; 40(1): 6-13.
- [24] The 1938 Food, Drug, and Cosmetic Act [homepage on the Internet] [cited 2014 May 29].
- [25] Thyssen JP, Sosted H, Uter W, Schnuch A, *et al.* Self-testing for contact sensitization to hair dyes—scientific considerations and clinical concerns of an industry-led screening programme. *Contact Dermatitis* 2012; 66: 300-11.
- [26] European Commission and Scientific Committee on Consumer Products. Memorandum on hair dye substances and their skin sensitising properties. European Commission, Health and Consumer Protection Directorate-General. 2006, December 19. [cited 2014 May 29].
- [27] U.S. Legal Code. Fair packaging and labeling program. U.S. Code, Title 15, Chapter 39. [cited 2014 May 29].
- [28] US Food and Drug Administration. Temporary tattoos, henna/mehndi/ and "black henna" safety and regulatory information. [homepage on Internet] [cited 2014 May 29].
- [29] Brancaccio RR, Brown LH, Chang YT, *et al.* Identification and quantification of paraphenylenediamine in a temporary black henna tattoo. *Dermatitis* 2002; 13: 15-8.
- [30] Kang IJ, Lee MH. Quantification of paraphenylenediamine and heavy metals in henna dye. *Contact Dermatitis* 2006; 55: 26-9.
- [31] Al-Suwaidi A, Ahmed H. Determination of paraphenylenediamine (PPD) in henna in the United Arab Emirates. *Int J Environ Res Public Health* 2010; 7: 1681-92.
- [32] Petigara B, Hollinger K. Temporary Tattoos: Raising Consumer Awareness of Safety. Food and Drug Administration, Center for Food Safety and Applied Nutrition, Office of Cosmetics and Colors. Presentation. Accessed May 13th, 2014.
- [33] Government of Canada. Healthy Canadians. [homepage on Internet] "Black henna" temporary tattoos. [cited 2014 May 29].
- [34] Sonnen G. Type IV hypersensitivity reaction to a temporary tattoo. *Proc (Bayl Univ Med Cent)* 2007; 20: 36-8.
- [35] Sanchez Moya AI, Gatica ME, Garcia Almagro D, Larralde M. Allergic contact dermatitis for temporary "black henna" tattoos. *Arch Argent Pediatr* 2010; 108: e96-9.

- [36] Thyssen JP, White JML, European Society of Contact D. Epidemiological data on consumer allergy to p-phenylenediamine. *Contact Dermatitis* 2008; 59: 327-43.
- [37] Jewell JA, McElwain LL. Cosmetic dermatitis from a henna "tattoo." *Consultant for Pediatricians* 2003; 2: 421-422. [cited 2014 May 29].

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