# Persistent Organic Pollutants (POPs) in Human Breast Milk Collected from Asian Developing Countries: Risk Assessment for Infants

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**SL 1: Title**

Thank you Mr. Chairman for introducing me. Here, today, I would like to talk about our recent study on "Persistent Organic Pollutants (POPs) in Human Breast Milk Collected from Asian Developing Countries in View of Risk Assessment for Infants".

**SL 2: Background 1**

First of all, I'd like to touch on the background of this study. As you know well, persistent organic pollutants (POPs) representing polychlorinated dibenzo-*p*-dioxins, dibenzofurans, PCBs, and organochlorine insecticides are lipophilic stable contaminants. They have been detected in a wide range of environmental media and biota, and have been of great concern on their toxic effect on humans and wildlife. In developed countries, comprehensive investigations on the POPs pollution have been documented well, and made clear that environmental residue levels have been decreasing in recent past decades. However, in developing countries, fewer information are available on the pollution of these contaminants, particularly dioxins and related compounds.

**SL 3: Dumping Site in Cambodia**

This is a view of the dumping site of municipal wastes in Phnom Penh, Cambodia.

**SL 4: Dumping Site in India**

This is a same view in India. Large scale dumping of municipal wastes is common in the urban regions of many developing countries. Variety of wastes including plastics, metals, papers, woods and raw materials are dumped in large open land areas.

**SL 5: Burning of Dumps**

The major problem here is burning of wastes at low temperatures due to the generation of methane gas. As you guess now, the burning of wastes forms dioxins.

**SL 6: Slum**

The additional problem in these areas is the anthropogenic pollution and their toxic effects on human health. Poor peoples form a slum near to the dumping site, collect the recyclable and usable items in this area, and keep them near their houses, as you can see here.

**SL 7: Waste Picker**

They are exposed to dioxins and other toxic chemicals here as they spend most of their time here, and therefore seem to be at risk of many toxic chemicals.

**SL 8: Background 2**

From the slides I showed now, dumping sites of municipal wastes in Asian developing countries may be expected as the sites of secondary formation of dioxins and related compounds, because huge

amounts of various wastes have been dumped daily and continuously burned under low temperature by spontaneous combustion or intentional incineration. Also, the usage of organochlorine insecticides at these sites for public health purposes is unavoidable, because of serious hygenic problems in dumping sites. Therefore, it is suspected that pollution sources are present in dumping sites, and many residents around there might be exposed to these contaminants.

**SL9: Objectives**

Based on this background, we have conducted a study with the following objectives. By analyzing PCDDs, PCDFs, PCBs, and organochlorine insecticides in human breast milk collected from dumping sites of municipal wastes and control sites in some Asian developing countries, we have attempted;

1) To elucidate the contamination status of human breast milk from these Asian developing countries,
2) To assess the risk of exposure on infants, and
3) To evaluate the effects of dioxins on the thyroid hormone and Vitamin A in lactating women.

**SL 10: Sample Collection**

Samples of Human breast milk used in this study were obtained from residents around dumping sites of municipal wastes in **India, Cambodia, Vietnam and Philippines** during 1999 to 2001, as shown here. In India, Cambodia and Vietnam, samples were also obtained from control sites, which are located more than 5 km far from dumping sites. Additionally, blood serum samples were obtained from some of the above individuals, in order to analyze thyroid hormone and Vitamin A levels. Informed consent was obtained before the collection of breast milk and blood from donors.

**SL 11: OCs**

As shown here, these POPs such as PCDD, PCDF, PCB, DDT, HCH, chlordane, and HCB, were analyzed in this study.

**SL 12: Dioxins and Related Compounds**

Concerning first objective of this study, I would like to talk about contamination status. This figure shows the mean concentrations of dioxins and related compounds, such as PCDDs, PCDFs, non-*ortho* PCBs, mono-*ortho* PCBs and their TEQs in human breast milk from residents around dumping sites in India, Cambodia, Vietnam and Philippines. Dioxins and related compounds were detected in all the samples of human breast milk analyzed. Among these compounds, mono-*ortho* PCBs were detected at the highest concentrations followed by PCDDs, non-*ortho* PCBs, and PCDFs in all the countries. Interestingly, concentrations of all the compounds and TEQs of dioxin in **India** were higher than those in **Cambodia, Vietnam and Philippines**.

**SL 13: Dumping and Control Sites – Dioxins**

These figures illustrates the mean and range concentrations of dioxins and related compounds in human breast milk collected from dumping sites and control sites in India, Cambodia and Vietnam. The X-axis shows concentrations of dioxins and related compounds, and the Y-axis shows dumping site **(D)** and control site **(C)** in **India**, **Cambodia** and **Vietnam**. In India, the mean concentrations of all the compounds and TEQs of dioxins in human breast milk from dumping sites were higher than those from control sites. This result suggests that significant pollution sources of dioxins and related compounds are present in the dumping sites in India. On the other hand, in Cambodia and Vietnam, concentrations of these compounds in human breast milk from dumping sites were comparable to those from control sites.

**SL 14: PCBs and Insecticides**

In the case of PCBs and organochlorine insecticides such as DDTs, HCHs, chlordanes and HCB, these contaminants were also detected in all the samples of human breast milk analyzed. In Cambodia, Vietnam and Philippines, **DDTs (blue)** were detected at the highest concentrations, followed by PCBs. In particular, DDTs levels in **Vietnamese human breast milk** were extremely high when compared with other countries. Concentrations of HCHs, chlordanes and HCB were much lower levels than those of DDTs and PCBs. However, HCHs in Indian breast milk shown by **red bar** were apparently higher than those in other countries. The high contamination by HCHs found in Indian breat milk and DDTs in Vietnamese breast milk agreed with earlier reports noted in food stuff and various wildlife. Continuous usage of HCH and DDT are suspected in these countries.

**SL 15: Dumping and Control Sites – OCs**

The mean and range concentrations of PCBs and organochlorine insecticides in human breast milk collected from dumping sites were compared with those from control sites. In Cambodia and Vietnam, concentrations of these compounds in human breast milk from dumping sites were comparable to those from control sites. However, in India, concentrations of **PCBs** and **chlordanes** in dumping site were significantly higher than control sites, suggesting that significant pollution sources of PCBs and chlordans are present in the dumping sites in India, and the residents around there have been exposed to these contaminants. Probably, PCB-containing electrical equipments such as older transformers and capacitors dumped are plausible sources for PCBs contamination in dumping site in India. The application of chlordane to eradicate pests might have conducted in this dumping site.

**SL 16: Bovine Feeding**

Additionally, the residents in dumping site in India might be affected by exposure to these contaminants through consuming the bovine milk. As seen here, buffalos and cows are feeding on the garbage in dumping site.

**SL 17: Bovine Feeding**

And the garbage fed bovines in dumping site return to the dairy farm in the evening and milked like this, and that milk is consumed by residents around here and sold in the market. So, the exposure and accumulation of toxic organochlorines originating from dumping site is unavoidable for residents through bovine milk. Actually, as seen in next slide,

**SL 18: Org.Cl in Cow Milk in India**

By the analysis of bovine milk from India, we found apparently higher concentrations of dioxins, PCBs and chlordanes in **dumping site samples** than in **control sites**. Considering these results, it may be concluded that the residents in dumping site are exposed to dioxins, PCBs and chlordane through bovine milk. Similar situation might be expected in other dumping sites in developing countries, if the domestic animals are feeding on garbage and residents use these animals and their products as food.

**SL 19: Global Comparison - TEQs and PCBs**

To understand the degree of contamination by organochlorine compounds in human breast milk collected from Asian developing countries, concentrations of these contaminants observed in this study were compared with those reported from other countries in 1990s.These two figures show international comparison of dioxins and PCBs concentrations in human breast milk. Generally speaking, dioxin residue levels were apparently lower in developing countries than in developed nations. However, dioxin levels in

human breast milk from dumping site in **India** were higher than those in general public from other developing countries, and comparable to those from developed nations. So far, it has been believed that the dioxin problem is a major issue in developed nations. No dioxin contamination and dioxin problems were known in developing countries other than some sporadic incidents such as herbicide agent orange in Vietnam and Yusho disease in Taiwan. However, as I pointed out here, the dumping sites of municipal wastes can be a significant emission source of dioxins in some developing countries like India. As seen in **right figure**, PCBs concentrations in human breast milk from Asian developing countries were lower than those from developed nations and former social countries.
As a whole picture, except for dumping site in India, contamination by dioxins and PCBs in human breast milk were higher in developed nations than in developing countries.

**SL 20: Global Comparison - DDTs and HCHs**

These two figures illustrates the comparison of DDTs and HCHs residue levels in developing and former social countries with those in developed nations. As seen here, we can clearly say that contamination by organochlorine insecticides in human breast milk are much higher in developing and former social countries than in developed nations.

**SL 21: Age and Child - TEQs and DDTs**

Earlier studies reported that concentrations of organochlorine compounds in human breast milk were affected by various factors, such as woman's age, number of children, lactational period, *ect*. So, we attempted to examine the relationship between concentrations of some organochlorine compounds and woman's age, and number of children. The left two figures show the variation of dioxins and DDTs concentrations in human breast milk with woman's age.
As shown here, no significant correlation was observed with woman's age. We considered that possible reason for it might be arisen from various number of children in lactating women. Hence, the relationship between concentrations of these contaminants and number of children were examined and given in the two right figures. As seen here, dioxins and DDTs concentrations in human breast milk tended to decrease with increase of number of children. This means that organochlorines in mother's body are significantly excluded by the experience of nursing lactation and become less. From this result, we can also guess that the first infants are exposed to higher levels of organochlorines from breast milk and might be at relatively higher risk of these contaminants. This fact was found in developing countries, but it poses serious problems for humans in developed nations also. Namely, we can not ignore this fact, since this may be trouble of some concern.

**SL 22: Newspaper in Japan**

This is a report of Japanese Economic News in June 2002 showing the decreasing population trend with an average of a mere 1.33 children per couple. This is the trend in almost all the developed nations where people prefer to have small families due to social and economic reasons. Here comes the problem I thought of. Based on my results which I have noticed in this study in the populations of the developing countries like Cambodia and India, the first child gets the major burden of toxic contaminants followed by second, third and so on. Having many children is rather common than an exception in developing countries. Having only the first child is the common phenomenon in Japan. One child families are the trend in most of the developed nations where women marry very late. On the other hand, early marriage are very common in developing countries.

**SL 23: Highly Contaminated Future Population in View of Birth Rates**

The general population of the **developing world** where families have many children will be **less contaminated** with POPs, because of the early marriage of mothers and lesser exposure to POPs through lactation in the second and later children. My concern in this is being the single child receiving greater amounts of pollutants from their mother who have married at a later age of their life, the available meager population will be highly contaminated by POPs. This is a case in **developed nations**. This situation may lead in future that, in developed nations, **young work force especially without contamination and with proper physical and mental fitness will be less**. The above assumption was drawn on the global birth rates. But the continuous usage and exposure should also be taken into account before making any consideration. If so, POPs exsisting at higher levels such as PCBs and dioxins seem to be the chemicals of prime concern for the future population of developed nations.

**SL 24: Daily Intake**

OK, back to the talk on the pollution in developing countries. I would like to explain daily intakes of dioxins, HCHs, and DDTs from human breast milk by infants. In this figure, the X-axis shows country, and the Y-axis indicates daily intake. Daily intakes were calculated, based on the assumption that an infant ingests 700ml of milk per day and weight of an infant is 5kg.The estimated daily intakes of **dioxins** by infants in all the four developing countries exceeded TDI proposed by WHO in 1998. Furthermore, in **Indian** infants, the daily intake of HCHs also exceeded TDI proposed by health Canada in 1996.

**SL 25: Thyroid Hormone**

In order to assess the toxic effects of POPs, we compared the levels of thyroid hormone and Vitamin A in serum of blood with dioxin concentrations in breast milk from lactating woman. By the result shown in this slide, no significant correlation could be found for all the thyroid hormones, indicating less effect of dioxins on thyroid hormones.

**SL 26: Vitamine A and dioxins in Human**

However, as seen here, significant negative correlation was observed between TEQ concentrations of **dioxins** in human breast milk and **Vitamin A** levels in serum in the blood from India and Cambodia. This may suggest an acceleration of vitamin A metabolism or the inhibition of vitamin A formation by dioxins in human body.

**SL 27: Vitamine A Metabolism**

The accelerated metabolism of vitamin A by dioxins forms active metabolites such as **retinoic acid**, and it leads to an imbalance of metabolic contents. It is well known in the experimental animals that the imbalance of **retinoic acid** cause growth retardation, skin disease and malformation.

**SL 28: Deformities (1)**

In slum near to dumping site, we found some deformities and diseases, in the people living there. This is a case of malformation in fingers.

**SL 29: Deformities (2)**

This is a case of malformation in legs.

**SL 30: Deformities (3)**

We also noticed Intellectual impediment in some individuals, as in the case of the small boy you see here.

**SL 31: Deformities (4)**

This is a case of deficience in leg and arm. Of course, we have no clear evidence yet to specify the cause of these abnormalities, but we should consider toxic contaminants originating from dumping sites as one of the possible cause. The additional epidemiological studies and POPs monitoring are required in dumping site populations in developing countries.

**SL 32: Conclusion – 1**

1. The residents in India, Cambodia, and Philippines have been exposed to PCDDs, PCDFs, PCBs, and organochlorine insecticides.
2. Concentrations of dioxins and related compounds in human breast milk of residents around dumping sites in India were significantly higher than those around control sites, and the levels of TEQs were comparable to those in general public of developed countries.
3. Levels of HCHs in Indians were significantly higher than those in other developing and developed countries.

The first, second and third conclusions indicate the widely contamination by POPs in human breast milk of residents in Asian developing countries. Particularly, Indian residents around dumping site were found to highly expose to dioxin related compounds as well as organochlorine insecticides.

**SL 33: Conclusion – 2**

4. Concentrations of organochlorine compounds in human breast milk tended to decrease with increase in number of children.
5. The estimated daily intakes of TEQs by infants in all the three developing countries and HCHs in Indian infants exceeded TDI.
6. Significant negative correlation was observed between TEQs in human breast milk and vitamin A in serum.

Forth conclusion is that, the first infant is exposed to higher levels of POPs from human bresat milk and might be at relatively higher risk by these contaminants. Fifth conclusion is that, the estimated daily intakes of some POPs by infants in some developing countries exceeded TDI. Final conclusion is that, significant negative correlation was observed between TEQs of dioxins in human breast milk and Vitamin A in serum. It may suggest a part of dioxin effect on the human health in dumping site. Further studies are needed in dumping sites in Asian developing regions. Thank you for your attention.

## Q&A

Toppari: Thank you, Professor Tanabe. Now we have time for one or two questions; short questions, short answers, please.

Q: Have you seen any evidence that the children of older parents are likely to be exposed to higher levels of persistent organic pollutants, i.e., that the parents might have had more time to collect the pollutants in their body over time?

Tanabe: I actually did study the relationship of food and children and moreover food and concentration in the mother's breast milk, but I did not find any particular tendency such as a high concentration because the mother ate lots of fish.

Q: You have not found the relationship or you have not looked for it?

Tanabe: We could not find a clear relationship between the feeding habit and the concentrations.

Q: No, between the age of the parents and the concentrations in the kids.

Tanabe: I observed a tendency for concentration to be higher for older parents.

Q: Thank you.

Toppari: OK, there is one more question.

Watanuki: You said dioxin concentration was high at places where trash was incinerated in India. I realize it comes from the food chain, but is the fact that dioxin comes from air pollution one of the reasons why there is a 5-kilogram difference with the control?

Also, is the surrounding are contaminated by dioxin when trash is incinerated in places like India?

Another thing I'd like to know is dioxin is coming from pesticides. Therefore, I'd like to ask if 245T is still being used.

Tanabe: The source of dioxin pollution in India is still not clear. It probably comes from multiple sources. Pesticides such as 245T are still being used. That is also probably a source of contamination.

In addition to places in India where massive quantities of garbage are dumped, there are many smaller dumping sites. Trash is also burned at these smaller sites, so they produce dioxin as well. So these small sites become sources of dioxin pollution, polluting the environment. Vegetables and other foods become contaminated, and when the general population eat such foods, the dioxins could accumulate in their bodies. It is a fact that the concentration is lower in the general population than in people living near dumping sites in India. The concentration was high in people living near dumping sites. I think the major cause of this is the fact they are drinking cow's milk.

Toppari: Thank you. Now I am sorry, but we have to stop discussion here for this talk.