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Lead Content in '*Surma/Kajal* Samples' from Japan, Pakistan and Saudi Arabia

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Abstract

Objective: Lead is a toxic metal. Cosmetic products are a potential source of exposure to lead, particularly in South Asia and Middle East. We analyzed the lead concentration in '*surma/kajal*' used in Japan, Pakistan and Saudi Arabia.

Methods: 33 '*surma/kajal*' samples were bought from the markets of Japan, Pakistan and Saudi Arabia. The chosen cosmetic products which capture the large respective market brand along with unbranded products were purposely chosen. These products had origin from England, France, Germany, India, Italy, Pakistan and Saudi Arabia. The samples were analyzed by metallic composition analysis by energy dispersive X-ray fluorescence spectrometry (EXDRF).

Results: Of the total 33 samples, six (6) had lead content in them. Four (4) samples had extremely high lead levels and some trace elements and comprise the largest market share of Pakistan and Saudi Arabia. The other two were local made products from Pakistan and Saudi Arabia and had relatively lower lead content.

Conclusion: Eye cosmetics are potential source of lead exposure for the population in South Asia and Middle East. An analysis of available market cosmetic products is needed and regular monitoring is required to limit this hazard.

Keywords: Surma/Kajal; Lead; Women and child health; Pakistan; Saudi Arabia; Japan

Introduction

Globally, every year 600,000 children develop intellectual disabilities secondary to lead exposure [1]. It is estimated that lead accounts for 143,000 deaths every year with more deaths from developing countries [1]. Lead is a widespread and naturally occurring toxic metal. Mining, smelting, leaded paints, leaded gasoline and batteries for motor vehicle are some important sources of lead. In addition, lead is also used in manufacturing of cosmetics like '*surma/kajal*', which is a common eye cosmetic used in South Asia and Middle East [1].

Lead sulfide is the main component in majority of the '*surma/kajal*' available in free market [2].In 'surma/kajal' formation, galena is used which is black in color and contains high levels of lead sulfide [3].Galena is considered a disinfectant as it keeps the flies and bugs away and also protects eyes from the sun [4].

Several studies have reported lead content in eye cosmetic products [5,6]. A case study in Moroccan woman reported high lead due to prolonged *surma* use [2]. One study in 36-60 months old children in Karachi showed association of *surma* use with elevated blood lead levels [7]. Another hospital based study from Karachi reported that daily *surma* use caused higher blood lead levels among study participants [8]. The Centre for Disease Control (CDC) reported cases of young children from Mexico with high blood lead levels (27.0 -33.5 µg/dl) whose family used *kajal* having lead content of 54% brought from their home country [9]. One study from Saudi Arabia assessed lead content in 107 samples of *surma*. 45 samples of 107 had lead concentrations of 0.001–1% while remaining 62 samples had lead concentration more than 24.7% reaching up to 53%. The origin of all 107 samples of *surma* was mainly from Saudi Arabia, Iran, Pakistan and India [10]. Reviews on *surma* as a source of lead exposure concluded that users of lead based *surma* had increased blood lead levels and include women and their children [11]. One of the regional studies has also shown that the s use in children was associated with high blood lead levels [5]. Application of surma on umbilical stump of newborn also plays an important role in increasing blood lead levels of developing countries children [11]. Use of surma to protect

eyes from ailments is an old practice and is used for several eye conditions [12,13]. *Surma* is also commonly used by Muslims. Culturally, it is a common practice in the Middle East and South Asia [14-16].

Regular use of *surma* by pregnant and lactating mothers as well as applying it to newborn and young children causes increased lead exposure [5]. These high levels affect the developing brain and decrease neurocognitive functions including fine motor movements and may cause low intelligence quotient (IQ) levels [17]. Prenatal lead exposure also significantly increases the risk of adverse birth outcomes such as low birth weight, reduced head circumference and length [17]. Lead exposure also leads to significantly impaired hematopoietic, renal, and hepatic functions in exposed children [18]. Blood lead levels in women, umbilical cord and children in Pakistan are high as compared to developed countries [19,20]. In order to plan intervention, it is required to identify sources of lead exposure. This paper examined the lead content of most commonly used eye cosmetics currently making the large market share in Japan, Pakistan and Saudi Arabia.

Methods

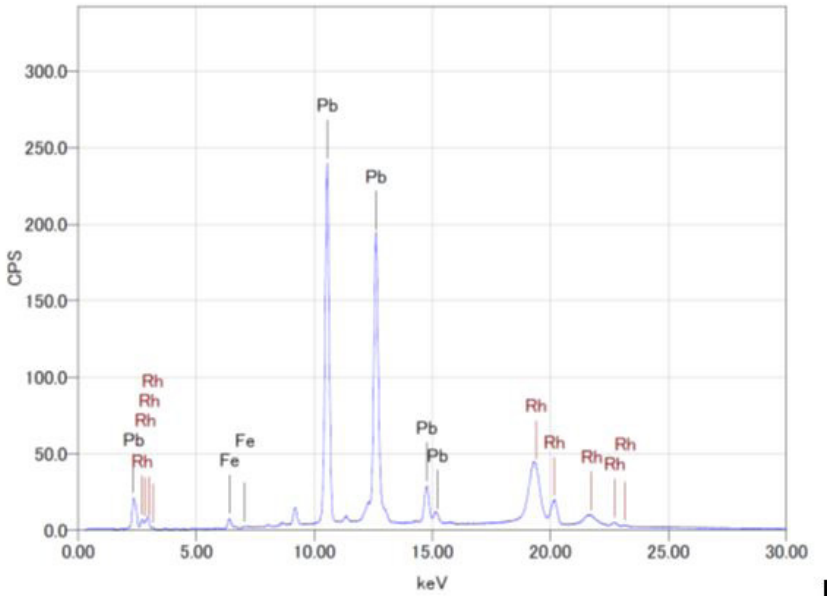
A total of 33 samples were collected and analyzed. 3 samples were purchased from Japan, 13 samples from Karachi and 17 samples from Saudi Arabia (from Medina and Riyadh). Samples were purposely chosen to include both, less costly and expensive as well as the most common brands used by the population. Samples were purchased from open market which includes shops which are nearby to community and people purchase their daily-use items from those shops. Samples were also purchased from marts and super stores. 3 samples from Japan represented the most commonly used *surma* in their population.

Metallic Composition Analysis

All samples were tagged and shipped to Japan and were analyzed by metallic composition analysis. Energy dispersive X-ray fluorescence spectrometry (EDXRF) was performed to determine the metallic composition of *surma*. EDXRF analysis was conducted by Industrial Technology Center of Tochigi Prefecture using JSX-3200RII element analyzer (JEOL Ltd., Tokyo, Japan). The samples were analyzed for 240s (live time) under air condition using an X-ray lamp voltage of 50 kV, an auto lamp current and 1 mm collimator.

Results

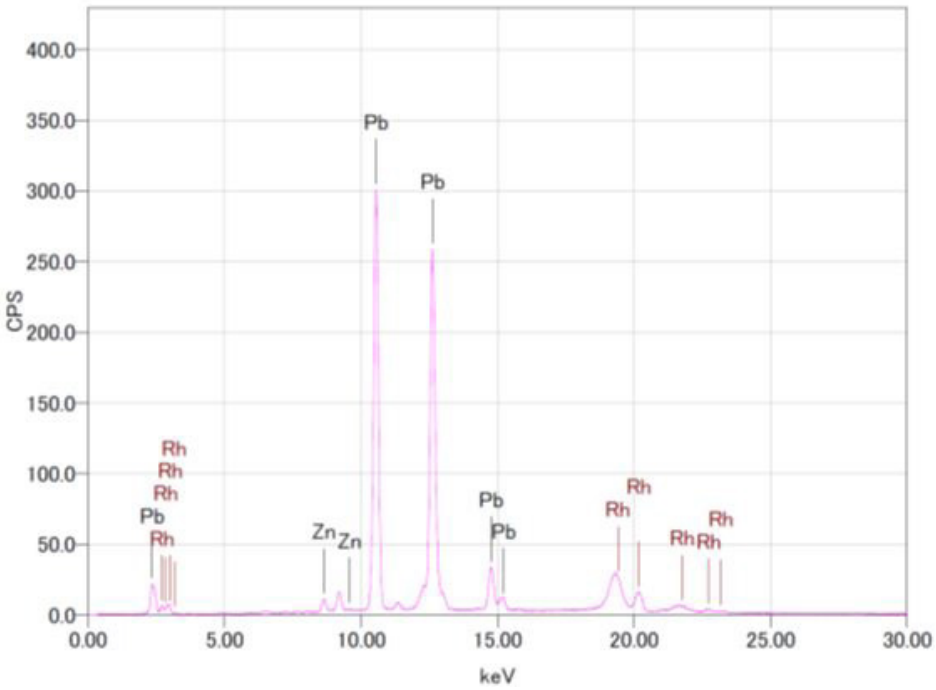
The products were in solid, powder and liquid form. The place from where they were purchased is indicated as location and origin is the place of manufacturing. Out of 33 samples, 6 contained lead, and from these, 4 samples had very high levels (96.8%-98.7%) (Table 1). These four highly contaminated samples were analyzed for all chemicals and weighted percentage were calculated. All samples had >97% of Pb while trace amounts of iron (20), rhodium (11), zinc (Zn), copper (21) and Barium (Ba) were also found (Figures 1,2,3,4). Two each of four contaminated samples with very high lead levels originated from Pakistan and Saudi Arabia.



Chemical name	Weighted percentage
Lead (Pb)	98.3112
Iron (20)	1.6888
Rhodium (11)	0.00001

[CPS=count per second; ke V =Kiloelectron volt]

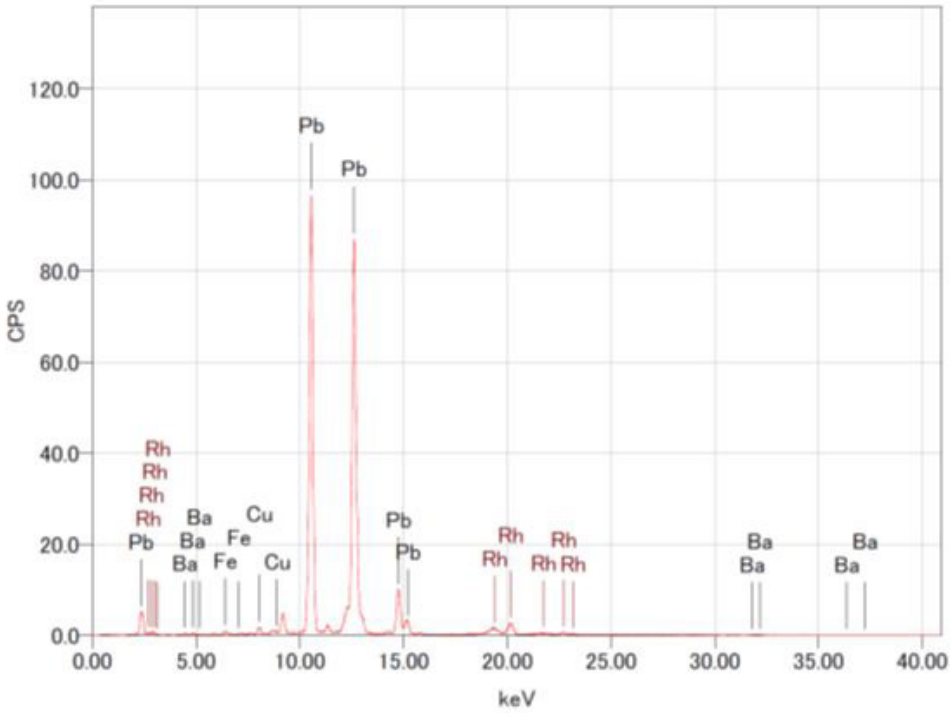
Figure 1: Energy dispersive X-ray fluorescence spectrogram for sample # SP-001



Chemical name	Weighted percentage
Lead (Pb)	98.9092
Zinc (Zn)	1.0908
Rhodium (11)	0.00001

[CPS=count per second; ke V =Kiloelectron volt]

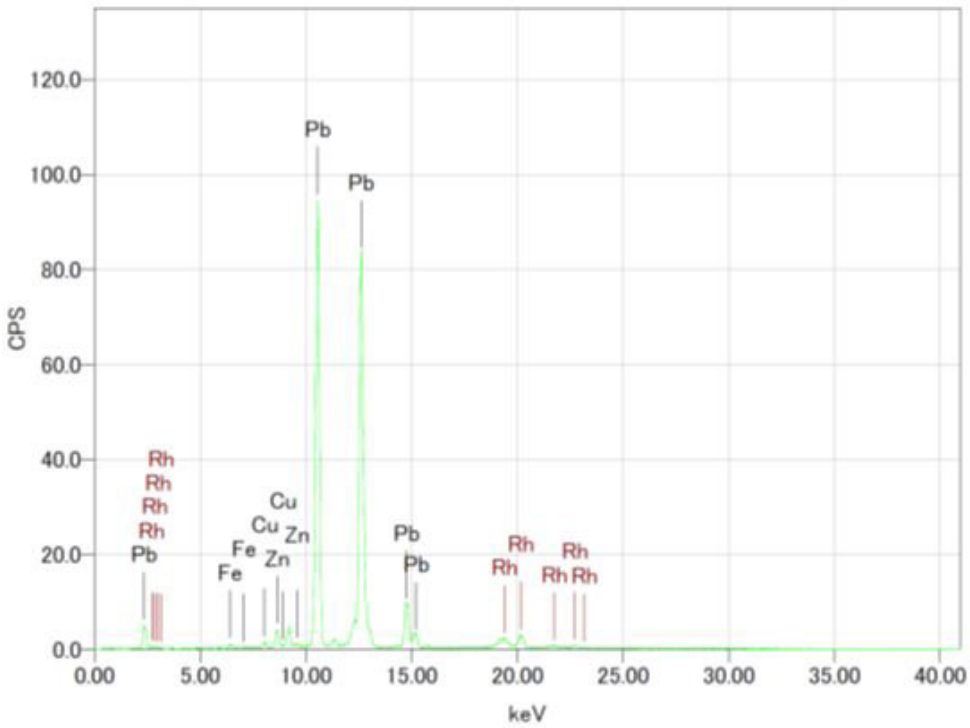
Figure 2: Energy dispersive X-ray fluorescence spectrogram for sample # SP-002



Chemical name	Weighted percentage
Lead (Pb)	97.1439
Barium (Ba)	1.8943
Copper (21)	0.6519
Iron (20)	0.3099
Rhodium (11)	0.00001

[CPS=count per second; ke V =Kiloelectron volt]

Figure 3: Energy dispersive X-ray fluorescence spectrogram for sample # S-SB-103



Chemical name	Weighted percentage
Lead (Pb)	97.6333
Zinc (Zn)	1.4116
Copper (21)	0.5444
Iron (20)	0.4107
Rhodium (11)	0.00001

[CPS=count per second; ke V =Kiloelectron volt]

Figure 4: Energy dispersive X-ray fluorescence spectrogram for sample # S-SB-106

Label	Name	Location*	Origin**	Via	Color	Form	Pb content (%)
SP-001	Asli	Pakistan	Pakistan	Market	Black	Powder	98.3
SP-002	Hashmi	Pakistan	Pakistan	Market	Black	Powder	98.9
SP-003	Lateef	Pakistan	Pakistan	Market	Gray	Powder	N.D.#
SJ-004	Mukuty	Japan	India	Internet	Black	Solid	N.D.
SJ-005	Himalaya	Japan	India	Internet	Black	Solid	N.D.
SJ-006	Biotique	Japan	India	Internet	Black	Solid	N.D.
SP-007	Essence	Pakistan	Luxembourg	Market	Black	Liquid	N.D.
SP-008	Rimmel	Pakistan	England	Market	Black	Liquid	N.D.
SP-009	L'oreal	Pakistan	France	Market	Black	Liquid	N.D.
SP-010	Clazona	Pakistan	Pakistan	Market	Black	Liquid	N.D.
SP-011	Essence	Pakistan	Germany	Market	Black	Solid	N.D.
SP-012	Rimmel	Pakistan	Italy	Market	Black	Solid	N.D.
SP-013	Goldenrose	Pakistan	EU	Market	Black	Solid	N.D.
SP-014	Bourjois	Pakistan	Czech Republic	Market	Black	Solid	N.D.
SP-015	Christine	Pakistan	Pakistan	Market	Black	Solid	N.D.
P-KJ 118	Unbranded	Pakistan	Local made	Market	Black	Solid	0.6
S-KT 101	Rani	Saudi Arabia	Saudi Arabia	Market	Black	Solid	N.D.
S-SB 102	Al-sharifain	Saudi Arabia	India	Market	Black	Powder	N.D.
S-SB 103	Alwatni	Saudi Arabia	Saudi Arabia	Market	Black	Powder	97.1
S-SB 104	MR	Saudi Arabia	Saudi Arabia	Market	Black	Powder	N.D.
S-EB 105	Elizabeth helen	Saudi Arabia	Saudi Arabia	Market	Black	Liquid	N.D.

Label	Name	Location*	Origin**	Via	Color	Form	Pb content (%)
S-SB 106	Harmain's	Saudi Arabia	Saudi Arabia	Market	Black	Powder	97.6
S-SB 107	Al-asmad	Saudi Arabia	Saudi Arabia	Market	Black	Powder	N.D.
S-SB 108	Unbranded	Saudi Arabia	Local made	Market	Black	Powder	0.4
S-LP 109	Lyra	Saudi Arabia	Italy	Market	Black	Solid	N.D.
S-KP 110	Elizabeth helen	Saudi Arabia	Germany	Market	Black	Solid	N.D.
S-LP 111	Smiling	Saudi Arabia	Italy	Market	Black	Solid	N.D.
S-LP 112	Smiling	Saudi Arabia	Germany	Market	Black	Solid	N.D.
S-LP 113	Dolce &gabbana	Saudi Arabia	Germany	Market	Black	Liquid	N.D.
S-LP 114	L'oreal	Saudi Arabia	Unknown	Market	Black	Liquid	N.D.
S-KP 115	Lancome	Saudi Arabia	Germany	Market	Black	Solid	N.D.
S-LP 116	Chanel	Saudi Arabia	Germany	Market	Black	Solid	N.D.
S-LP 117	Aqua eyes	Saudi Arabia	Germany	Market	Black	Solid	N.D.

*Location: place where sample was bought

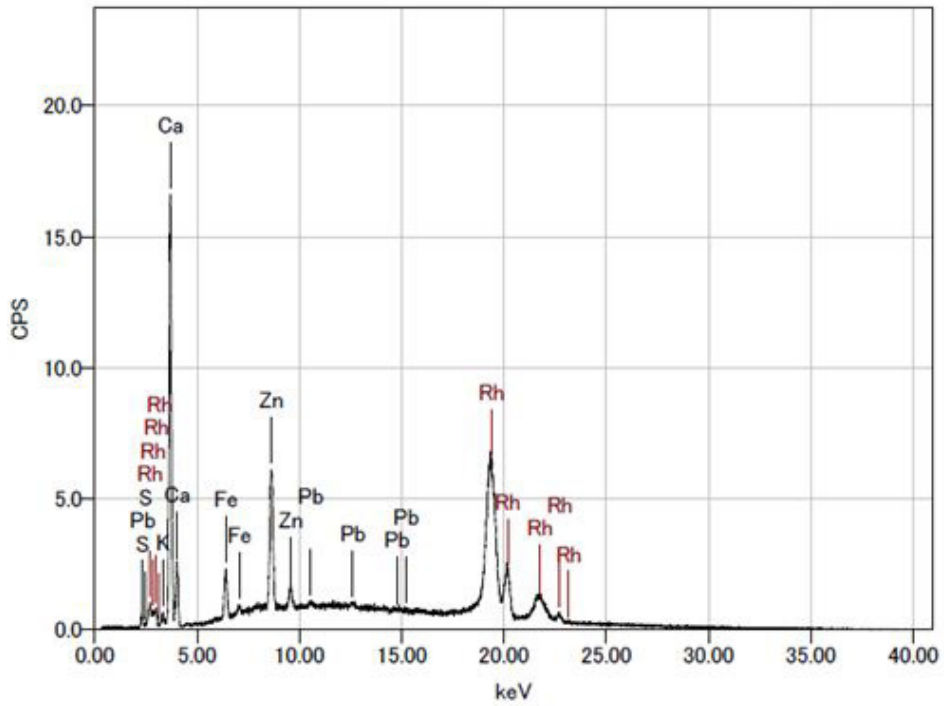
**Origin: place where sample was made

#ND: not detected

Table 1: Eye cosmetics (Surma, Kajal and similar products) from Japan, Pakistan and Saudi Arabia

There were two *surma* samples which had comparatively low lead levels. They were unbranded and one of them originated from Pakistan and other from Saudi Arabia. These samples had 0.6% and 0.4% of lead with some other elements of varying percentages like zinc (Zn), calcium (Ca), iron (20), rhodium (11), potassium(K) , sulfur (S) and strontium [17] (Figures 5,6).

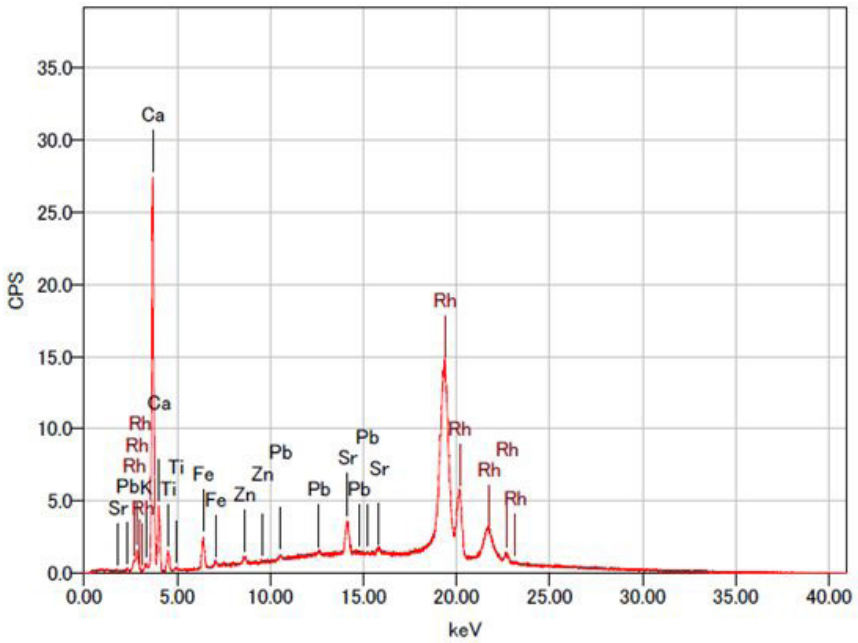
Three 'surma/kajal' samples bought from Japan which originated from India were free from lead.



Chemical name	Weighted percentage
Lead (Pb)	0.4028
Zinc (Zn)	6.8251
Calcium (Ca)	76.7753
Iron (20)	4.0533
Rhodium (11)	0.00001
Potassium(K)	3.1679
Sulfur (S)	8.7757

[CPS=count per second; ke V =Kiloelectron volt]

Figure 5: Energy dispersive X-ray fluorescence spectrogram for sample # S-SB 108



Chemical name	Weighted percentage
Lead (Pb)	0.5581
Zinc (Zn)	0.4778
Calcium (Ca)	85.3241
Iron (20)	4.0060
Rhodium (11)	0.00001
Potassium(K)	1.7082
Strontium (8)	1.0678

[CPS=count per second; ke V =Kiloelectron volt]

Figure 6: Energy dispersive X-ray fluorescence spectrogram for sample # P-KJ 118

Discussion

Lining eyes with '*surma/kajal*', its rubbing and then finger licking enhances the absorption of lead causing elevated blood lead levels [5, 21]. Our study found 98% lead concentrations in one of the famous '*surma/kajal*' brand from Pakistan. This is new addition in literature as there is scarcity of literature and the available studies are outdated. A study in 1988, conducted in Faisalabad reported that 80% of 20 samples of surma had a lead content >65 % [22]. Another study from Pakistan in 1982 showed that lead concentration in different types of *surma* available in Pakistan ranged from 0.03-81.37% [23]. Our study has shown much higher levels, which show that there is lack of legislation and need for regular check on the quality of products. These products are freely available in market and are commonly used by population. Although there is legislation about lead in petrol and other such products but there is no law to identify lead in cosmetics and other related items [24].

In South East Asia, Middle East and Africa using '*surma/kajal*' to line eyes both in women and in children is a common practice [5,6]. Studies from Afghanistan and India have also shown that *surma* samples from market had high lead contaminations which are in consistent with our study results [5,6]. Study from Iran has reported that cosmetics like lipsticks and eye shadows were contaminated with lead [25]. There are any environmental factors contributing in elevating blood lead levels and studies have reported that the use of *surma* was one the environmental factors responsible for high blood lead levels among South and East Asian immigrants from Canada [26-29].

Presence of high lead content is alarming and particularly in those samples of '*surma/kajal*' which are very popular. There is need to identify those brands and take appropriate control measures. These samples are less costly and easily available in the local market; hence do attract the poor population. These people are neither aware about the high lead contents in these products nor about its adverse consequences.

We conducted a quick market survey of most popular '*surma/kajal*' by women and children in Karachi and we found that SP-002 made around 90% of market share which had high lead content (98.7%). Our assessment suggested that 98% of the '*surma/kajal*' user consume this brand in Karachi.

Most commonly used '*surma/kajal*' from developed country like Japan has no lead in it. Situation in Saudi Arabia is slightly different. Samples from Medina did not show any lead levels, however, two locally manufactured samples from markets of Riyadh did show very high lead levels around 97%, and one local sample had low but detectable lead levels around 0.4%. This percentage is very high compared to previous study by Al-Ashban, et al. in which 107 samples from all over Saudi Arabia were analysed [10].

'*Surma/kajal*' samples were analysed using energy dispersive X-ray fluorescence spectrometer in study of Saudi Arabia by Al-Ashban, et al. In our study we have used the same method to determine the metallic composition of surma as used by Al-Ashban, *et al*. It is a suitable method with good accuracy, immediate results and low cost as compared to other analytical methods [30]. The reason for difference in lead levels may be due to different products included in the study. However, popular '*surma/kajal*' from Saudi Arabia had high lead levels in it and Saudi Arabia, being a very sacred place for Muslims, '*surma/kajal*' which is brought from there to Pakistan is considered holy and is applied to new-borns and children very frequently.

Conclusion

Although there is enough evidence available about elevated blood lead levels in our population, there is still need for proper action by our policy makers. There is need of awareness about hazardous effects of lead to general population and for that there is need of health education sessions. Media can play its role in raising awareness. Use of other non-harmful metals should be made mandatory for manufacturing of '*surma/kajal*'.

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