Kohl: a hazardous eyeliner

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Abstract

Kohl is a widely used traditional cosmetic. It is mainly worn around the eyes in the Middle East, Asia and Africa. The elemental composition of twenty-one kohl specimens originating from various parts of Saudi Arabia, India and the Middle East was determined by energy dispersive X-ray analysis (EDAX). The data indicates the presence of significant lead levels in two thirds (14/21) of the kohl specimens ranging from 2.9–100% (mean 48.5%). Other less frequent elements present in kohl preparations include aluminum, carbon, iron, titanium, calcium, magnesium, oxygen, silver silicon, sulfur and antimony. Seven kohl specimens were totally lead-free, four had a lead content in the range of 2.9–34.1% and ten had lead levels in excess of 84%. Carbon levels in excess of 60% were detected in six kohl samples. Antimony was present in only one kohl specimen at a concentration of 7.8%.

Five western made eyeliner pencils analyzed for comparative purposes consistently revealed iron as a common constituent (mean 46%) but no lead or carbon were detected in these specimens.

The findings of this study indicate that modern kohl preparations contain a number of metals derived from natural sources in addition to carbon. The predominance of lead in the kohl preparations tested is of major concern due to the documented adverse effects in humans and the increased susceptibility of children to lead intoxication. Application of lead-containing kohl needs to be considered as a source of lead in evaluating patients with symptoms of lead intoxication in regions where this tradition prevails. The documented toxic effects of lead in humans and the increased sensitivity of children to lead exposure serve to emphasize potential health risks of using traditional lead containing kohl preparations and the need for increased surveillance and regulation of the manufacture of kohl.

Introduction

Kohl (from the Arabic kuhl, kohhel, kohol and cohol) is a traditional eyeliner which has been widely used as an eye cosmetic since antiquity in the Middle East, Far East and Northern Africa [1]. It was worn for traditional reasons, beautification, to ward off the ‘evil eye’, for medially beneficial reasons to improve visual acuity and mainly because wearing kohl is encouraged within the traditional behavioral guidelines of the Islamic religion [2]. Further to the cosmetic appeal of kohl, there has been a strong traditional belief that kohl has a curative effect in the treatment of eye diseases which accounts for its popularity as a topical folk remedy. In addition to the cosmetic and medical applications of kohl it is known to prevent sunglare and has been widely used for this purpose by Bedouins in the Arab Peninsula.

Kohl is a fine powder with a texture and appearance similar to mascara. It is used to darken the eyelids but is applied in the conjunctival surfaces rather than the outside of the eyelids, a practice which has been observed in newborn children. The traditional practice of applying kohl in infants continues even today. A recent study of 500 individuals indicated that 45% applied kohl on a daily basis and only 18% on an occasional basis [3]. A comparative study in a matched population of kohl and non-kohl using infants (6–16 months old) revealed that blood lead levels were significantly higher (p < 0.001)
in infants in whom kohl was applied than in non-kohl users (11.2 versus 4.3 μg/dl) [4]. They also noted that blood lead levels in infants of kohl using mothers were considerably higher than those of non-kohl using mothers (5.2 versus 2.8 μg/dl). Studies by Yaish et al. have also confirmed teething powder as a source of lead poisoning in nine Saudi children leading to typical symptoms of lead encephalopathy and even death in two cases [5].

Notwithstanding findings on the high prevalence of lead and the occasional presence of antimony and carbon in kohl, no comprehensive studies on the elemental composition of kohl have so far not been reported. The present investigations were therefore undertaken in order to characterize the chemical content of various types of kohl and to ascertain the presence of other toxic elements in kohl which may have public health implications.

Materials and methods

Numerous brands of homemade, commercially prepared and natural kohl stone (Kohl hajar) were purchased locally from random sources in various parts of Saudi Arabia and India. The kohl specimens were kept in elegant traditional containers, homemade receptacles and commercial bottles (Fig. 1). The five western-made eyeliner pencils were purchased as normal consumer products from a local pharmacy or cosmetic shops.

The elemental composition of the kohl was determined employing a Hitachi S-570 scanning electron microscope equipped with a Kevex energy dispersive X-ray spectroscopy system. All analyses were performed by the standardless energy dispersive spectroscopy mode. An example of bright metallic kohl, in rock form, identified as galena or lead sulfide [6] is shown in Fig. 2. Another type of kohl preparation commonly known as 'ethmid' was obtained in the form of red brown stone or kohl powder (Fig. 3).

Results

We determined the elemental composition of 21 different samples of kohl, consisting of six home-made powders, nine commercial preparations and six natural stone kohl samples by energy dispersive X-ray analysis (EDAX). Two thirds of the kohl samples contained lead at a concentration of 2.9–97%. Lead levels in excess...