Korean National Environmental Health Survey (KoNEHS)
The past, Present and Future of Human Bio-monitoring in Korea

Suejin Kim & Yong-Wook Baek
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02_ Survey Contents and Process
03_ Results from the 1st and 2nd KoNEHS
04_ Start-up 3rd stage of KoNEHS
05_ Further study
Korean National Environmental Health Survey (KoNEHS)

Introduction and Background
Environmental Policy Paradigm shift - towards “Receptor” and “Health”

- Limitation of environmental policy focused on pollution sources and media
  - Increased environmental diseases: Atopic, Asthma, itai-itai disease and etc.
  - Emerging health risk factors: Asbestos, Radon, Climate change, Microorganism

- Increased Public Awareness and public expectation of environmental policy
  - Wide spread of LOHAS (Lifestyles of Health and Sustainability)

Media Base
- View-point: Air, Water, Soil
- Approach: Case - Based
- Policy: Expansion of facilities

Receptor Base
- View-point: Receptor
- Approach : Integral and strategic
- Policy: Surveillance, RA
Environmental Health Polity & DATA

Establishment and Support of Environmental Health Polity

Understanding Of the national and regional environmental health status

Identifying the correlation between exposure and health effects

Prioritizing basic plans & Decision making

Increasing demand for fundamental information

- Human exposure levels of contaminants
- Exposure factors and pathway
- Status of disease occurrence due to environmental hazardous factors
- Risk assessment, etc
History of Human Bio-monitoring in Korea

1st stage of KoNEHS
- over 19 aged: 6,311
- Questionnaire: 146 items
- Chemicals analysis: 16 items
  Metals (5), PAHs (2), Cotinine, ECDs (2), Pesticides (1), VOCs (5)

2nd stage of KoNEHS
- over 19 aged: 6,478
- Questionnaire: 142 items
- Clinical exams: 19 items
- Chemicals analysis: 21 items
  Metals (3), PAHs (4), Cotinine, ECDs (7), Pesticides (1), VOCs (5)

3rd stage of KoNEHS
- over 3 aged: 5,523
- Questionnaires: 148
- Clinical exams: 16 items
- Chemical analysis: 26 items
  Metals (3), PAHs (4), Cotinine, ECDs (15), Pesticides (1), VOCs (2)

Korean National Survey for Environmental Pollutants in Human Body
- over 19 aged: 9,500
- Questionnaire: <111 items
- Chemical analysis: <13 items
  Metals, PAHs, ECDs, etc.

Environmental Health Act
- Release of the National Statistics
  - Representative value and Percentiles of 16 chemicals
  - Open the raw-data ('13)
- Release of the National Statistics
  - Representative value and Percentiles of 21 chemicals
  - Online open the raw-data ('16)
Korean National Environmental Health Survey (KoNEHS)
@ Survey Contents (1st and 2nd)
Survey Process

Survey sampling

Field Survey

Biological sample analysis

Clinical analysis
Sampling Design

1\textsuperscript{st} STAGE (2009–2011)

- Sampling Site: 350 Collection Sites
- Sample size: 6,000 ( > 20 years old), 18 persons/site

2\textsuperscript{nd} STAGE (2012–2014)

- Sampling Site: 400 Collection Sites
- Sample size: 6,000 ( > 20 years old), 15 persons/site

3\textsuperscript{rd} STAGE (2015-2017)

“only adult” expanded to “over 3 age”

- 3 to 18 age : $n = \text{about 2,000}$
- over 19 age : $n = \text{about 3,500}$
**Sampling Design**

1st : Regional stratification
- 7 metropolitan cities (including the capital)
- 9 provinces
- 1 Coastal Area (West/South/East sea area)
- 1 urban air monitoring station

2nd : Socio-economic stratification
- House type (Apartment, general house....)
- Urban housing/ Rural (farming, fishing, etc)

Total
60 Layers
# Questionnaires

<table>
<thead>
<tr>
<th>Section</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Household information (20)</strong></td>
<td></td>
</tr>
<tr>
<td>Housing characteristics [3]</td>
<td>Distance from road / traffic information</td>
</tr>
<tr>
<td>Indoor environment [13]</td>
<td>Type of housing / construction year / type of air conditioning / ventilation method / drug use for vermin control</td>
</tr>
<tr>
<td>Food security [3]</td>
<td>Storage container / purchasing route</td>
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<tr>
<td><strong>Socioeconomic characteristics [1]</strong></td>
<td>Household monthly income</td>
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<td><strong>Individual information (122)</strong></td>
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<td>Personal information [11]</td>
<td>Name / gender / date of birth / number of family</td>
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<tr>
<td>Transportation [8]</td>
<td>Public transportation use / type of transportation used / average time to using transportation</td>
</tr>
<tr>
<td>Indoor environment [15]</td>
<td>Living duration / type of air conditioning(except house), ventilation methods / remodeling status of living place</td>
</tr>
<tr>
<td>Health behavior [32]</td>
<td>Smoking habits / smoking history / passive smoking / alcohol consumption drinking history, frequencies and amount / exercise / cosmetics / time activities on week day and weekend</td>
</tr>
<tr>
<td>Food security [26]</td>
<td>Type of drinking water / intake of certain food</td>
</tr>
<tr>
<td>Dietary supplement &amp; medicine use [5]</td>
<td>Medicine use / oriental medicine use</td>
</tr>
<tr>
<td><strong>Socioeconomic &amp; demographic [6]</strong></td>
<td>Level of education / marital status / economic status / occupation</td>
</tr>
<tr>
<td>Reproductive health [3]</td>
<td>Pregnancy history / delivery history / menopause</td>
</tr>
<tr>
<td>Dietary behavior [16]</td>
<td>Recent dietary behavior/height, weight / health tonic &amp; digestive medicine use</td>
</tr>
</tbody>
</table>
Korean National Environmental Health Survey (KoNEHS)

@ Results from the KoNEHS
**Participant Characteristic**

- Stage 1: Persons aged 19 years and older (n=6,311, male=2,928, female=3,383)
- Stage 2: Persons aged 19 years and older (n=6,478, male=2,774, female=3,704)
Concentrations of Heavy metals
- Blood Lead Levels (µg/dL)

<table>
<thead>
<tr>
<th>Total</th>
<th>Male</th>
<th>Female</th>
<th>19-29</th>
<th>30-39</th>
<th>40-49</th>
<th>50-59</th>
<th>60-69</th>
<th>70+</th>
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<tbody>
<tr>
<td>1.77</td>
<td>1.31</td>
<td>1.46</td>
<td>1.46</td>
<td>1.75</td>
<td>1.83</td>
<td>2.16</td>
<td>2.20</td>
<td>2.30</td>
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<tr>
<td>1.94</td>
<td>1.98</td>
<td>2.30</td>
<td>2.30</td>
<td>2.21</td>
<td>2.21</td>
<td>2.25</td>
<td>2.30</td>
<td>2.30</td>
</tr>
<tr>
<td>2.16</td>
<td>2.00</td>
<td>2.00</td>
<td>2.00</td>
<td>2.00</td>
<td>2.00</td>
<td>2.00</td>
<td>2.00</td>
<td>2.00</td>
</tr>
</tbody>
</table>

1st stage vs 2nd stage
Concentrations of Heavy metals
- Blood Mercury Levels (µg/L)

<table>
<thead>
<tr>
<th></th>
<th>1st stage</th>
<th>2nd stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>3.08</td>
<td>3.11</td>
</tr>
<tr>
<td>Male</td>
<td>3.65</td>
<td>2.62</td>
</tr>
<tr>
<td>Female</td>
<td>2.70</td>
<td>2.37</td>
</tr>
<tr>
<td>19-29</td>
<td>3.18</td>
<td>3.59</td>
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<tr>
<td>30-39</td>
<td>3.45</td>
<td>3.75</td>
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<tr>
<td>40-49</td>
<td>3.11</td>
<td>3.64</td>
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<tr>
<td>50-59</td>
<td>3.23</td>
<td>3.05</td>
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<tr>
<td>60-69</td>
<td>2.54</td>
<td>2.58</td>
</tr>
<tr>
<td>70+</td>
<td>4.80</td>
<td>4.29</td>
</tr>
<tr>
<td>Urban</td>
<td>3.11</td>
<td>3.11</td>
</tr>
<tr>
<td>Rural</td>
<td>3.05</td>
<td>2.51</td>
</tr>
<tr>
<td>Coastal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Total
- Male
- Female
- 19-29
- 30-39
- 40-49
- 50-59
- 60-69
- 70+
- Urban
- Rural
- Coastal
Concentrations of Environmental Phenols

- Urinary Bisphenol-A Levels (µg/L)
Concentrations of Phthalate

- Urinary DEHP (MEHHP+MEOHP) metabolites Levels (µg/L)

<table>
<thead>
<tr>
<th></th>
<th>1st stage</th>
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</tr>
</thead>
<tbody>
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<td>Male</td>
<td>37,6</td>
<td>30,6</td>
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<tr>
<td>Female</td>
<td>34,8</td>
<td>28,6</td>
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<td>19-29</td>
<td>35,3</td>
<td>27,6</td>
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<tr>
<td>30-39</td>
<td>34,1</td>
<td>27,4</td>
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<tr>
<td>40-49</td>
<td>36,8</td>
<td>29,3</td>
</tr>
<tr>
<td>50-59</td>
<td>35,0</td>
<td>30,7</td>
</tr>
<tr>
<td>60-69</td>
<td>38,1</td>
<td>31,3</td>
</tr>
<tr>
<td>70+</td>
<td>41,0</td>
<td>33,9</td>
</tr>
<tr>
<td>Urban</td>
<td>35,7</td>
<td>29,3</td>
</tr>
<tr>
<td>Rural</td>
<td>42,9</td>
<td>32,4</td>
</tr>
<tr>
<td>Coastal</td>
<td>32,3</td>
<td>32,3</td>
</tr>
</tbody>
</table>
Data Comparison (HBM & Other Countries)

**Blood Lead (µg/dL)**
- Korea ('12-'14)
- USA ('11-'12)
- Canada ('12-'13)
- German ('98)

**Blood Mercury (µg/L)**
- Korea ('12-'14)
- USA ('11-'12)
- Canada ('12-'13)
- German ('98)

USA CDC
('12, Guidance level for children)

- **Blood Lead**
  - GM: 1.94, 0.58, 1.10
  - 95th: 1.09

- **Blood Mercury**
  - GM: 3.11, 0.86, 0.79, 0.58
  - 95th: 2.30

Japan: 8.5 µg/L ('15)
Hong-Kong: 3.65 µg/L ('06)
Data Comparison (HBM & Other Countries)

**Urinary Mercury (µg/L)**

- Korea('12-'14)
- USA('11-'12)
- Canada('12-'13)
- Germany('98)

**HBM-I (Adults)**

- GM: 0.38, 0.35, 0.43
- 95th: 1.27, 1.93, 2.00
- 95th: 3.30

**HBM-II (Adults)**

- GM: 0.38, 0.19, 0.39, 0.23
- 95th: 1.36, 1.08, 0.96

**Urinary Cadmium (µg/L)**

- Korea('12-'14)
- USA('11-'12)
- Canada('12-'13)
- Germany('98)

**HBM-I (Adults)**

- GM: 0.38, 0.35, 0.43
- 95th: 1.27, 1.93, 2.00
- 95th: 3.30

**HBM-II (Adults)**

- GM: 0.38, 0.19, 0.39, 0.23
- 95th: 1.36, 1.08, 0.96
Data Comparison (HBM & Other Countries)

**Urinary Bisphenol-A (µg/L)**
- Korea('12-'14)
- USA('11-'12)
- Canada('12-'13)

**Urinary DEHP metabolites (µg/L)**
- Korea('12-'14)
- USA('11-'12)
- Canada('12-'13)
The Risk of Mercury Exposure
- Exceed the HBM-I / II Levels

Stage 1 (2009~2011)

- 15 µg/L (HBM-II)  
  - N = 1,630  
  - (25.8%)

- 5 µg/L (HBM-I)  
  - N = 4,560  
  - (72.3%)

- 0 µg/L  
  - N = 5,003  
  - (77.2%)

Stage 2 (2012~2014)

- 15 µg/L (HBM-II)  
  - N = 1,369  
  - (21.1%)

- 5 µg/L (HBM-I)  
  - N = 106  
  - (1.7%)

- 0 µg/L  
  - N = 5,003  
  - (77.2%)
The Risk of Mercury Exposure
- Excess rate of HBM-II Level

<table>
<thead>
<tr>
<th>Gender</th>
<th>Age Group</th>
<th>1st Stage</th>
<th>2nd Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>19-29</td>
<td>79.3 %</td>
<td>2.8 %</td>
</tr>
<tr>
<td>Female</td>
<td>19-29</td>
<td>62.3 %</td>
<td>0.8 %</td>
</tr>
<tr>
<td></td>
<td>30-39</td>
<td>37.7 %</td>
<td>7.5 %</td>
</tr>
<tr>
<td></td>
<td>40-49</td>
<td>20.7 %</td>
<td>8.5 %</td>
</tr>
<tr>
<td></td>
<td>50-59</td>
<td>19.0 %</td>
<td>19.0 %</td>
</tr>
<tr>
<td></td>
<td>60-69</td>
<td>43.0 %</td>
<td>26.4 %</td>
</tr>
<tr>
<td></td>
<td>70+</td>
<td>22.3 %</td>
<td>34.0 %</td>
</tr>
</tbody>
</table>

- Gender-specific
- Age-specific
The Risk of Mercury Exposure - Fish Consumption from Excess HBM-II Level participant

- Large Fish Consumption
- Small Fish Consumption
- Shellfish Consumption

1st stage
2nd stage

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Large Fish Consumption</th>
<th>Small Fish Consumption</th>
<th>Shellfish Consumption</th>
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<tr>
<td>No</td>
<td>72,7</td>
<td>65,1</td>
<td>56,6</td>
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<tr>
<td>1/M.</td>
<td>11,3</td>
<td>13,2</td>
<td>52,9</td>
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<tr>
<td>2-3/M.</td>
<td>9,9</td>
<td>14,2</td>
<td>33,1</td>
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<tr>
<td>1/W.</td>
<td>3,3</td>
<td>5,7</td>
<td>25,5</td>
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<tr>
<td>2-3/W.</td>
<td>2,5</td>
<td>8,5</td>
<td>17,9</td>
</tr>
<tr>
<td>No</td>
<td>2,5</td>
<td>13,2</td>
<td>6,6</td>
</tr>
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<td>Monthly</td>
<td>24,5</td>
<td>13,2</td>
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</tr>
<tr>
<td>Weekly</td>
<td>71,1</td>
<td>60,4</td>
<td></td>
</tr>
<tr>
<td>Daily</td>
<td>6,6</td>
<td></td>
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</table>

- 1st stage
- 2nd stage

- No
- Monthly
- Weekly

- 100,0
- 90,0
- 80,0
- 70,0
- 60,0
- 50,0
- 40,0
- 30,0
- 20,0
- 10,0
- 0,0
Korean National Environmental Health Survey (KoNEHS)

@ Start-up 3rd stage of KoNEHS
Pilot Study - Korean Environmental Health Survey in Children & Adolescent


Study Goal: Design and Feasibility of the Children/Adolescent’s Env. Health Survey of National scale

Prepared 3rd stage of KoNEHS

Taeget : over 3 to 18 aged (n= about 2,400)
9 Chemicals analysis
## Pilot Study

- **Korean Environmental Health Survey in Children & Adolescent**

### Metabolites of Phthalate (μg/L)

<table>
<thead>
<tr>
<th>Year</th>
<th>Age</th>
<th>B-Pb (μg/dL)</th>
<th>B-Hg (μg/L)</th>
<th>U-Cd (μg/L)</th>
<th>U-BPA (μg/L)</th>
<th>MEHHP</th>
<th>MEHHP</th>
<th>MEOHP</th>
<th>MEOHP</th>
<th>MECPP</th>
<th>MECPP</th>
<th>DBP</th>
<th>DBP</th>
<th>BBP</th>
<th>BBP</th>
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<tr>
<td>KorEHS-C (Korea)</td>
<td>2014</td>
<td>Over 3-5</td>
<td>1.34</td>
<td>1.64</td>
<td>0.39</td>
<td>2.33</td>
<td>77.77</td>
<td>43.49</td>
<td>34.28</td>
<td>65.47</td>
<td>55.50</td>
<td>7.46</td>
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<td>2012</td>
<td>Over 6-12</td>
<td>1.26</td>
<td>1.93</td>
<td>0.31</td>
<td>1.50</td>
<td>64.29</td>
<td>34.47</td>
<td>29.82</td>
<td>59.39</td>
<td>68.26</td>
<td>7.58</td>
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<td></td>
<td>2013</td>
<td>Over 12-18</td>
<td>1.11</td>
<td>1.90</td>
<td>0.23</td>
<td>1.31</td>
<td>48.66</td>
<td>28.28</td>
<td>20.38</td>
<td>41.15</td>
<td>55.87</td>
<td>6.82</td>
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<td>NHANES 4th (USA)</td>
<td>2009</td>
<td>1-5</td>
<td>1.17</td>
<td>-</td>
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<td>-</td>
<td>-</td>
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<tr>
<td></td>
<td>2010</td>
<td>6-11</td>
<td>0.84</td>
<td>-</td>
<td>0.06</td>
<td>1.81</td>
<td>24.78</td>
<td>15.0</td>
<td>9.78</td>
<td>27.7</td>
<td>21.7</td>
<td>11.6</td>
<td></td>
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<td></td>
<td></td>
<td>12-19</td>
<td>0.68</td>
<td>0.53</td>
<td>0.08</td>
<td>2.11</td>
<td>25.3</td>
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<td>18.9</td>
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<td>CHMS (Canada)</td>
<td>2009</td>
<td>3-5</td>
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<td>0.27</td>
<td>0.23</td>
<td>1.4</td>
<td>44</td>
<td>27</td>
<td>17</td>
<td>-</td>
<td>32</td>
<td>17</td>
<td></td>
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<tr>
<td></td>
<td>2011</td>
<td>6-11</td>
<td>0.79</td>
<td>0.28</td>
<td>0.25</td>
<td>1.4</td>
<td>39</td>
<td>24</td>
<td>15</td>
<td>-</td>
<td>36</td>
<td>19</td>
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<td></td>
<td></td>
<td>12-19</td>
<td>0.71</td>
<td>0.27</td>
<td>0.27</td>
<td>1.3</td>
<td>26</td>
<td>16</td>
<td>10</td>
<td>-</td>
<td>28</td>
<td>12</td>
<td></td>
<td></td>
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<tr>
<td>HBM</td>
<td>2015</td>
<td>I</td>
<td>-</td>
<td>5</td>
<td>0.5</td>
<td>100</td>
<td>500</td>
<td>-</td>
<td>-</td>
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<tr>
<td></td>
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<td>II</td>
<td>15</td>
<td>2</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
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</tr>
</tbody>
</table>

### Geomean & Percentile 95th

- **B-Lead (μg/dL)**
  - Over 3~5 old: 2.28 (Percentile 95th: 1.34)
  - Over 6-12: 1.64 (Percentile 95th: 1.11)
  - Over 12-18: 1.37 (Percentile 95th: 1.11)

- **B-Mercury (μg/L)**
  - Over 3~5 old: 0.39 (Percentile 95th: 0.23)
  - Over 6-12: 1.50 (Percentile 95th: 0.23)
  - Over 12-18: 1.37 (Percentile 95th: 0.23)

- **U-Cadmium (μg/L)**
  - Over 3~5 old: 2.33 (Percentile 95th: 1.33)
  - Over 6-12: 1.50 (Percentile 95th: 1.33)
  - Over 12-18: 1.37 (Percentile 95th: 1.33)
Distribution of participant’s Blood Mercury Level (µg/L)

3rd stage of KoNEHS (2015-2017)
- Concept & Plan of 3rd stage

Target

Expend Population
- Children
- Adolescent
- Adult

Survey Expansion

Exposure Search
- Extended chemicals
- Route of Exposure

Data Shearing

Data

- Open Raw-data
- Paper competition

National scale Environmental Health Survey (over 3 years old)
3rd stage of KoNEHS (2015-2017)  
- Sampling Design of 3 type populations

Population / Sampling Frame
• Population: Over 3 years old
• Sex: male / female

Error Range & Sample Size
• Error Range: Within 5%
• Total population: **5,500 people**
  - (Children) about 500 people
  - (Adol.) about 1,500 people
  - (Adult) about 3,500 people

(Children) Multi-stratified sampling
Stratification: 16 Regional
1st: Kindergarten, Day-care center
2nd: Infant (over 3 years old)

(Adelescent) Multi-stratified sampling
Stratification: 16 Regional
1st: School
2nd: Class

(Adult) Multi-stratified sampling
Stratification: 16 Regional
1st: Sample of Enumeration district
2nd: House

※ The number of children using [Kindergarten] and [Day-care Center] comparison to ’14 demographic statistics (Autumn): **91%**
※ The number of [Elementary / Middle / High school’s students] comparison to ’14 demographic statistics (Autumn): **99%**
3rd stage of KoNEHS (2015-2017) - Chemical Selection

- Reflect Public Interest & Including substitute of bisphenol-A
  - Considering [Life environment] & [Amount of chemicals in circulation]
  - Substances which could be harmful depending on exposure level to human body

• Necessary for selecting chemicals to deal with health issues
  → Using of hand disinfectants increased due to expand of MERS
  → 3 types of Paraben (methyl-, ethyl- and propyl-)

<table>
<thead>
<tr>
<th>품목</th>
<th>증가률</th>
</tr>
</thead>
<tbody>
<tr>
<td>홍시 마스크</td>
<td>Sales growth(%)</td>
</tr>
<tr>
<td>Nonmedical Hand Washes</td>
<td>2,373 %</td>
</tr>
<tr>
<td>거품형 손세정제</td>
<td>1044 %</td>
</tr>
<tr>
<td>물비누</td>
<td>199 %</td>
</tr>
<tr>
<td>Hand disinfectants</td>
<td>66,583 %</td>
</tr>
<tr>
<td>Liquid hand soap</td>
<td>1,727 %</td>
</tr>
<tr>
<td>Group</td>
<td>Target Chemical or Metabolite</td>
</tr>
<tr>
<td>----------------------------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>Metals (3)</td>
<td>Lead</td>
</tr>
<tr>
<td></td>
<td>Mercury</td>
</tr>
<tr>
<td></td>
<td>Cadmium</td>
</tr>
<tr>
<td>PAHs (4)</td>
<td>1-Hydroxypyrene</td>
</tr>
<tr>
<td></td>
<td>2-Napthol</td>
</tr>
<tr>
<td></td>
<td>1-Hydroxyphenanthrene</td>
</tr>
<tr>
<td></td>
<td>2-Hydroxyfluorene</td>
</tr>
<tr>
<td>Environmental Tobacco (1)</td>
<td>Cotinine</td>
</tr>
<tr>
<td>Environmental Phenols (7)</td>
<td>Bisphenol-A</td>
</tr>
<tr>
<td></td>
<td>Bisphenol-F</td>
</tr>
<tr>
<td></td>
<td>Bisphenol-S</td>
</tr>
<tr>
<td></td>
<td>methyl-Paraben</td>
</tr>
<tr>
<td></td>
<td>ethyl-Paraben</td>
</tr>
<tr>
<td></td>
<td>propyl-Paraben</td>
</tr>
<tr>
<td></td>
<td>Triclosan</td>
</tr>
<tr>
<td>Phthalate (8)</td>
<td>mono(2-ethyl-5-hydroxyhexyl) phthalate</td>
</tr>
<tr>
<td></td>
<td>mono(2-ethyl-5-oxohexyl) phthalate</td>
</tr>
<tr>
<td></td>
<td>mono(2-ethyl-5-carboxypentyl) phthalate</td>
</tr>
<tr>
<td></td>
<td>mono-n-butyl phthalate</td>
</tr>
<tr>
<td></td>
<td>mono-benzyl phthalate</td>
</tr>
<tr>
<td></td>
<td>mono(2,6-methyl-6-carboxyhexyl) phthalate</td>
</tr>
<tr>
<td></td>
<td>mono(2,7-methyl-7-carboxyheptyl) phthalate</td>
</tr>
<tr>
<td></td>
<td>Mono(3-carboxypropyl) phthalate</td>
</tr>
<tr>
<td>Pyrethoid (1)</td>
<td>3-Phenoxybenzoic acid</td>
</tr>
<tr>
<td>VOCs (2)</td>
<td>t,t-Muconic acid</td>
</tr>
<tr>
<td></td>
<td>N-Acetyl-S-(benzyl)-L-cystein</td>
</tr>
</tbody>
</table>
3rd stage of KoNEHS (2015-2017)
- Poster & Leaflet (Ver. KOR)

당신은 우리나라 국민 10,000명을 대표합니다.

국민환경보건 기초조사

조사기간
2015.8 ～2017.12

조사대상
전 국민 대표으로 표본선택된 어린이·청소년·성인 총 5,500명

조사내용
환경노출관련 설문조사
설문지 및 10종 답변지
환경오염물질 26종 등도 분석

www.ier.or.kr
www.anmsalgh.kr

본 조사는 환경오염물
해태재해 피대책의 핵심적조사입니다.

모두, 국민환경보건 기초조사는 어린이가 교시를 하시는

무엇을 조사하나요?

- 환경오염물질의 성장과 성장에
  영향을 미치는 유전자에 영향을
  미치는 물질
- 환경오염물질의 성장과 성장에
  영향을 미치는 유전자에 영향을
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  미치는 물질

조사완료 후 언제까지 돕기요?

- 조사완료 후 1주일 내에, 응답자로부터
  환경오염물질의 성장과 성장에
  영향을 미치는 유전자에 영향을
  미치는 물질
- 응답자로부터 1주일 내에, 응답자로부터
  환경오염물질의 성장과 성장에
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- 응답자로부터 1주일 내에, 응답자로부터
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  영향을 미치는 유전자에 영향을
  미치는 물질

이외 같은 환경오염물질들은
수질, 화학, 바람 등 다양한 영향을 주며, 또한
환경오염물질은 본 조사의 결과에 반영될 수 있습니다.
### 3rd stage of KoNEHS (2015-2017) - Questionnaire (Ver. KOR)

#### Basic Information

1. Type of Study: Questionnaire (Ver. KOR)
2. Title: 3rd stage of KoNEHS (2015-2017)
3. Language: Korean

#### General Instructions

1. Please answer the questions accurately.
2. You may refer to the help section if needed.
3. Your answers will be used for research purposes.

#### Table: Questions

<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What is your gender?</td>
<td>Male, Female</td>
</tr>
<tr>
<td>2. What is your age?</td>
<td>Below 18, 18-24, 25-34, 35-44, 45-54, 55-64, 65 or older</td>
</tr>
<tr>
<td>3. What is your education level?</td>
<td>Primary, Secondary, High School, College, University, Graduate</td>
</tr>
</tbody>
</table>

#### Help Section

If you have any questions, please refer to the help section.
Korean National Environmental Health Survey (KoNEHS)

@ Further study
Further Study
- Thinking about Next Human Bio-monitoring

Guideline for chemical concentration levels in body
Necessary for establishing standard guideline of environmental harmful chemicals considering characteristics
☞ Considering health impact of people who participated KoNEHS & standard of communication
☞ Considering necessary of site-specific environmental health survey when group size influence factors found

Pilot study for non research chemicals using household item
- POPs, Chlorophenols, Benzophenol and etc.
- Consider simultaneous determination & using little sample
- Develop SOP, QA/QC, Specimen management manuals

Korean Reference value of Creatinine
- 1st & 2nd participant’s creatinine levels analysis ($n=12,789$)
- Calculate geometric mean value and percentile 95
- Using the correction of chemical concentrations in urine

Intergrated analysis of the 2nd stage survey results
- Conducting an in-depth study on the identification of exposure pathways and related variables
Further Study
- Prepare next survey, Evaluate POPs levels in our body
감사합니다

“감사합니다” means “Thank you” / “Vielen Dank”