TPM8 - Session 3

Presentations on Specific Research Activities at Each Institution
Environmental Health Research in NIER

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Lee, Chul-Woo
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Overview

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Current Status of Chemicals in Korea

- 6th largest of the world chemicals industry (’07)
- Account for 13.4% of the domestic manufacturing Industry

Place on the market (us $ billion)

- USA: 637.3 (22.4%)
- China: 310.1 (10.9%)
- Japan: 222.6 (7.8%)
- Germany: 203.7 (7.2%)
- France: 125.4 (4.4%)
- Korea: 104.7 (3.7%)
- UK: 100.8 (3.5%)
- Italy: 99.4 (3.5%)
- Brazil: 81.6 (2.9%)
- India: 76.4 (2.7%)

 Amount of place on the market of each country

More than 41,000 chemicals in the market
600 new chemicals are produced or imported annually

417 million tons in distribution (2006)
HPV (>1,000 ton/yr) chemicals (415 million tons, 99%)
Toxic Chemicals Circulation

**Designated Chemicals by Toxic Chemicals Control Act** (2010)

- **Toxic Chemicals** 623
- **Observational Chemicals** 67
- **Restricted Chemicals** 12, **Banned Chemicals** 60
- **Accident Precaution Chemicals** 69

* harmful to human health or the environment
* Being likely to be harmful to human health or the environment
* They have high acute toxicity, explosive hazard, etc. and cause severely harmful effect if an accident occurs

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**Trend of Toxic Chemicals Circulation in Korea**

[Graph showing the trend of toxic chemicals circulation from 2001 to 2007, with categories labeled as 'Product' and 'Import'.]
Environmental Diseases on the Rise

- The number of asthma patients of primary students soared five-fold since 1970s
- The number of atopic dermatitis patients doubled or tripled in the last 3 decades

Patients received medical treatment:


Health-Threatening Factors are increasing

- Asbestos, Radon, Climate Change, Microorganisms etc.
- A concern for residents near asbestos mines & areas for re-development
- Radon was detected in underground water etc.
- 1.5°C rise in temperature (in major 6 cities) in the last century
The Notion of Environmental Health Policy

**Environmental Standards/ Environmental Impact Assessment (EIA)**

- **Medium Environment** (water, air, soil)
- **Natural Environment**

**Environmental Pollution and Degradation**

- **Pose risks**

**Risk Assessment**

- **People**

**Ecosystems**

- **Pose risks**

**EH (Environmental Health) Policy**:
An area of public health policies, which focuses on all aspects of both the natural and living environment that affect human health
Strengthening Environmental Health Policy and Research

Introduction of Environmental Health & Implementation of Relevant Policies (2000 ~ present)
- Established a 10-year Environmental Health Plan in 2006
- Environmental Health Act was enacted in 2008 (enforcement in March 2009)
  ⇒ Focus on Protection of Human Health and Management of Toxic Chemicals

Efforts to Reduce Environmental Risks and Health Impacts from Environmental Hazardous Substances
- Information Collection on Exposure, and Promotion of Scientific Risk Assessment
- Effective and Efficient Risk Management from a Viewpoint of Reducing Risks
- Prevention and Management of Environmental Disease
- Expanding Environmental Health Infrastructure
  • Developing and Applying R&D Research in Environmental Health
Policies and Laws for Environmental Health

- Establishment of Comprehensive Plan for Environmental Health
  - Framework of Korea NEHAP
    (National Environmental Health Action Plan)

- Laws Regarding Environmental Health
  - Environmental Health Act
  - Toxic Chemicals Control Act
Establishment of Comprehensive Plan for Environmental Health

Ministry of Environment shall establish comprehensive plan for environmental health to promote public health by surveying, preventing and managing impact and damage of environmental hazardous factors on receptors.

Comprehensive Plan contains the items below (1):

- **Basic policies and goals** of Environmental Health
- **Impact of environmental hazardous factors** on the public health and the **current situation of the incidence of diseases** due to environmental hazardous factors
- **Impact and damage** that environmental hazardous factors have on the ecosystem
- **Risk assessment** of environmental hazardous factors
- **Survey, research, analysis, prevention and management** of the impact of environmental pollution on the public health
Establishment of Comprehensive Plan for Environmental Health

Comprehensive Plan contains the items below (2)

- Special management programs for the population group including children, the elderly and the pregnant who are vulnerable to environmental pollution
- Special management programs for the residents in regions susceptible to environmental degradation such as industrial complex, abandoned mining area, and waste treatment facilities
- Comprehensive receptor-based environmental standards
- Administrative and financial support to prevent and manage negative public health impact of environmental risk factors
- Ways to procure environmental health related fund
- International cooperation in the field of environmental health
- Others to promote environmental health
Vision

Safety and Healthy Society, free from the Environmental Risk and the Threat of Environmental Disease
- To reduce environmental burden of disease for the better health and well-being of people

Principles

- Precautionary Principle
- Receptor-based Policy
- Protection of Vulnerable Population
- Right to Know
To Become a Leading Country in Environmental Health

Execution Strategy

Vision & Strategy of NEHAP (2011-2020, 10-year Plan)

Prevention & Management of Environmental Disease

Health Impact Reduction by Upgrading Risk Management

Laying Foundation for Environmental Health
Execution Strategy

Laying Foundation for Environmental Health
- Enhancing Legislative & Institutional Framework
- Developing Base Technologies for R&D
- Creating a Website to Provide Environmental Health Information & Data

Prevention & Management of Environmental Disease
- Comprehensive Action on Environmental Risk Factors Management
- National Environmental Health Bio-monitoring
- Conducting Health Impact Assessment on Vulnerable Groups
- Investigation on the Health Impact on Residents in Areas of Environmental Concern

Health Impact Reduction by Upgrading Risk Management
- Surveying/Managing Circulated & Emitted Amounts to Give Management Priorities to Chemicals
- Active Responding to Latest Trend in Global Policy on Chemicals
- Better Framework to Safely Assess and Manage the Environmental Hazards
Laws Regarding Environmental Health

Environmental Health Act (enact. 2008)

Basic law regarding Environmental Health in Korea

“To protect and sustain the health of the public and ecosystem by establishing measures to prevent and reduce public health threat from environmental degradation and toxic chemicals”

Chapters

- Comprehensive Plan for Environmental Health, Committee, etc.
- Risk Assessment and Others
- Prevention and Management of Environment-related Health Damages
- Protection of Health of Children
- Supplementary Provisions
- Penalty Provisions
Laws regarding Environmental Health

Basic law regarding Chemicals Management in Korea

“To prevent risk caused by chemicals to human health or the environment” and “to control hazardous chemicals so that everyone can live in a healthy environment”

Chapters

- Framework Plan for Hazardous Chemicals Control, TRI, etc.
- New Chemical Notification, Risk Assessment, etc.
- Safe Control of Toxic Chemicals & Banned or Restricted Chemicals, Responses to Chemical Accidents, etc.
- Supplementary Provisions
- Penalty Provisions

Toxic Chemicals Control Act (rev. 2006)
Laws regarding Environmental Health

Area-specific Management System

**General Public Health**
- Public Health Act
- Ministry of Health & Welfare

**Environment**
- Environmental Health Act
- Ministry of Environment
- National Institute of Env. Res.

**School**
- School Health Act
- Ministry of Education, Science & Technology

**Food**
- Food Sanitation Act
- Korea Food & Drug Administration

**Industry**
- Industrial Safety Health Act
- Ministry of Employment and Labor
Risk Assessment and Management of Environmental Hazards

Conduct risk assessment and come up with measures to manage excessive environmental hazardous factors that violate the risk standard stipulated in ordinance of the Ministry of Environment

Limitation of the Use and Application of New Technology and Substance

In case new technology and substances are evaluated to be harmful by risk assessment, Ministry of Environment shall limit application of new technology or use of substance in consultation with heads of related central agencies and under review of committee.
2-2 Environmental Health Act (2)

**Prevention and Management of Environment-related Health Damages**

- **Basic Survey on the Public Environmental Health and Others**
- **Epidemiological Survey on Environment-Related Health Damage**
  - People sensitive to environmental pollution (Vulnerable groups)
  - Residents living areas with much health impact concerns
- **Health Impact Assessment Petition**
  - In case health damage is concerned or actually occurs, the public may file a petition to Ministry of Environment to conduct a survey on the health impact of environmental risk factors
- **Development of Environmental Health Indicators**
  - Develop indicators to gauge and assess the public environmental health
- **Management of Environmental Health Information and Statistics**
Risk Management of Children's Activity Area

In an effort to protect children's health, Ministry of Environment shall assess the exposure of environmental hazardous factors in children's activity areas and set up standard for environmental safety management.

Risk Management of Hazard Substance in Children's Product

Risk assessment and management of hazardous chemicals in toys and stationary that children often use or contact (referred to as "children's product") affecting their health.
Environmental Health Act (4)

Protection of Children Health

- **Securing environmental safety of children activity places**
  - playground, classroom, school zone

- **Protecting children health from hazardous chemicals release from children Products**
  - Periodic monitoring of exposure to hazardous substances contained in children’s goods and establishment of management system

- **Establishment of risk assessment for children**

Article 23~24

Environmental Health Act (enforcement, Mar 2009)
Current Research on Environmental Health in NIER

- Environmental Health Research and Management
- Current Status of Research on Environmental Health Research in NIER

www.nier.go.kr
Paradigm shift to Environmental Health

Traditional approaches: “compliance with standard”
- **Media of concern**
  - Air, water, soil, groundwater, etc
- **Problems**
  - Standards outdated and many without scientifically sound rationale
  - Relevance to human/eco health being questioned

Integrated “Exposure” and “Effects” approach
- **Receptors of concern**
  - Human and Ecosystem
- **Approaches**
  - Risk Assessment surveillance of environmentally related diseases
Institutional Framework

Ministry of Environment
- Environmental Health Policy Division
- Chemicals Management Division

National Institute of Environmental Research
- Environmental Health Research Dept.

Related Ministry:
- Ministry of Employment and Labor
- Ministry of Knowledge-Economy
- Ministry of Health and Welfare
- Korea Center for Disease Control and Prevention
- Korea Food and Drug Administration
To produce scientific information for the advanced environmental health policy and safe management of hazardous factors, working to protect the public health

Study on the public health, health of residents in areas of environmental concerns and the environmental impacts on vulnerable people such as children and seniors

- Work to prevent environmental diseases and hazards and cope with the pending environmental issues
- Develop the environmental health indicators
1. Foundation Study on Environmental Health

2. Korea National Environmental Health Survey (National Bio-monitoring)

3. Survey on Exposure to Environmental Pollution and Health Impact on Residents in Areas of Environmental Concerns

4. Environmental Health Research and Risk Assessment in Vulnerable People (Children, Pregnant women, Elders)

5. Environmental Toxicity Research
1. Foundation Study on Environmental Health

- Development and Utilization of Environmental Health Indicators
  - Conceptual Framework for the Developing Environmental Health Indicators

- Establishment of Environmental Health Information System
  - To maximize the utilization of data on environmental health surveys in studies and policies, we establish an information management system (Database)

- Standardization of Biological Sample Analysis and Quality Control
Korea National Environmental Health Survey was conducted to analyze/ determine systematically and continuously the level of people's exposure to harmful pollutants and contributing factors so that the result can be used as basic data for the establishment of environmental health policies and for the protection of people’s health.

The survey is carried out on 6,000 adults aged in nationwide from 2009 to 2011 (3-year ongoing project) based on demography, socioeconomic status, residential environment and lifestyle and the bio-analysis is carried out on 16 hazardous substances.

Ex: 3 heavy metals in blood (Pb, Hg, Mn) and 3 heavy metals in urine (Hg, Cd, As)

The results will be compiled and the levels of public exposure and related factors will be presented ('12)
3. Survey on Exposure to Environmental Pollution and Health Impact on Residents in Areas of Environmental Concerns

- Survey on the health impact on residents of major industrial complex regions
  - Approximately 6000 residents in 4 industrial complex (Ulsan, Shihwa/Banwol, Pohang, Cheongju/Daesun) and 1 district (Gwangyang bay district)

- Survey on the health impact on residents in areas of abandoned metal mines
  - Each year, approximately 2000 residents in a total of 10 locations in 5 districts
  - Health effects (biological samples), Quality of water and soil, and Heavy metal pollution

- Survey on the health impact on residents as requested by the community
  - Cement factory in Yeongwol-gun: Evaluate the health conditions’ correlation with pollution
  - The former Refiner: To identify the health impact of exposure to heavy metals
### Exposure Status of Heavy metals in Residents in Areas of Environmental Concerns

<table>
<thead>
<tr>
<th></th>
<th>Cadmium</th>
<th>Lead</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Blood (µg/L)</td>
<td>Urine (µg/L)</td>
</tr>
<tr>
<td><strong>Industrial Complex Region</strong></td>
<td>1.38</td>
<td></td>
</tr>
<tr>
<td><strong>Abandoned Metal Mines Region</strong></td>
<td>1.64</td>
<td>2.75</td>
</tr>
<tr>
<td><strong>The former Refinery Region</strong></td>
<td>3.12</td>
<td>3.47</td>
</tr>
</tbody>
</table>

- Observation of adverse health effect from the exposure of dust and heavy metals to the residents living near ‘Yeongwol Cement plant’ and ‘Janghang Refinery’
- COPD (Chronic Obstructive Pulmonary Disease) patients in Yeongwol-gun
- Highly Cd levels in Biological samples and Slightly Damage in Renal tubules in residents living in Janghang
4. Environmental Health Research and Risk Assessment in Vulnerable People (Children, Pregnant women, Elders)

**Vulnerable Group**

People sensitive to environmental pollution such as children, the elderly and the pregnant ⇒ Need special management programs for their health

For some pollutants other health compromises (immunodificiency) may render people more vulnerable. Genetic traits, nutritional status and life-style factors may also contribute (TNO and RIVM, 2006)

**Children may be more vulnerable to environmental exposures than adults**
- Their bodily systems are still developing
- They eat more, drink more, and breathe more in proportion to their body size
- Their behavior can expose them more to chemicals and organisms
Exposure Pathway of Environmental Hazards affecting Children’s Health

Studies on Children’s Health and Environment
The Mother and Child Environmental Health study ('06- )
Prospective hospital- and community-based cohort study designed to investigate the effects of pre- and post-natal environmental exposures on growth, development, and health from early fetal life into young adulthood.

Studies on Children’s Health and Environment

**Stage 1. At Obstetrics**
- Recruitment
  - Explanation of study purpose and incentives
  - Informed consent
- First trimester screening exam
  - Collection of Questionnaires
  - Confirmation of first screening exam schedule
  - Collection of biological samples: Blood, Urine
  - Ultrasonography, Dietary record: 24h recall
- Third trimester screening exam
  - Maternal ASQ test
  - Ultrasonography

**Stage 2. At Delivery Room**
- Delivery
  - Contact with mother before delivery
  - Sending cooperative letter to other hospital
  - Collection of biological samples
  - (Blood, Urine, Placenta, Cord blood, Breast milk)
  - Confirmation of birth outcomes

**Stage 3. At Pediatrics**
- 2 month
  - Questionnaires
- 6 month
  - Questionnaires
  - Bayley test
- 1 year
  - Pediatric screening test
  - Collection of biological samples: Urine, Blood
  - Dietary record: 24h recall
- 3 year
  - Questionnaires
  - Bayley test
  - Collection of biological samples: Urine, Blood
  - Dietary record: 24h recall
- 5 year
  - Collection of biological samples: Urine, Blood
  - Dietary record: 24h recall
Studies on Children’s Health and Environment

Study of Risk Assessment of Children’s Products (‘07-)
Exposure and Risk assessment of hazardous chemicals in children’s products (toy, stationary etc.) that children often use or contact in order to manage environmental hazardous factors and to protect children’s health

Framework for the risk assessment of hazardous chemicals in children’s products

1. Priority Setting
2. Artificial Saliva, Gastric juice, Sweat, Water
3. (Selection of Products)
4. Exposure Amount Calculation
5. Exposure Scenario
6. Hazard Identification

Studies on Children’s Health and Environment
Studies on Children’s Health and Environment

Exposure Scenario & Algorithm

[Basic Exposure Algorithm]

\[
\text{Daily exposure amount (mg/kg/day)} = \frac{\text{Migration rate of chemicals} \times \text{exposure time} \times \text{other factors}}{\text{Body weight}}
\]

Oral Exposure

Mouthing

\[\text{ADD} = \frac{M \times ET \times SA \times AD}{BW}\]

Hand-to-Mouth

\[\text{ADD} = \frac{M \times ET \times AD \times SA \times \text{other factors}}{BW}\]
Studies on Children’s Health and Environment

The process of exposure assessment (Phthalates in Children’s products) (Probabilistic approach - Using Monte Carlo Simulation)

Body weight (kg)
Active time (hr/day)
Mouthing time (min/hr)

Migration rate (ug/cm²/min) = Mouthing time (min/hr) X Active time (hr/day) X Mouthing area (cm²) / Body weight (kg)
Environmental Hazards

Exposure Assessment

Hazard Identification
Toxicity Study (Dose-Response)

Health Risk Assessment

Mechanism?
Social/Cultural Interaction?
Gene-Environmental Interaction?
Sensitivity factors?
Life Style/Pattern?
Metabolism?

Environmental Disease
Atopy, Asthma,
Neuro-development disorders

Identification of Cause-Effect

Health Effect Research

Identification and Prevention of Children’s Health Risk
5. Environmental Toxicity Research

- Development and Standardization of Eco-toxicity testing and assessments using indigenous animals
  - To develop new test models and new test methods

- Chemical Hazard Assessment using *in vitro* Alternative Toxicity Testing Methods
  - To advance testing tools and methods

- Toxicity Research at the Molecular and Biochemical Level using the Tools of Toxicogenomics
  - To introduce and apply a new test tool

- Toxicity Testing and Hazard Assessment of Manufactured Nanomaterials
  - To assess a new issue compounds

- Fundamental Research for Whole Effluent Toxicity and Management
  - To assess an environmental matrix

- Ecological Toxicity Testing Labs and Aquatic Organisms Rearing Rooms (eg. Fish and Waterflea)
- Human Health Toxicity Research Labs and Experimental Animals Rearing Rooms (eg. Rats and Mouse)
Future Direction

Continuous Monitoring Basis
- Assessment on chronic health impact due to environmental hazardous factors

Defined Connection between Hazards Exposure and Health Impact
- To interpret the cause and effect

Risk-based Research
- To prevent the environmental risk

Comprehensive Use of Research Results