





Environment and Social Development Organization-ESDO





# Study report On **Toxic Jewellery: High Risk to Health and Environment in Bangladesh**

[no regulation, lack of awareness possesses a high risk to human health and the environment]

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# **Executive Summary**

Jewellery is an individual embellishment that people used from ancient time to complement themselves. Jewellery may be made from an extensive range of materials, but gemstones, precious metals, beads, and shells have been widely used. From time to time, lots of things have been added for the production of ornaments. Many of these are elements, like mercury (Hg), lead (Pb), cadmium (Cd), chromium (Cr), nickel (Ni), arsenic (As), etc. and they are harmful to human health. The wide uses of some of these elements in the ornaments are for making them more durable and glossy. Metallic gold is the major primary component of the gold ornaments. In addition to harming the environment, some of these elements have a strong possibility of entering the food chain. Jewelers and regular users of jewellery are particular targets of the excessive presence of toxic metals in these. In the poorly ventilated working space, jewelers continuously inhale the invisible, odorless toxic vapour and suffer from diseases like anxiety, memory loss, skin problems, and poor cognitive function.

No investigation has yet been carried out on the harmful effects of heavy metals used in the jewellery.Environment and Social Development Organization-ESDO has taken a pioneer step to conduct a primary study to find out mainly the toxic metal contents of several pieces of jewellery and also the current level of awareness of the jewellery manufacturers and users about their toxicity.

With this objective in view adults' and children's jewellery, such as Earrings, Necklaces, Bracelets, Finger rings, Chains, Bangles were collected from shopping malls, retail shops and tested in the EARTH XRF laboratory in Bangkok. The samples were tested for Titanium Dioxide (TiO<sub>2</sub>), Arsenic (As), Cadmium (Cd), Lead (Pb), Mercury (Hg), Nickel (Ni), Bromine (Br), Chromium (Cr), Silver (Ag), Manganese (Mn), Iron (Fe), Cobalt (Co), Copper (Cu), Zinc (Zn), Chlorine (Cl) and Calcium (Ca). The test results show that the samples contain high level of As, Pb, TiO<sub>2</sub>, Cd, Ni, Hg and Zn. Necklaces and chains are found to contain Hg, while the pieces of children's jewellery contain high levels of Cd, Pb, Ni, As and TiO<sub>2</sub>. Tests show that most of the earrings contain Cd and Pb in high levels and Hg in medium level. Most of the children's jewellery contains high level of Pb, Cd, Br and TiO<sub>2</sub>.

Research results found evidence that cadmium and other toxic elements could leach out of the jewellery when children sucked or scratched them, and ingesting even tiny amounts of the toxic elements can harm children's brain development. Most of the products have never got screened for their toxic contents and slip through even though the toxic limit surpasses the internationally set safety standard.

High bromine contents of many samples indicate that recycled plastic containing hazardous brominated flame retardants (BFRs) has been used as a filler for the jewellery beads.

The study reveals that the current status of awareness level of the hazards associated with the jewellery items is really low. 55 % of the users mentioned about having a red rash on the skin.On the basis of the collected data some suggestions have been put forwarded.



## Key Findings of the Study:

- ✓ Most of the jewellery items were found to contain Titanium (Ti) in very high concentration (1300-7500) ppm.
- ✓ Lead (Pb) content was found to be the highest in pendants. Pb concentration varied from 800 ppm to over 10,000 ppm in different jewellery items. The maximum recommended level for adults 0.03 ppm
- ✓ Cadmium (Cd) were high in concentration in almost every item tested. The concentration varied from 2000 ppm to almost 6500 ppm. Permissible limit of Cadmium for the human body is 0.01 ppm.
- Nickel (Ni) was found in greater than 100 ppm (110-800) ppm in almost every sample.
  Maximum permissible limit of Ni for the human body is 0.04 ppm
- ✓ Earring and finger ring samples were found to contain Mercury (Hg). Maximum 0.01 ppm of Hg is allowed for human.
- ✓ Arsenic (As) was detected in every sample in high concentration. 0.05 ppm As is allowable for human body.
- $\checkmark$  Zinc (Zn) concentration varied up to 3500 ppm in different samples.
- ✓ Bracelet sample found to contain Calcium (Ca) in very high concentration.
- ✓ 12 children jewellery samples contained high level of Br, 1200-3200 ppm and 9 contained BFR. Allowed Br level for adults is 0.1 ppm





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# 1. Background

These days, different types of toxic elements are being used in jewellery manufacturing. Mercury, lead, chromium, cadmium, titanium and arsenic are some most common elements which are used in jewellery to make it more presentable and durable. It is high time for us to create awareness about the toxic element contents of the jewellery and the very bad and long term effects they have on human health and environment.

It is reported that in the USA Pb and Cd contents in jewellery items, particularly those of children, are high. In our country, no one has come forward to take any action for making further awareness against that toxicity in Jewellery. ESDO has taken an initiative to conduct a study to get to know the recent awareness level of users in Dhaka city about the presence of toxic elements in their jewellery. Toxic elements used in jewellery:

People, animals, and fish are mainly exposed to lead by breathing and ingesting it in food, water, soil, or dust. Lead accumulates in the blood, bones, muscles, and fat. Infants and young children are especially sensitive to even low levels of lead. Lead causes damage to the kidneys, liver, brain and nerves, and other organs. Exposure to lead may also lead to osteoporosis (brittle bone disease) and reproductive disorders. Excessive exposure to lead causes seizures, mental retardation, behavioral disorders, memory problems, and mood changes. Low levels of lead damage the brain and nerves in fetures and
young children, resulting in learning deficits and lowered IO.







Children and adults will have similar health effects if exposed to toxic levels of cadmium. Chewing toxic jewellery or drinking water with very high cadmium levels severely irritates the stomach, leading to vomiting and diarrhea, and sometimes death. Eating lower levels of cadmium over a long period can lead to kidney damage, and can cause bones to become fragile and break easily. Exposure to cadmium in air has caused lung cancer, and perhaps prostate cancer, in workers. The US Department of Health and Human Services has determined that cadmium and cadmium compounds are known human carcinogens (can cause cancer).

Long-term exposure to lower levels of cadmium leads to a buildup of cadmium in the kidneys and possibly kidney damage. Other potential longterm effects, but not confirmed in humans, are lung damage, high blood pressure and weak painful bones.

Bromine is corrosive to human tissue in a liquid state and its vapors irritate eyes and throat. Bromine vapors are very toxic by inhalation.

Humans can absorb organic bromines through the skin, with food and during breathing. Organic bromines are widely used as sprays to kill insects and other unwanted pests. But they are not only poisonous to the animals that they are used against, but also to larger animals. In many cases, they are poisonous to humans, too. The most important health effects that can be caused by bromine-containing organic contaminants are malfunctioning of the nervous system and disturbances in genetic materials. But organic bromines can also cause damage to organs such as liver, kidneys, lungs and milt and they can cause stomach and gastrointestinal malfunctioning. Some forms of organic bromines, such as ethylene bromide, can even cause cancer.







methylmercury might begin to experience trembling hands and numbness or tingling in their lips, tongues, fingers or toes. These effects can begin long after the exposure occurred. At higher exposures, walking could be affected, as well as vision, speech and hearing. In sufficient quantities, methylmercury can be fatal.

Inorganic arsenic is a known human carcinogen. Highest arsenic exposures have been found in children living very near to smelting plants, and exposures decrease geometrically with distance; near smelters, contaminated air, and dust appear to be the principal routes of exposure.

There is strong evidence that arsenic is linked to lung, skin, and bladder cancer. Inorganic arsenic may also cause skin irritation, skin color cardiovascular changes, blood disorders. diseases, and hormone disruption. Preliminary data suggest that inorganic arsenic may interfere with normal fetal development and cause deficits in brain development and intelligence. Preliminary studies have correlated type 2 diabetes with low-level arsenic consumption, implying that drinking low levels of arsenic may lead to type-2 diabetes.

Titanium is a chemical element and a lustrous transition metal with silver color, low density and high strength. Titanium exposure may be harmful to our brain. Titanium nano particles can enter directly into the hippocampus region of the brain through the nose and olfactory bulb. Longterm chronic exposure and environmental pollution are not documented and a relationship between nano particle exposure and the development of degenerative brain diseases may exist.







# 2. Objectives of research:

Overall objectives of this study by ESDO are-

To assess which metallic elemnets are used in jewellery items and in what concentration

To assess general people's awareness on heavy metal use in jewellery;

To find out best possible ways to increase awareness level about metal containing jewellery;

# 3. Justification of the study:

Nowadays colorful, glossy and cheap pieces of jewellery are widely and regularly used.Gold plated and fancy jewellery are cheaper and an easy replacement of precious jewellery or high-quality jewellery. As a result, people are now fond of such jewellery. All of those contain heavy metals like mercury, lead, cadmium, arsenic, etc. which are harmful for our skin and health. In other countries, people are now becoming concerned. In Bangladesh, so far, no one came forward to increase awareness for toxic free ornaments. Not a single investigation has yet been done on the uses of toxic elements in jewellery making in this country on harmful and long lasting effect of toxic elements which is used in the manufacture of jewellery. Environment and Social Development Organization-ESDO has taken a pioneering initiative to conduct a primary study on the general awareness of the users of heavy metal containing jewellery in Dhaka city. This involvement of ESDO in this matter will help the relevant authorities and the Government to take necessary steps for formulating policies against toxic elements in jewellery. Besides, it will encourage more comprehensive study of this problem.

# 4. Literature review

#### 4.1 Origin of jewellery

Pieces of jewellery are items of personal adornment, and made from gemstone or precious metals like gold, silver, etc. They are shaped into necklace, rings, broach or bracelets, earrings and other body adornments. The history of jewellery is a long one, with different use among differentculture. Initially, jewellery were prepared from natural materials, such as bone, animal teeth, shell, and wood and carved stone, etc. Later, Gemstones and precious metals, such as silver or gold as well as metals were used.

#### 4.2 Heavy metals in jewellery

A recent study<sup>1</sup> of the Ecology Center of Michigan reveals that half of the low cost jewellery has a "high" level of concern due to the presence of one or more hazardous chemicals, among which lead,



cadmium, arsenic, mercury, bromine and chlorine (PVC) have been detected. These chemicals, among others, have been linked to acute allergies, birth defects, impaired learning, liver toxicity and cancer. The study tested 99 pieces of jewellery from 14 different retailers from 6 different states. Fifty percent of the products tested contained lead, with over half, 57% of these

exceeding the limits in children's products set by the Consumer Product Safety Commission (CPSC).

Four products contained over 10% cadmium, a known carcinogen. Some of the jewellery that was almost pure lead was labeled as lead-free. Among all these heavy metals, comparatively lead and mercury are used in a large amount in processing of jewellery. Lead has often been used in jewellery, to make the article heavier, brighten colors, and to



stabilize or soften plastic. Lead is a toxic substance extremely harmful to peoples' health. Both adults and children are susceptible to its adverse effects, but kids under the age of six are especially vulnerable to lead's negative influence as their brain and central nervous system are still being formed. However, lead as well as mercury can be dangerous, even deadly when used mostly in children's jewellery.



#### 4.3 Different toxic elements used in jewellery in all over the world :

Nowadays, most of the jewelry pieces contain mercury. Unaware of the hazards, broken glass beads for necklaces containing mercury cause spills. Once broken, the spilled mercury warrants an evacuation and a hazardous material cleanup response. In terms of careless disposal of mercury contained jewellery is an important source of environmental degradation, whether at school or home, mercury spills of any kind or size pose a serious health risk. The necklaces are often a beaded chain, cord, or leather strand with a glass pendant that contains mercury.

The mercury appears as a silvery clump of liquid that rolls around in the hollow glass pendant. The glass pendant may also be filled with brightly colored liquid - red, green, blue, yellow - along with the mercury. Pendants can be in various shapes, such as hearts, bottles, saber teeth and chili peppers. It is very important that school officials warn students not to purchase or bring mercury-containing jewellery to school<sup>1</sup>. High levels of lead and arsenic have been found in children's jewellery sold at the Fall River Walmart, and from other familiar retailers in Massachusetts and other states. The research was conducted by the Ecology Center<sup>2</sup>, a Michigan based nonprofit environmental organization. It discovered that more than half the items tested had high levels of one or more hazardous chemicals. A pair of colorful earrings from the Fall River Walmart, under the Faded Glory brand name, was marketed as hypo-allergenic. Tests showed a high level of arsenic and lead, and a medium level of mercury present. A Barbie watch from the same Walmart had low levels of cadmium and mercury.



<sup>&</sup>lt;sup>1</sup> Department of Environment Qualities, IDAHO, Mercury in Jewelry.

<sup>&</sup>lt;sup>2</sup> Deborah Allard, 2012, Study finds lead, arsenic in children's jewelry at Fall River Walmart, The Herald News



#### 4.4 Toxic elements in children's jewellery

A report- issued by HealthyStuff.org based on a project initiated by a Michigan-based environmental group called the Ecology Center mentions that inexpensive jewellery items sold at popular retail stores including several stores in Minnesota continue to contain dangerous levels of toxic chemicals. The chemicals discovered in the children's jewellery, which included lead, cadmium, arsenic, mercury, bromine and chlorine, have been linked in animal and some human studies to birth defects and neurological problems as well as liver disease and cancer. Expert warns- that piece of jewellery that are bought, particularly those of children need to be reviewed. The most used elements in jewellery manufacturing process such as lead, mercury, cadmium, etc. are hazardous to human health and the environment as well.



#### 4.4 Mercury used in jewellery manufacture process

In every country, people especially women are so dependent on different types of jewellery for making themselves presentable in a crowd. Different hazardous elements are used in jewellery to make it more durable, glossy and presentable. Among them, mercury is a most used element in

manufacture process of jewellery. A report entitled "An Inorganic Mercury Hazard in the Manufacture of Artificial Jewellery" mentions that a significant mercury hazard is likely to be present commonly at the following sites in any factory:





**Mould room**: Two melting pots for amalgam, under hoods; unventilated centrifuges; wallstorage racks for rubber moulds;

- > Plaster casting room: Small quantities of mercury-containing dust;
- Oven room: Two electric ovens plus a mercury still in the melting of amalgam; floor sweepings kept in covered rubbish cans in this room;

#### 4.6 Risk of exposure of some toxic elements in jewellery

➤ Lead :

Lead-glazed jewellery can on occasions release large amounts of lead into food and drink and have been responsible for outbreaks of serious poisoning. Airborne lead is generally a low-dose source of

exposure. Automotive and industrial emissions are the major contributors to lead in the air, and of the more than100,000 tons of lead particles released into the air each year in the United States, more than 95 percent derives from automotive emissions. Studies of children living near freeways in New Jersey and in California have shown significantly higher blood lead levels in children living within



100 feet of major roadways than in those living at greater distances. Lead workers' children may be exposed to lead dust carrying it with them to home from the workplace on workers' shoes and clothing. In an evaluation of lead exposure in workers' children, a close correlation was found between children's blood lead levels, the severity and duration of parental lead exposure, and the lead concentration of household dust.

#### > Cadmium :

Cadmium is used in the manufacture of jewellery. It is not so extensively dispersed in the environment as lead, but community residents may be exposed to it by many of the same routes as they are to lead. Chewing toxic jewellery with very high cadmium levels severely irritates the stomach, leading to vomiting and diarrhea, and sometimes death. Cadmium is released into the air at scrap recycling plants from the burning of cadmium based jewellery.

#### ➢ Mercury:

Mercury in the air may settle into water bodies and affect water quality. This airborne mercury can fall to the ground in raindrops, in dust, or simply due to gravity (known as "air deposition"). After the mercury falls, it can end up in streams, lakes, or estuaries, where it can be transferred to methyl mercury through microbial activity. In terms of careless disposal of mercury contained jewellery is an important source of environmental degradation. Methyl mercury accumulates in fish at levels that



may harm the fish and the other animals that eat them. Mercury deposition in a given area depends on mercury emitted from local, regional, national, and international sources. The amount of methyl mercury in fish in different water bodies is a function of a number of factors, including the amount of mercury deposited from the atmosphere, local non-air releases of mercury, naturally occurring mercury in soils, the physical, biological, and chemical properties of different water bodies and the age, size and types of food the fish eats. This explains why fish from lakes with similar local sources of methyl mercury can have significantly different methyl mercury concentrations Birds and mammals that eat fish are more exposed to methyl mercury than any other animals in water ecosystems. Similarly, predators that eat fish-eating animals are at risk. Methyl mercury has been found in eagles, otters, and endangered Florida panthers. Analyses conducted for the Mercury study report to Congress suggest that some highly-exposed wildlife species are being harmed by methyl mercury. Effects of methyl mercury exposure on wildlife can include mortality (death), reduced fertility, slower growth and development of abnormal behavior that affects survival, depending on the level of exposure.

#### ➤ Arsenic :

Community exposure to arsenic from jewellery has been caused through airborne emissions from smelters using thrown away old pieces of jewellery and the scraps from the jewelers. Contaminated drinking water has also been found near the jewellery industries.





# **5. Regulations against use of toxic elements in jewellery**

In Bangladesh, there are no significant regulations still now on the prohibition of uses of toxic elements in the manufacture of jewellery in our Environment conservation act. There is a general

act against the hazardous element use in production works. According to, "The Bangladesh Environment Act- 1995", a clause defines, "Hazardous substance, means a substance, the chemical or bio-chemical properties of which are such that its manufacture, storage, discharge or unregulated transportation can be harmful to the Environment." So, it should be protected. On the "Bangladesh conservation Act- 1995, for the industrial waste release containing mercury in water, land and air, every industry should maintain the minimum standard of mercury which cannot exceed the limit of 0.01 ppm.

#### 5.1 Regulations on mercury

There is a comprehensive body of existing EU and national legislation tackling various aspects of the mercury problem. The main areas are concerned with emissions and the use of mercury. As a result of these measures and certain other factors (switching from coal burning to oil for example), European emissions of mercury have been cut considerably in recent decades, falling by about 60% between 1990 and 2000.<sup>6</sup>

Emissions of mercury from major industrial sources are now subject to the EU Directive (96/61/EC) on Integrated Pollution Prevention and Control (IPPC), which had to be implemented in Member States by October 1999. Existing installations had until October 2007 to comply. The IPPC Directive also covers the EU's chlor-alkali industry, which is phasing out the use of mercury in its production process. Mercury emissions have also been reduced by the application of sector-specific EU directives dealing with large combustion plants and waste incineration. Some EU Member States have introduced further emission controls, for instance on cremation.

EU legislation also prohibits, or severely restricts, the use of mercury in the following applications: batteries; electrical and electronic equipment; pesticides and biocides; cosmetics; wood preservatives; textile treatment agents; anti-fouling agents for boat hulls; and switches in vehicles. Some Member States have introduced further controls, for example to restrict the use of mercury in dental amalgam.<sup>3</sup>

<sup>&</sup>lt;sup>3</sup> http://eur-lex.europa.eu/LexUriServ/site/en/com/2005/com2005\_0020en01.pdf



### **5.2 Regulations on lead:**

In terms of Lead, the most appreciated regulation is -The Laboratory at the Birmingham Assay Office is UKAS accredited to the three methods defined by the new American Lead Safety Standard, the CPSIA – Consumer Product Safety Improvement Act 2008. However, these test methods are very stringent. The Laboratory also offers testing using their own UKAS accredited in-house method, which gives equally accurate results and is perfectly acceptable for companies supplying to any country except for the US.

#### 5.3 US legislation:

As of the 14th August 2011, all products intended for the use by children may not contain more than 100ppm lead (ASTM Children's Safety Standard). Under the bill the new 100 ppm lead content limit will be prospective, allowing older products already on the shelves to be sold, while products manufactured on 14thAugust 2011 or later would have to meet the lower lead content limit. The CPSC has denied a request by the Fashion Jewellery Trade Association (FJTA) to exclude crystal and glass beads contained in children's jewellery and other products from the lead content limits established by the Consumer Product Safety Improvement Act of 2008 (CPSIA).<sup>4</sup>

#### 5.4 Regulations on cadmium:

In the UK, The REACH Enforcement Regulations 2008 (Registration, Evaluation, Authorization and Restriction of Chemicals) regulate the use of cadmium in jewellery. Anyone who supplies products intended to come into direct and prolonged contact with the skin, and that may contain nickel or its compounds or cadmium will be affected by the Regulations. Examples are as follows:

- i. Earrings and other body piercing items;
- ii. Necklaces, bracelets, chains, anklets and finger rings;<sup>5</sup>

<sup>&</sup>lt;sup>4</sup> http://www.assayoffice.co.uk/latest-news-and-press/lead-content-testing---how-does-new-legislation-affect-me

<sup>&</sup>lt;sup>5</sup> http://www.tradingstandards.gov.uk/cgi-bin/manchester/bus1item.cgi?file=\*BADV095-1111.txt



# 6. Methodology

Before making a proper methodology to conduct our study on the awareness level of toxic elements in jewellery, we conducted a team orientation to set the goal of our study, who will be our target group of survey, what type of questionnaire we need, what will be the analysis method for collected data and so on. After the team orientation, we have placed a consequent process of our overall study to finish it in a proper way. After gathering primary and secondary data, we collected jewellery samples and proceeded for their laboratory analyses. The flow of the method was-



#### 6.1 Location

The study was carried out within Dhaka and Chittagong city. The targetedareas for survey to know the current status of heavy metals in jewellery were retail, wholesale shops of new market, chondrima market, chawk bazaar, Genetic Plaza, Rapa plaza and Dhaka University campus. In Chittagong new market, agrabad shopping area, Chittagong shopping center, chawk bazar, CDA avenue.

#### 6.2 Data collection mapping:

Data were collected as:-

- Primary Data
- Secondary Data



For the primarydata, we have made four types of questionnaire and they are- for Consumers, for retailers, for Importers and for Producer. Then we have performed a test survey to ensure the correctness of the questionnaire. After that, on 11<sup>th</sup> February, 2014we have conducted the main survey of total 60 persons individually. Among them, 30 surveys done for consumers, 15 for retailers and another 15 were for producers and importers.

For the secondary data, we have gone through some articles, in journals and reports. The information about toxic elements in jewellery in our country is limited because of less amount of work in this area.







# 7. Results and discussion

#### 7.1 Consumer perception

#### 7.1.2 Demographic perception of surveyed consumers:

	Age							
	≤ 19	20-29	30-39	40-49	$\geq$ 50			
Male	3%	13%	10%	0	0			
Female	10%	27%	17%	13%	7%			
Total	13%	40%	27%	13%	7%			

	Occupation							
	Student	Businessman	House Wife	Govt. Officer	Private Service			
Percentage	39%	20%	17%	17%	7%			



#### Figure-1



Among the targeted consumers for the survey, 26% were male and 74% were female (Fig. 1).

In terms of age, 13% were less than 19 years, 40% were from 20-29 years, 27% were from 30-39 years, 13% were 40-49 years, and 7% were above 50 years. Among all 30 consumers, most of them were students because young generations are the main consumers of jewellery. Rests of them were businessmen, govt. Officer, housewife and private service holder. Profession-wise, targeted consumers are shown in Fig 2.



### 7.1.3 Awareness and perception regarding jewellery

It was needed to find out the shopping trend of jewellery of the targeted segment to know their perception regarding heavy metals in jewellery. Therefore, several questions were asked for them.



## Figure-3



The survey shows that (Fig. 3) 53% users buy gold plated jewellery, 21% fancy, 14% silver and the rest 12% usually buy gold jewellery. Fig. 4 shows the distribution of consumers, according to their choice of markets for buying pieces of jewellery . 57% buy them from local shops, 26% from abroad and 17% of both local foreign shops. Accordingly, the local shops and markets are the main sources of jewellery supply to the Dhaka City users.

# 7.2 Skin problems of users from different jewellery items

Fig. 5 shows the results. 47% have skin problems after wearing ornaments, 33 % never faced any problems and 20% did not respond. Among the 47% of those who had skin problems because of wearing ornaments, 55% ended up with red rash on the skin and 25% had pimples on the nose and other parts of the skin. The rest 20% suffered from itching because of wearing jewellery pieces containing toxic elements. Fig. 6 shows the distribution of the three main skin problems generally found among those who wear these jewellery pieces.





Figure-5

Figure-6

#### 7.3 Awareness level of mercury and other toxic metals in jewellery

Our one of the prime objectives was to know about the awareness level of toxic elements use in jewellery. For that, we have asked some questions to our target group and came up with moderate results.



#### Figure-7

#### **Figure-8**

Fig. 7 shows that almost 70% of the people that were surveyed did not have any idea about the use of any hazardous elements in jewellery. 13% of consumers answered they were actually not sure about the uses of heavy metals in jewellery and only 17% said that they knew about toxic metals and other related elements were used in ornaments manufacture and they were bad for our skin.

Of the 17% of the users, 40 % of them knew about mercury from online articles and journals, another 40% knew it from conversation with their friends, relatives and rest the 20% knew from television news and talk shows of foreign countries [Figure-8].



#### 7.4 Perception about toxic elements in jewellery





Fig. 9 shows the results of this survey. Although most of the surveyed people don't have any idea of heavy metals which are used in the manufactures of their regular jewellery, they want to make themselves aware regarding this. When we asked them what should be the next step against heavy metals, they gave us some interesting responses. 37% of them want to avoid purchasing toxic element containing jewellery, 33% will go for making themselves more aware regarding this, 20% said they will go for alternative metal free ornaments and 10% said they will follow safety while using old jewelleries.

Moreover, after analyzing all the collected data from consumer groups, we have come to know people, especially young group are now tending to use different jewelleries both from local and foreign shops. Their preference are mostly for gold plated types and then for cheap and fancy jewelleries. Some of them are more for silver and gold types. Every type contains different quantities of toxic elements in time of production. But most of them are unaware about it. Although some of them know about the hazardous element in jewellery, they are not properly aware of its effect on their skin.

All of them are needed to become aware regarding hazardous elements in jewellery for safer health in future.

#### 7.4.1 Retailer perception

Under the survey, we interviewed almost 20 retailers who generally sell gold-plated, fancy, silver and gold jewelleries. We asked them several questions to get an idea about their awareness level of toxic elements in jewellery.



## **7.4.2 Source of their jewellery**

Retailers were asked about the sources of the import of jewelleries. The results are shown in Fig.10, 60 % of the retailers imported jewellery from foreign sources and 40% procured them from local sources. This information may help policy making on export of heavy metals containing jewellery and also the consumers.



## Figure-10

Figure-11

The guarantee periods on the sale of Jewellery are shown in Fig. 11.



As regards the quality of the jewellery only 11% of the retailers responded that they used to get complaints about durability and quality of jewellery (Fig. 12)



#### Figure-12

#### Figure-13

# 7.5 Awarness level of the use of heavy metals in jewellery

Fig 13 shows the levels of awareness among retailers of the presence of hazardous elements in the jewellery. Only 15 % said that they knew about the use of some hazardous colour and elements in the production of jewellery. 40% said that they had no idea about the use of mercury in jewellery. The 15% who knew about it mentioned that private conversation and television were the sources of information. However, most of them agree that the media can alert people about the adverse effects of these types of jewellery pieces.





# **7.6 Preference** of retailers regarding steps to be taken against heavy metals containing jewellery

This is shown in Fig. 15, 45% were willing to be careful about what they are used to sell, 20% will avoid selling them at all and 35 % were worried about their profit and did not respond.



After getting their current status on use of toxic metals in jewellery, we asked them to share their ideas about it. 45% of them said they will carefully sell their jewellery, 20% said they will try to avoid selling those jewelries which is contained hazardous element and 35 % were neutral on that because they have to look their profit margin as well.

#### Figure-15

#### 7.7 Awareness level of producers and importers

We could not reach targeted importers and producers at the time of our survey. We talked with two producers and two importers and tried to know their perspective about use of heavy metals in jewllery. When we asked the producers about the percentage of complaints they used to get about the jewellery, the answer was, none.



# Figure-16

# Figure-17

Among importers, 50 % get complaints about quality of the jewellery [figure-16]. All of the target importers were unaware of the hazards of the presence of heavy metals in jewellery (Fig 17).



## 7.8 Laboratory findings

#### 7.8.1 XRF test result of adult jewelleries:

Sample Name	As	Cd	Hg	Pb	Ni	Zn	Cl	Ca	TiO <sub>2</sub>
	(2222)	(1111)	(2222)	(2222)	(2222)	(nnm)	(2222)	(2222)	(2222)
	(ррт)	(ppm)	(ррт)	(ppm)	(ppm)	(ррт)	(ppm)	(ppm)	(ppm)
Pendant	9.9	2358	<lod< td=""><td>10678</td><td>ND</td><td>290</td><td><lod< td=""><td>ND</td><td>6482</td></lod<></td></lod<>	10678	ND	290	<lod< td=""><td>ND</td><td>6482</td></lod<>	ND	6482
Necklace	3.9	6511	<lod< td=""><td>3456</td><td>746</td><td>32.9</td><td><lod< td=""><td>ND</td><td>7562</td></lod<></td></lod<>	3456	746	32.9	<lod< td=""><td>ND</td><td>7562</td></lod<>	ND	7562
Silver coated earring	4.7	2387	<lod< td=""><td><lod< td=""><td>467</td><td>6.1</td><td><lod< td=""><td>ND</td><td>ND</td></lod<></td></lod<></td></lod<>	<lod< td=""><td>467</td><td>6.1</td><td><lod< td=""><td>ND</td><td>ND</td></lod<></td></lod<>	467	6.1	<lod< td=""><td>ND</td><td>ND</td></lod<>	ND	ND
Bracelet	7.5	2396	<lod< td=""><td><lod< td=""><td>ND</td><td>3439</td><td><lod< td=""><td>1485</td><td>4356</td></lod<></td></lod<></td></lod<>	<lod< td=""><td>ND</td><td>3439</td><td><lod< td=""><td>1485</td><td>4356</td></lod<></td></lod<>	ND	3439	<lod< td=""><td>1485</td><td>4356</td></lod<>	1485	4356
Earring	3.8	4567	3.8	4523	123	9.3	<lod< td=""><td>ND</td><td>ND</td></lod<>	ND	ND
Silver coated necklace	5.8	3807	<lod< td=""><td>1976</td><td>ND</td><td>8961</td><td><lod< td=""><td>ND</td><td>ND</td></lod<></td></lod<>	1976	ND	8961	<lod< td=""><td>ND</td><td>ND</td></lod<>	ND	ND
Bracelet with chain	2.0	2348	<lod< td=""><td><lod< td=""><td>ND</td><td>9</td><td><lod< td=""><td>ND</td><td>ND</td></lod<></td></lod<></td></lod<>	<lod< td=""><td>ND</td><td>9</td><td><lod< td=""><td>ND</td><td>ND</td></lod<></td></lod<>	ND	9	<lod< td=""><td>ND</td><td>ND</td></lod<>	ND	ND
Bracelet (metal imitated)	4.8	3498	<lod< td=""><td>3214</td><td>152</td><td>11.5</td><td><lod< td=""><td>ND</td><td>ND</td></lod<></td></lod<>	3214	152	11.5	<lod< td=""><td>ND</td><td>ND</td></lod<>	ND	ND
Silver coated earring	4	2368	<lod< td=""><td>1265</td><td>211</td><td>8.1</td><td><lod< td=""><td>ND</td><td>3567</td></lod<></td></lod<>	1265	211	8.1	<lod< td=""><td>ND</td><td>3567</td></lod<>	ND	3567
Bracelet with stone	5.7	3457	<lod< td=""><td><lod< td=""><td>765</td><td>9.2</td><td><lod< td=""><td>ND</td><td>4532</td></lod<></td></lod<></td></lod<>	<lod< td=""><td>765</td><td>9.2</td><td><lod< td=""><td>ND</td><td>4532</td></lod<></td></lod<>	765	9.2	<lod< td=""><td>ND</td><td>4532</td></lod<>	ND	4532
White gold plated bracelet	2.8	5621	<lod< td=""><td><lod< td=""><td>ND</td><td>11.5</td><td><lod< td=""><td>ND</td><td>ND</td></lod<></td></lod<></td></lod<>	<lod< td=""><td>ND</td><td>11.5</td><td><lod< td=""><td>ND</td><td>ND</td></lod<></td></lod<>	ND	11.5	<lod< td=""><td>ND</td><td>ND</td></lod<>	ND	ND
Finger ring	4	3567	5.8	872	112	6.4	<lod< td=""><td>ND</td><td>ND</td></lod<>	ND	ND
Metallic Beads Necklace	3.9	3171	ND	4187	136	3.9	<lod< td=""><td>ND</td><td>2487</td></lod<>	ND	2487
Necklaces +Bracelets (plastic & wooden mix)	4.7	5931	ND	4234	132	4.3	<lod< td=""><td>ND</td><td>2324</td></lod<>	ND	2324

Most of the jewellery items were found to contain Titanium (Ti) in very high concentration (1300-7500) ppm.Lead (Pb) content was found to be the highest in pendants. Pb concentration varied from 800 ppm to over 10,000 ppm in different jewellery items.Cadmium (Cd) were high in concentration in almost every item tested. The concentration varied from 2000 ppm to almost 6500 ppm.Nickel (Ni) was found in greater than 100 ppm (110-800) ppm in almost every sample.Earring and finger ring samples were found to contain Mercury (Hg). Arsenic (As) was detected in every sample in high concentration.Zinc (Zn) concentration varied up to 3500 ppm in different samples. Some bracelet samples were found to contain Calcium (Ca) in very high concentration. It was over 1400 ppm.

Sample Name	As	Cd	Hg	Pb	Ni	Zn	Br	Ca	TiO <sub>2</sub>
	(ppm)								
Metallic Beads Necklace (Children)	2.9	3418	ND	4533	122	2.9	2374	ND	2376
Finger ring (Children)	ND	4311	ND	5434	ND	ND	2123	ND	1242
Plastic & Wooden mix Necklace (Children)	5.8	3478	ND	5431	ND	ND	3214	ND	2381
Assorted metal bracelet (Children)	2.4	3212	ND	4312	121	2.3	3247	ND	2134
Plastic and stone Necklace (Children)	ND	2315	ND	3112	ND	2.7	3276	ND	1121
Finger ring (Children)	ND	2710	ND	2175	ND	ND	3215	ND	ND
Bracelet with chain (Children)	ND	2108	ND	2314	ND	ND	2104	ND	2123
Earring (Children)	2.6	2017	ND	2578	ND	ND	2134	ND	ND
Assorted Bracelet (Children)	2.1	2975	ND	2713	ND	ND	2164	ND	2134
Colored Necklace (Children)	ND	3286	ND	2145	ND	ND	1286	ND	2391
Wooden Bracelet (Children)	2.1	1245	ND	3126	ND	ND	2314	ND	2941

#### 7.8.2 XRF test result of children jewelleries:

\*LOD= Level of Detection

\*ND= Not Detected

XRF tests on 35 children jewellery samples showed that 12 contained high concentration of multiple toxic metals and 17 one or two metals in medium concentration and six in low concentration. Of the 12 samples that contained bromine, 9 had brominated flame retardants-BFR. Very high concentrations of lead, cadmium and titanium dioxide were found in most of the samples. Lead, cadmium, titanium dioxide and bromine concentrations (ppm) were in the order: 200-5500, 1200-4300, 1200-2900 and 1200-3200.





#### 7. 9 Findings of Ecology Centre, Michigan on toxic jewellery

The Centre (www.HealthyStuff.org) released some new results on toxic chemicals in low-cost children's and adult jewellery. They have collected Ninety-nine pieces of jewellery from 14 different retailers, including: Ming 99 Cities, Burlington Coat Factory, Target, Big Lots, Claire's, Glitter, Forever 21, Walmart, H&M, Meijers, Kohl's, Justice, Icing and Hot Topic. Samples were collected from 6 different states, including Ohio, Massachusetts, Michigan, Minnesota, New York and Vermont.Researchers tested for chemicals -- including lead, cadmium, arsenic, mercury, bromine and chlorine (PVC) – which have been linked in animal and some human studies to acute allergies and to long-term health impacts such as birth defects, impaired learning, liver toxicity, and cancer. Over half (59%) of the products tested had a high level of concern due to the presence of one or more hazardous chemicals detected at high levels. Four products contained over 10% cadmium, a known carcinogen. Fifty percent contained lead, with over half (57%) of these containing more than 100 ppm of lead in one or more components, exceeding the Consumer Product Safety Commission (CPSC) limit of lead in children's products.

#### 7.10 Highlights of this study results:

- Overall 59% (58) of the products tested were rated as having a HIGH level of concern due to the presence of one or more hazardous chemicals detected at high levels.
- LEAD 27 of 99 (27%) of jewellery contained greater than 100 ppm lead in one or more components. 100 ppm is the CPSC limit of lead in children's products and the 90 ppm limit for lead in paint.
- CADMIUM -10 of 99 (10%) of jewellery contained greater than100 ppm cadmium in one or more components.
- CHROMIUM -- 92 of 95 (93%) of jewellery contained greater than 100 ppm chromium.
- NICKEL 30 of 95 (30%) of jewellery contained greater than 100 ppm nickel.
- BROMINATED FLAME RETARDANTS -- 7 of 95 (7%) of jewellery contained brominated flame retardants (greater than 1,000 ppm bromine).
- CHLORINE 11 of 95 (12%) of jewellery contained PVC (greater than 25,000 ppm chlorine).

Other chemical analyzed include mercury and arsenic.<sup>6</sup>

<sup>&</sup>lt;sup>6</sup> The Ecology Center, 2012, Cheap jewelry still contains chemicals toxic to children, environmental group finds



## 8. Medical experts' opinion

Jackson *et al.*, 2016, has the opinion that the metals may enter the body by ingestion, inhalation, absorption through the skin or mucous membranes. They are then stored in the soft tissues of the body. The heavy metals once absorbed compete with other ions and bind to proteins, leading to impaired enzymatic activity resulting in damage to many organs throughout the body. They opined different metals' poisoning effect on human health. Some of them are discussed below:

#### Mercury:

Acute poisoning by mercury includes pneumonitis (± adult respiratory distress syndrome (ARDS)), Flu-like symptoms, Irritability, Myalgia, Gastrointestinal upset, Subsequent peripheral neuropathy, hepatic dysfunction or renal failure may develop. Chronic poisoning can cause Irritability, Personality changes, Headache, Peripheral neuropathy, Memory problems, Ataxia, Coma, Respiratory problems (pneumonitis and ARDS), Gastrointestinal upset (abdominal pain, gingivitis and stomatitis, nausea, vomiting), Renal problems include acute renal failure, nephrotic syndrome and acute tubular necrosis.

#### **Cadmium:**

Cadmium can betoxic by inhalation and ingestion and also absorbed through the skin.Complications include metallic taste and increased salivation, nausea, vomiting and diarrhoea, impaired sensation, difficulty in breathing, cough, chest pain, pneumonitis and pulmonary oedema. Chronic exposure may cause anaemia, emphysema or renal failure and cadmium may be a risk factor in the development of prostate or lung cancer<sup>7</sup>.

#### Lead:

Knott *et al.*, 2015, explained the severity of symptoms of acute lead poisoning often correlates with blood levels and at high levels: abdominal pain - moderate to severe, vomiting, encephalopathy-more common in children, Jaundice, lethargy, black diarrhoea, chronic poisoninginclude mild abdominal pain, constipation, weight loss, aggression, antisocial behaviour, headaches, hearing loss, sub-fertility, foot drop due to motor peripheral neuropathy, wrist drop, carpal tunnel syndrome, gout, autonomic dysfunction<sup>8</sup>.

<sup>&</sup>lt;sup>7</sup> http://patient.info/doctor/heavy-metal-poisoning

<sup>&</sup>lt;sup>8</sup> http://patient.info/doctor/lead-poisoning-pro



#### Arsenic:

According to Hartree *et al.*, 2015, skin lesions, cardiac/respiratory,coronary heart disease, myocarditis, pericarditis, hypertension, peripheral arterial disease, restrictive or obstructive lung disease, Neurological complication, diabetes, cancer can be caused by arsenic exposure. Effects are seen in children after an average of seven years of exposure.





# 9. Opinion of Bangladesh Jewellery Manufacturers and Exporters

### Association

According to Mr. Anwar Hossain, the President of Bangladesh Jewellery Manufacturers and Exporters Association, in gold and silver jewellery, they use only gold, silver, copper and cadmium. But they do not use any other metals like mercury, lead. He said that, they use cadmium for welding purpose, as cadmium melts quickly. During the welding process, the excess cadmium is removed as vapor. So, the test results do not suppose to show the presence of cadmium in the jewelleries. But when he was asked about the imitated jewelleries, he replied that those jewelleries might contain other ingredients, but they are not much concerned about those jewelleries. They do not monitor the quality of those jewelleries.



# **10. Conclusion**

Nowadays, mercury, lead, cadmium etc. are commonly used in the manufacture of different types of ornaments. These toxic metals are harmful to the users. Therefore, it is high time for us and for every member of our society to know about different hazardous elements' use in jewellery and make ourselves careful to buy such jewelries. ESDO's prime target was to find out the current status of awareness level of different people of Dhaka city about their concern of the presence of these metals in jewellery. After analyzing all data, we found mass awareness is needed for metal use in jewellery. Formulation of proper regulation is needed to restrict or ban the use of those elements in jewellery production. There is no proper environmental act Prohibiting use of toxic elements in manufacture of different type of jewellery. So, concerned authority should take some necessary steps for formulating and implementing necessary acts<sup>9</sup>.

<sup>&</sup>lt;sup>9</sup> http://patient.info/doctor/arsenic-poisoning

# **11. Recommendations**

- Government should formulate an act to ban the import and manufacture of jewellery which contain toxic elements more than the tolerance limit;
- The concerned authorities should enlist the shops where toxic chemical containing jewelleries are found and immediately should take steps against it;
- > Mass awareness should be created among general consumers of toxic jewelries;
- Retailers, wholesalers and importers are also needed to be aware and should not bring heavy metal containing jewelleries;
- Media, NGOs and other organizations should come forward for awareness campaigns.
  Warning label should be put with packets containing such products;
- > Making of of eco-friendly and non-toxic alternative jewellery should be encouraged
- If SMEs of jewellery need technical assistance to produce jewellery without toxic elements, related authority should provide it to them;
- More comprehensive study is needed;
- Adequate laboratory facilities for testing toxic elements should be increased in the country
- > Proper treatment facilities of waste water contaminating toxic metals need to be set up.



# **12. References**

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9 The Ecology Center, 2012, Cheap jewelry still contains chemicals toxic to children, environmental group finds.



# **13. Annexure**

# Annexure- A

# I. <u>Field Survey</u>











# **II. Jewellery Samples**





# Annexure-B

# III. a. Sample Questionnaire for consumers:

Time: .....

Date: .....

Location.....

	Part-1 [Participant's Identical outline]					
Name						
Sex		🗌 Male 🗍 Female				
Age			40-49,  ≤ 50			
Profes	sion	Student, Govt. Officer, B	usinessman, Private Business, others			
Educat	tion	 [] Illiterate, [] Primary educati	on, High school education, Higher			
		education				
Incom	e	<u> </u>	10,000-20,000 25000-35,000 45000			
		Part-2 [Survey (	Questions]			
1. W	hat type of jewe	ellery do you use/buy	Silver			
re	epeatedly?		Gold-plated			
			Gold			
			☐ Others			
2. W	/hy type of speci	ficjewellery you buy markedly?	Local			
			☐ Foreigner			
3. D	o you have any o	complain regarding the quality	Yes			
of jewellery?			L No			
			□ Neutral			
4. Have you ever face any skin problem in time of		e any skin problem in time of	☐ Yes			
U:	sing any jeweller	γ?				
			L Neutral			
5. If yes, then what type of skin problem did you		type of skin problem did you				
tace?						
6 0	o vou have anv i	dea about any bazourdous				
0. D	lement/mercury	used in jewellery?				
	iententy mereury	used in jewenery:				
7. If yes, what is the source of your knowledge on			Newspaper			
mercury in jewellery?			Television			
	, ,	,	Online source			
			Conversation with people			
			Others			
8. What do you think about Mercury based			Avoid purchasing those jewellery			
je	ewellery?	-	Purchase alternative safe jewellery			
			Be careful about using			
			Make awareness among customers			





		☐ More than 1 Year
15.	If yes, What type of complain do you get usually?	Skin problem
		Quality of the jewellery
		$\Box$ Durability of the product
		Regarding colour changing
16.	Do you have any idea about any hazardous	☐ Yes
	element/mercury used in jewelry?	□ No
		□ Neutral
17.	If yes, what is the source of your knowledge on	Newspaper
	mercury in jewellery?	Television
		Online source
		Conversation with people
		Others
18.	What do you think about Mercury based	Avoid selling those jewellery
	jewellery?	Be careful about selling
		Others
19.	Any opinion about mercury in Jewellery?	I

Name of Interviewer:

Signature