

Korean National Environmental Health Survey (KoNEHS)

The past, Present and Future of Human Bio-monitoring in Korea

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mev 환경부·국립환경과학원

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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)



Environmental Health Polity & DATA

Establishment and Support of Environmental Health Polity

Understanding
Of the national
and regional
environmental
health status

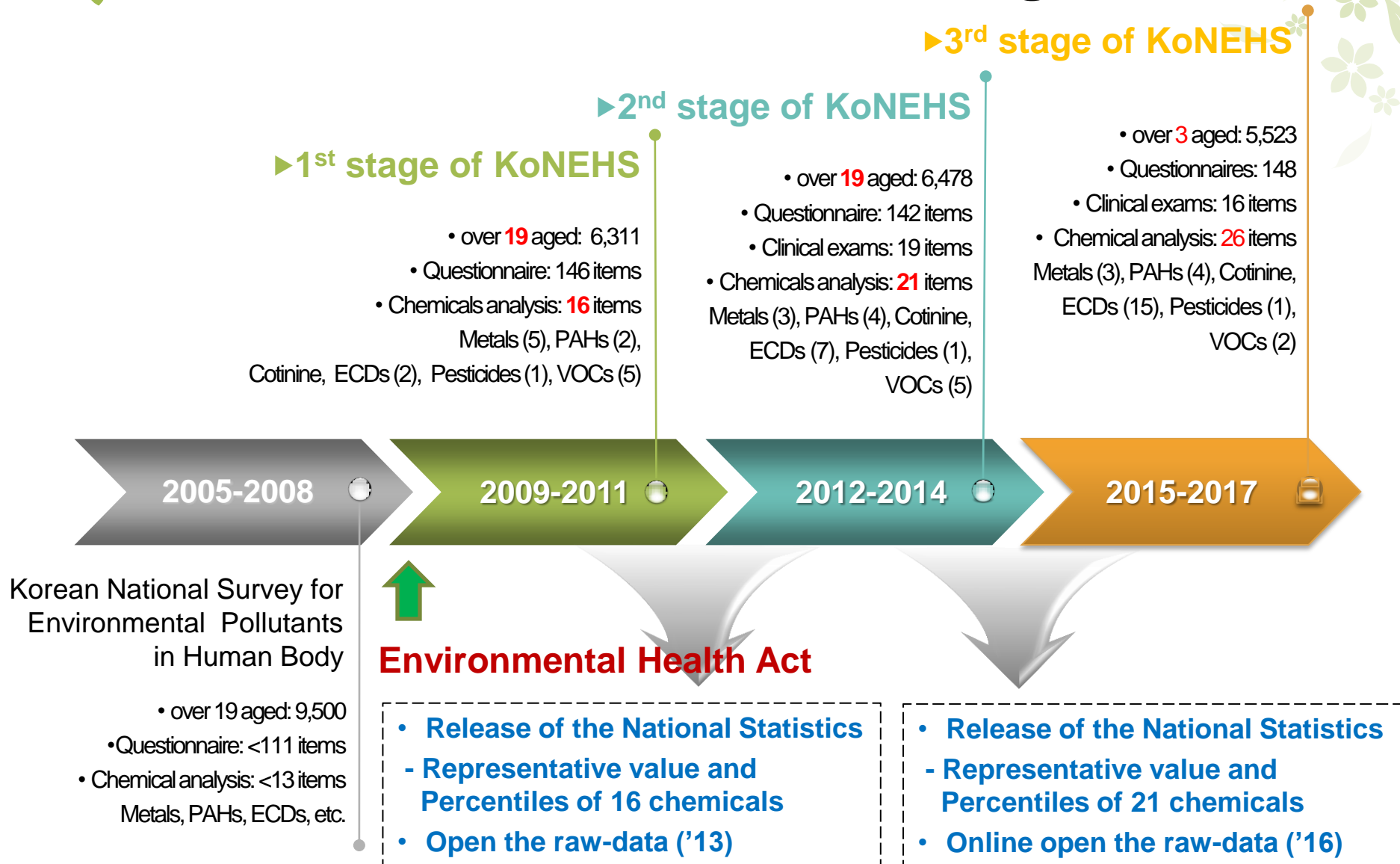
Identifying
the correlation
between
exposure and
health effects

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



Korean National Environmental Health Survey (KoNEHS) @ Survey Contents (1st and 2nd)



국민환경보건기초조사



Survey Process

Survey sampling



2012년 국민환경보건조사 가주 영부

조사유형		조사방법		조사대상	
조사일	조사시간	조사장소	조사대상	조사대상	조사대상
가주	영부	가주영부	가주영부	가주영부	가주영부

구분	구분	구분	구분	구분	구분	구분	구분	구분	구분
가주	영부	가주영부	가주영부	가주영부	가주영부	가주영부	가주영부	가주영부	가주영부

Field Survey



NIER

Biological sample analysis



Clinical analysis



Sampling Design

1st STAGE (2009–2011)

- * Frame: Population & Housing Census (2005)
- * Sampling Site: 350 Collection Sites
- Sample size: 6,000 (> 20 years old), 18 persons / site

2nd STAGE (2012–2014)

- * Frame: Population & Housing Census (2010)
- * Sampling Site: 400 Collection Sites
- Sample size: 6,000 (> 20 years old), 15 persons / site

3rd STAGE (2015-2017)

- “only adult” ⇒ expanded to “over 3 age”
- 3 to 18 age : $n =$ about 2,000
 - over 19 age : $n =$ about 3,500



Sampling Design

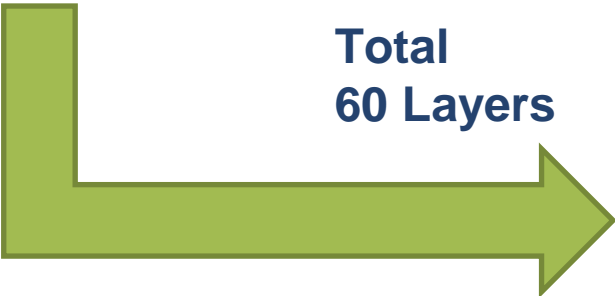
1st : Regional stratification

- 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



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

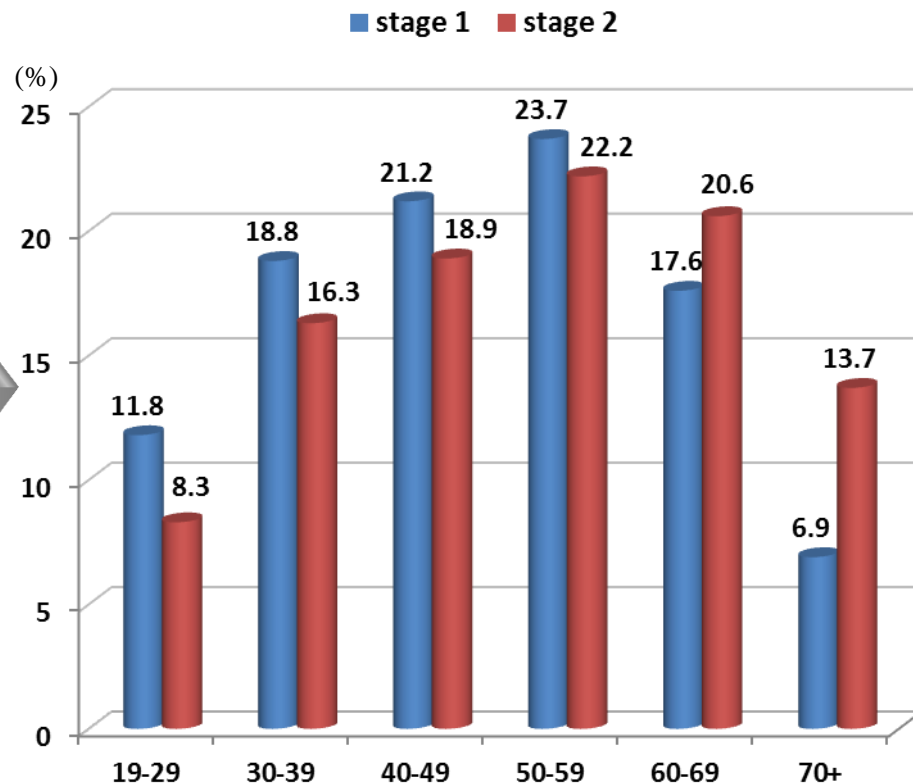
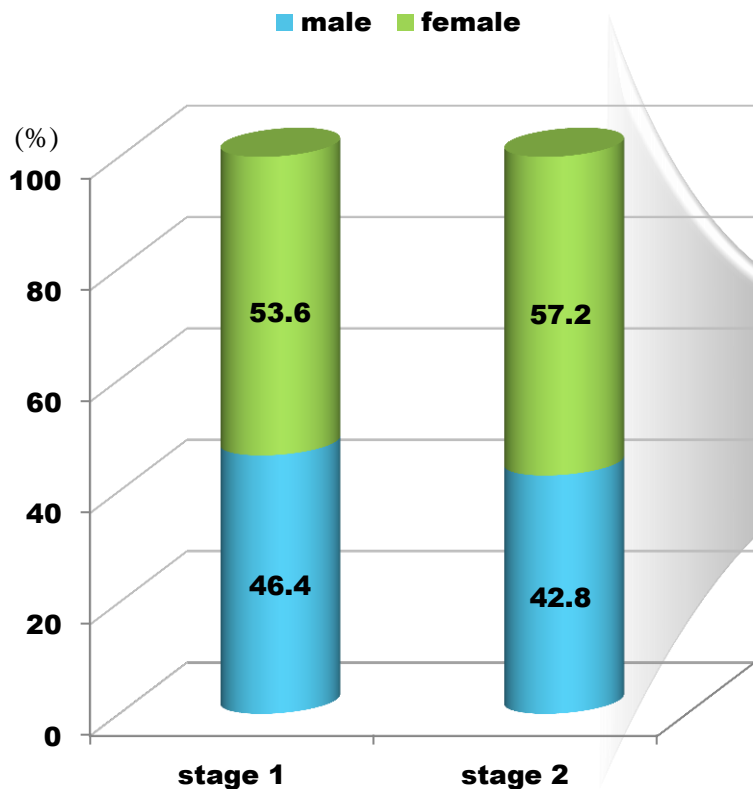


Korean National Environmental Health Survey (KoNEHS) @ Results from the KoNEHS



Participant Characteristic

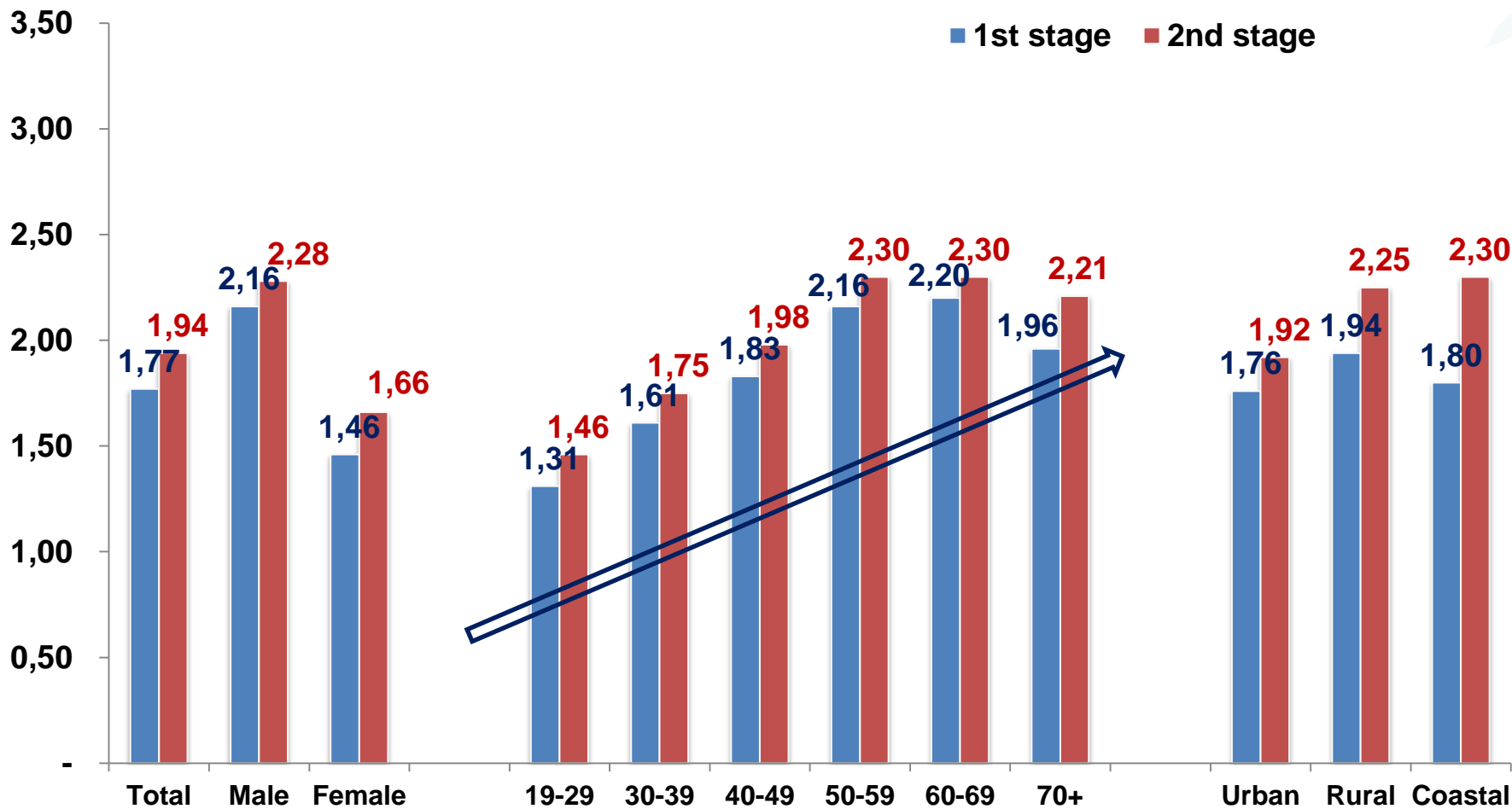
- Stage 1 : Persons aged 19 years and older (n=6,311, male=2,928, female=3,383)
- Stage 2 : Persons aged 19 years and older (n=6,478, male=2,774, female=3,704)





Concentrations of Heavy metals

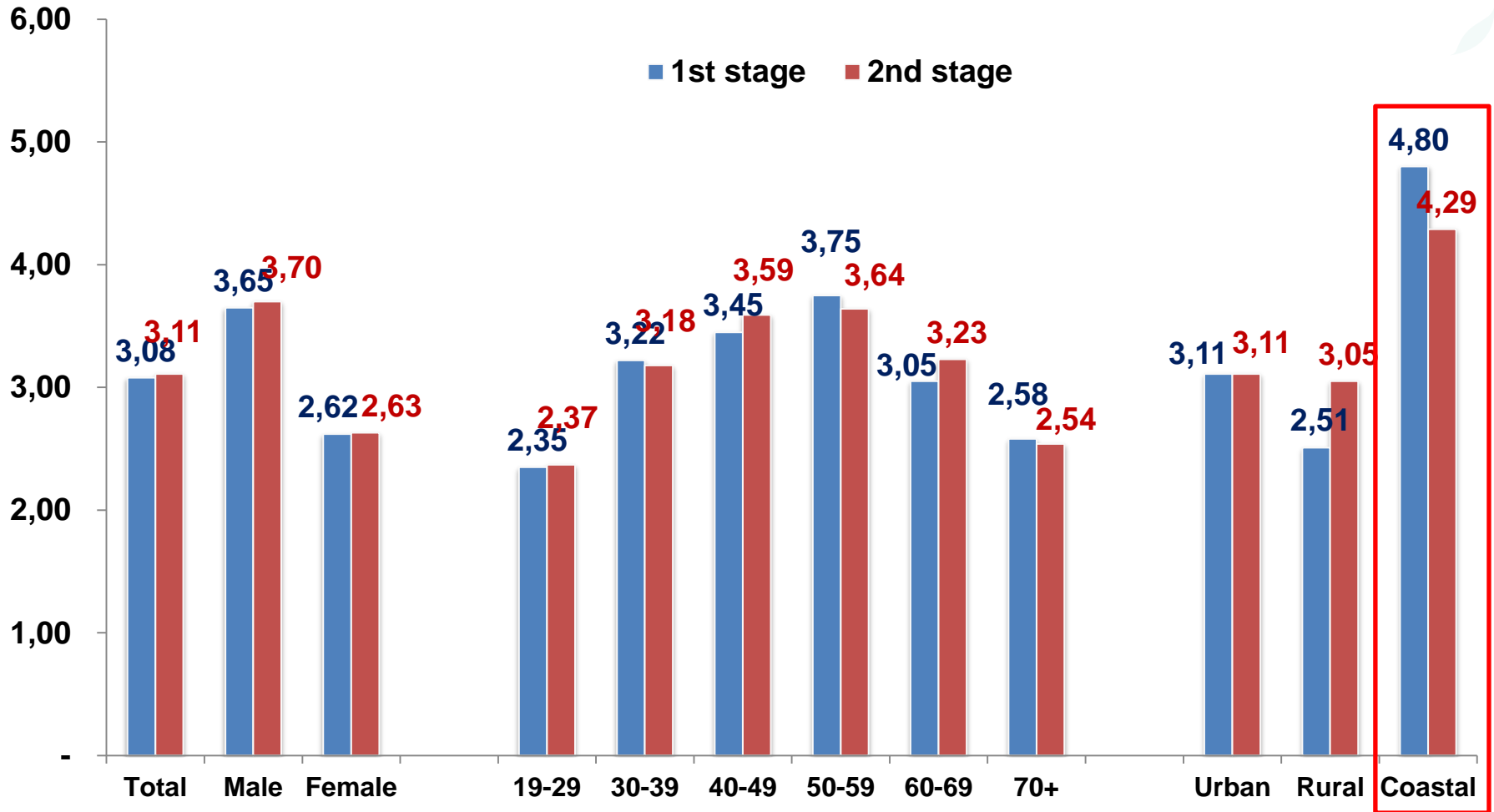
- Blood Lead Levels ($\mu\text{g}/\text{dL}$)





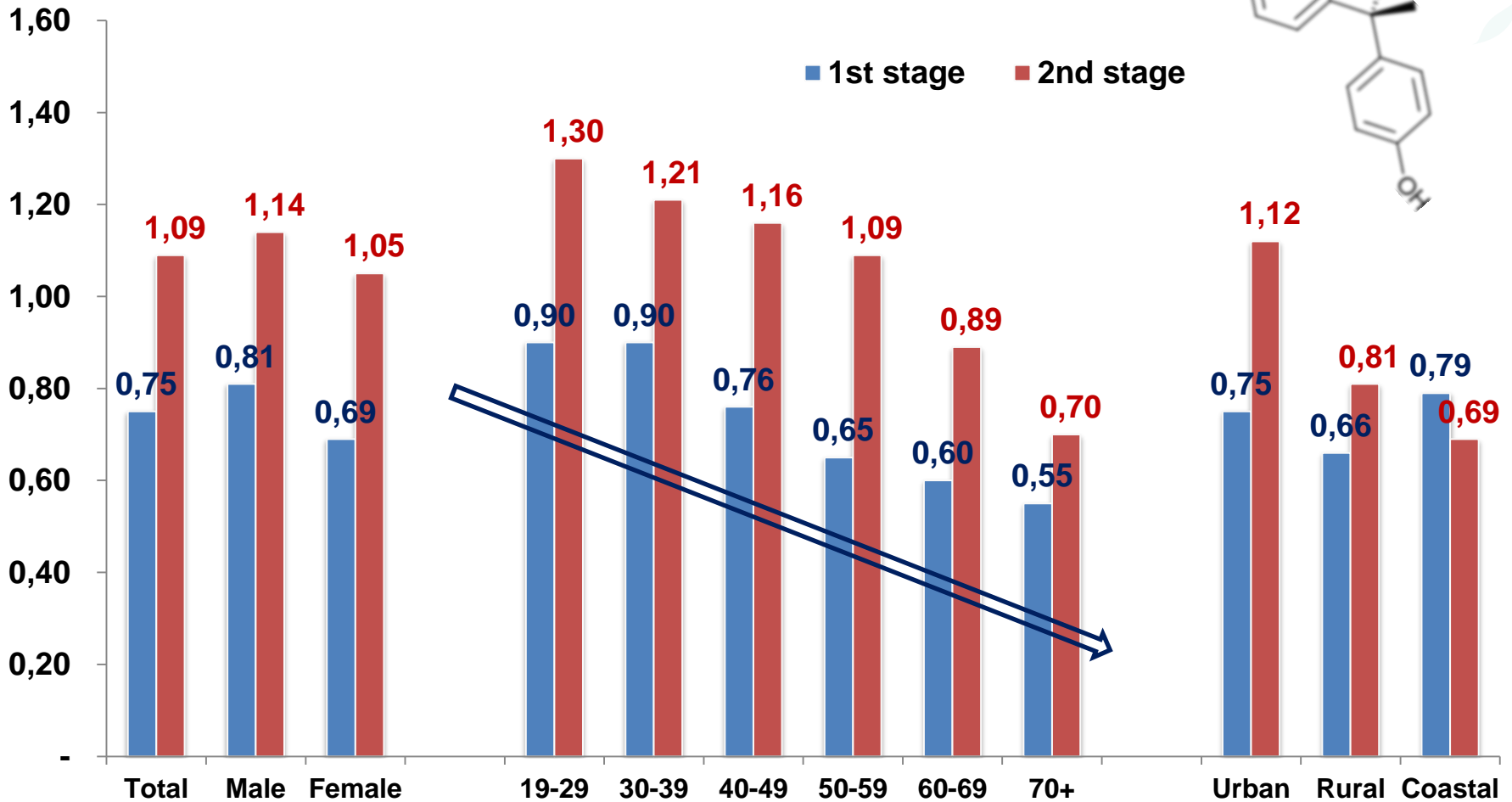
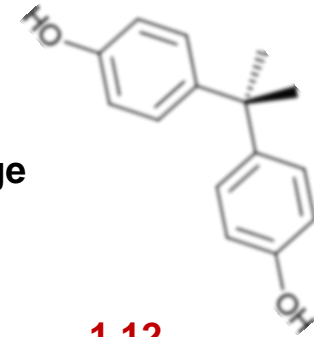
Concentrations of Heavy metals

- Blood Mercury Levels ($\mu\text{g/L}$)



Concentrations of Environmental Phenols

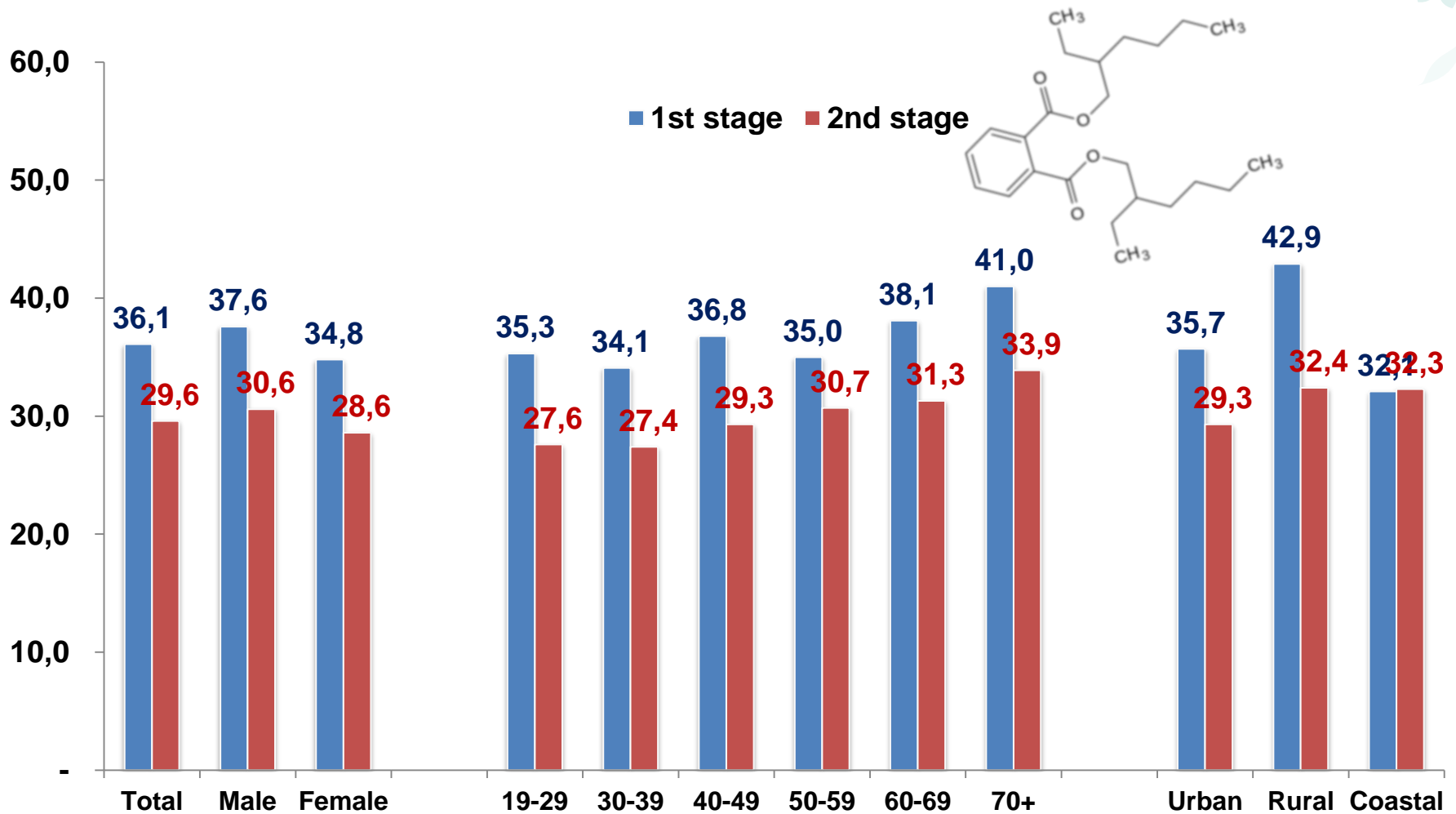
- Urinary Bisphenol-A Levels ($\mu\text{g/L}$)





Concentrations of Phthalate

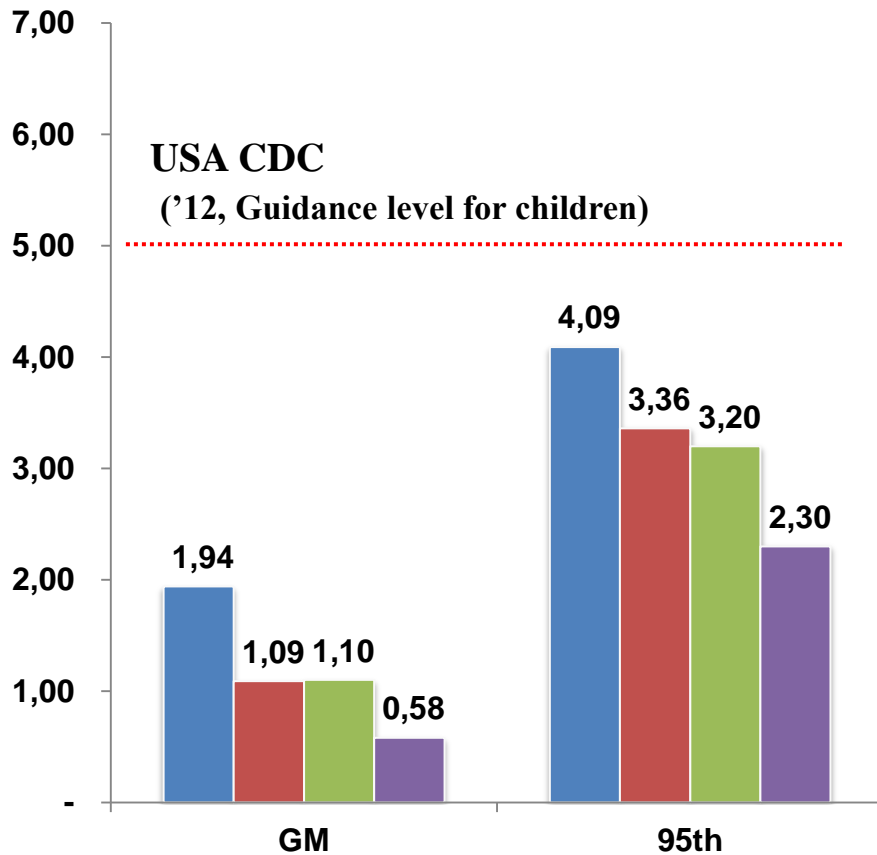
- Urinary DEHP (MEHHP+MEOHP) metabolites Levels (µg/L)



Data Comparison (HBM & Other Countries)

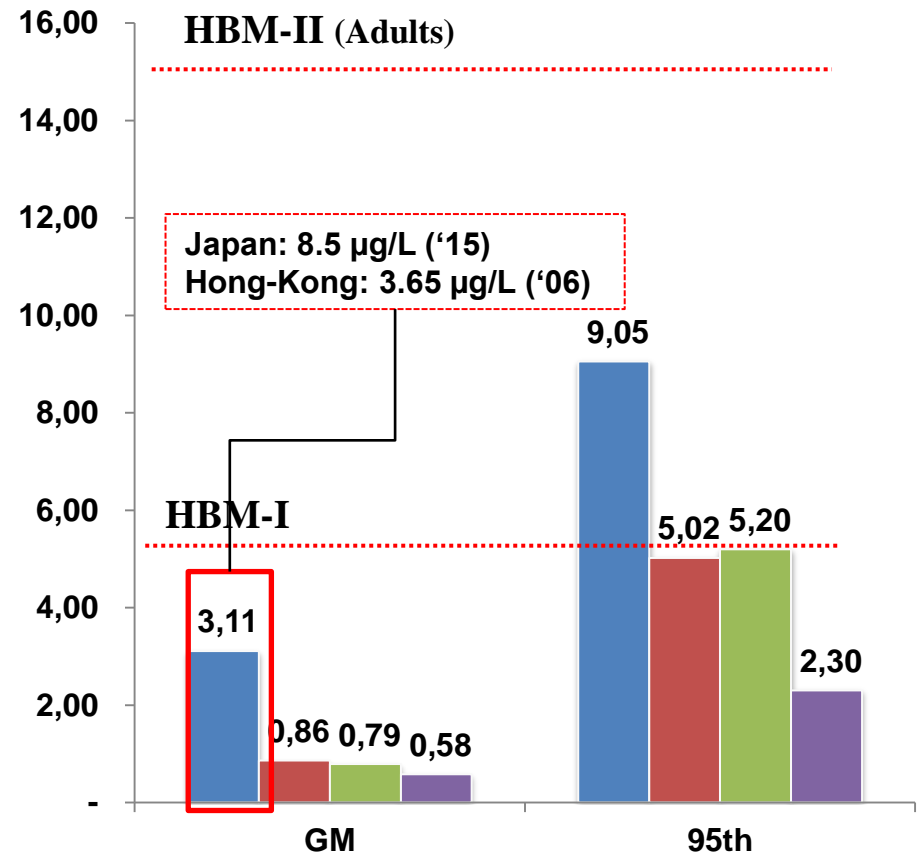
Blood Lead ($\mu\text{g/dL}$)

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



Blood Mercury ($\mu\text{g/L}$)

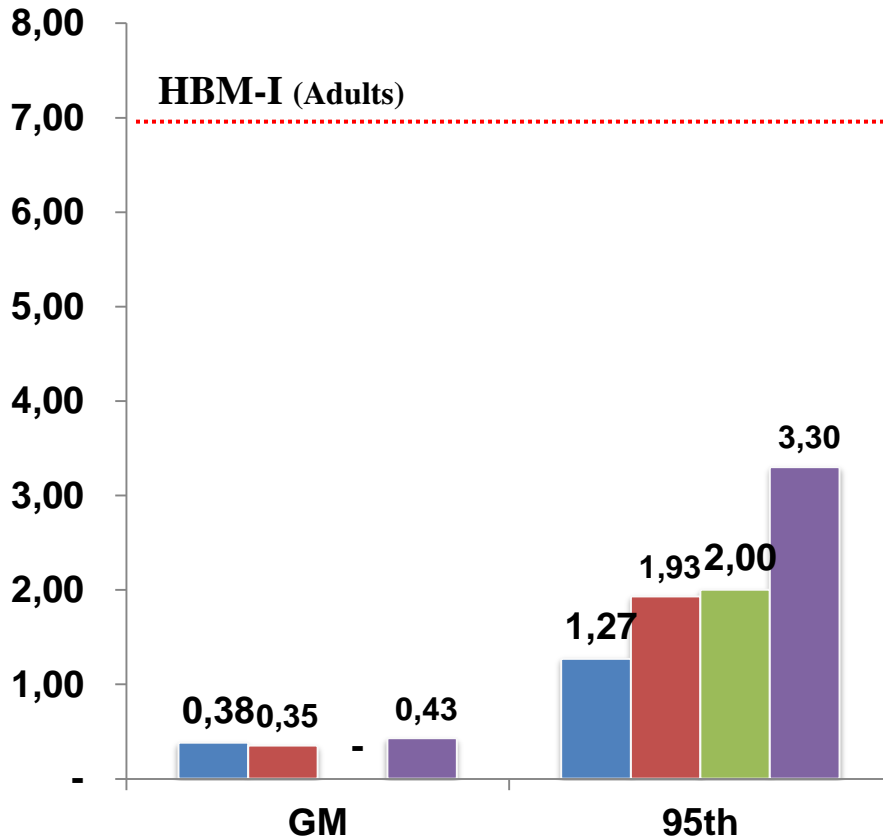
- Korea('12-'14)
- USA('11-'12)
- Canada('12-'13)
- German('98)



Data Comparison (HBM & Other Countries)

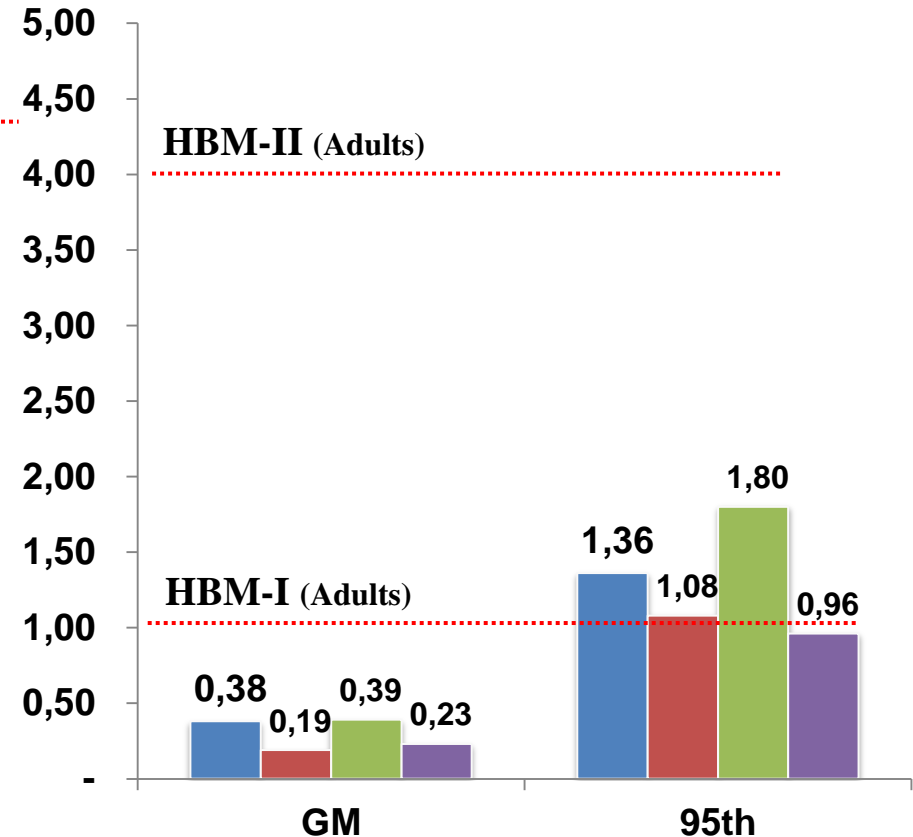
Urinary Mercury ($\mu\text{g/L}$)

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



Urinary Cadmium ($\mu\text{g/L}$)

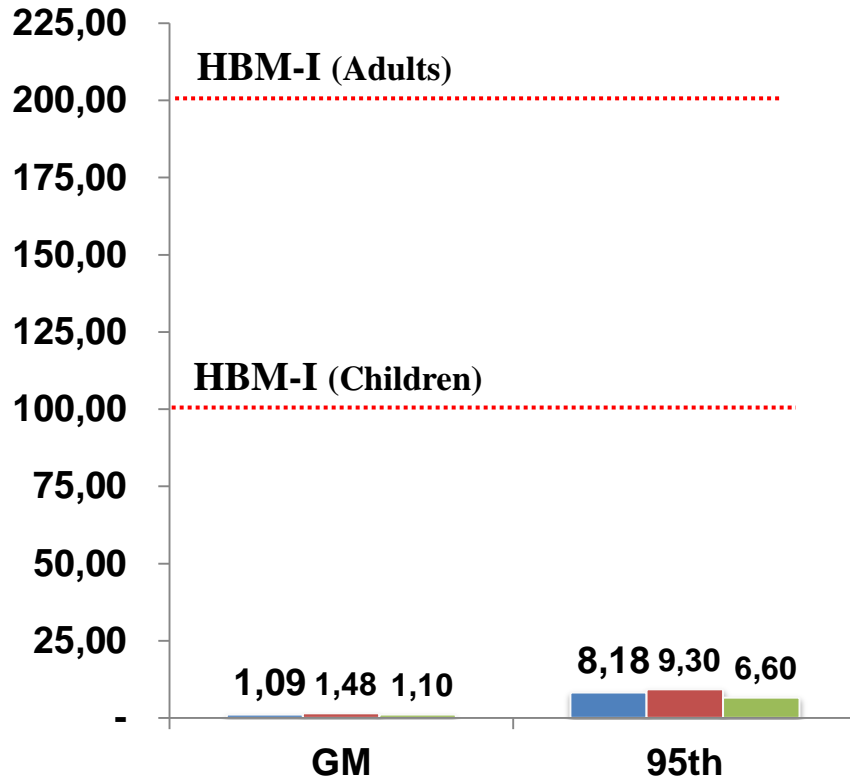
■ Korea('12-'14)
 ■ USA('11-'12)
 ■ Canada('12-'13)
 ■ German('98)



Data Comparison (HBM & Other Countries)

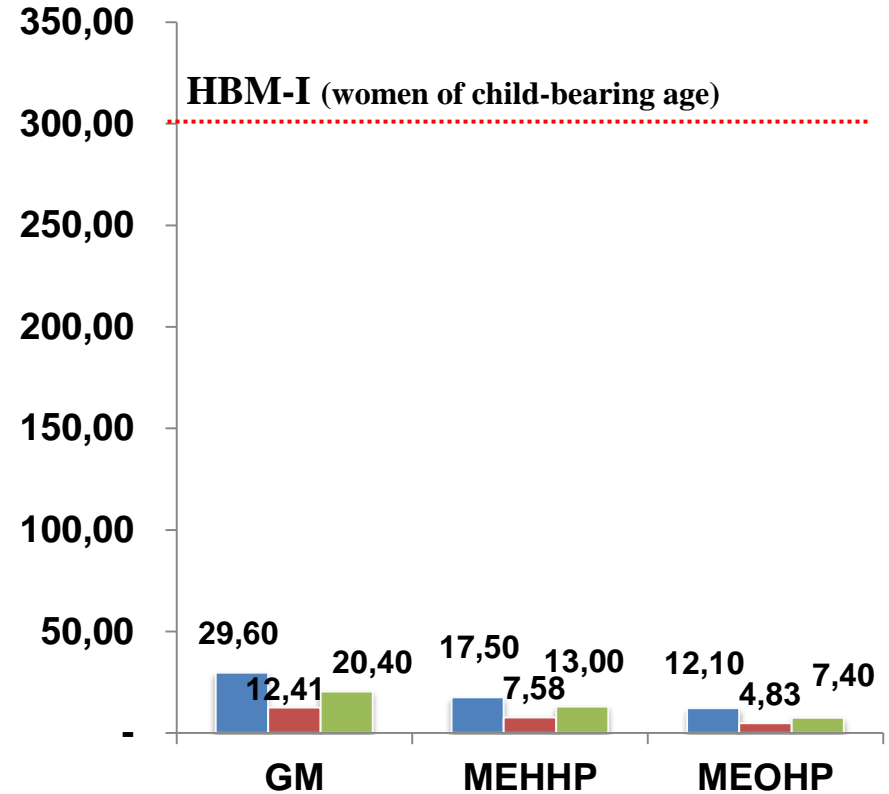
Urinary Bisphenol-A ($\mu\text{g/L}$)

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



Urinary DEHP metabolites ($\mu\text{g/L}$)

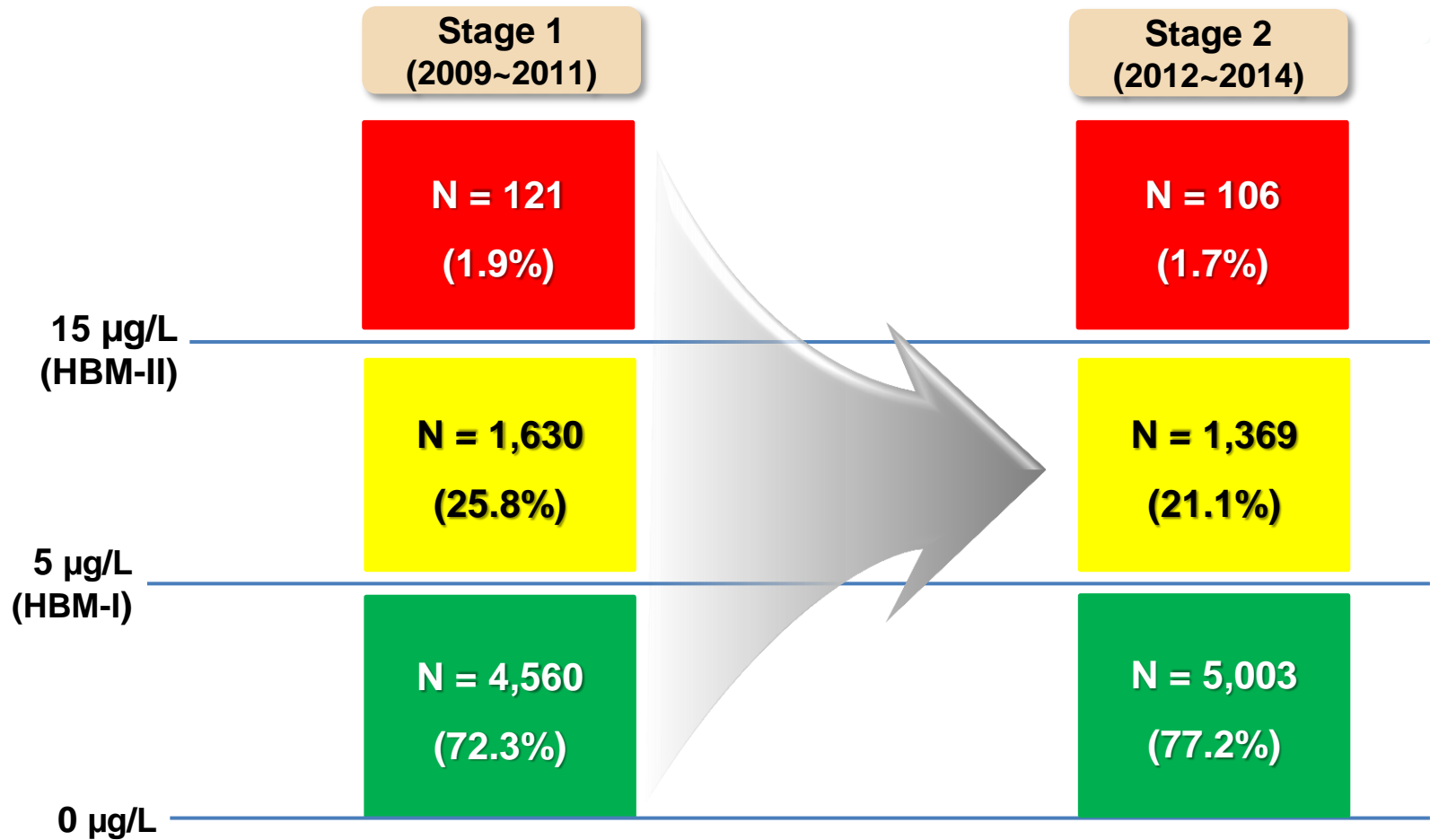
- Korea('12-'14)
- USA('11-'12)
- Canada('12-'13)





The Risk of Mercury Exposure

- Exceed the HBM-I / II Levels



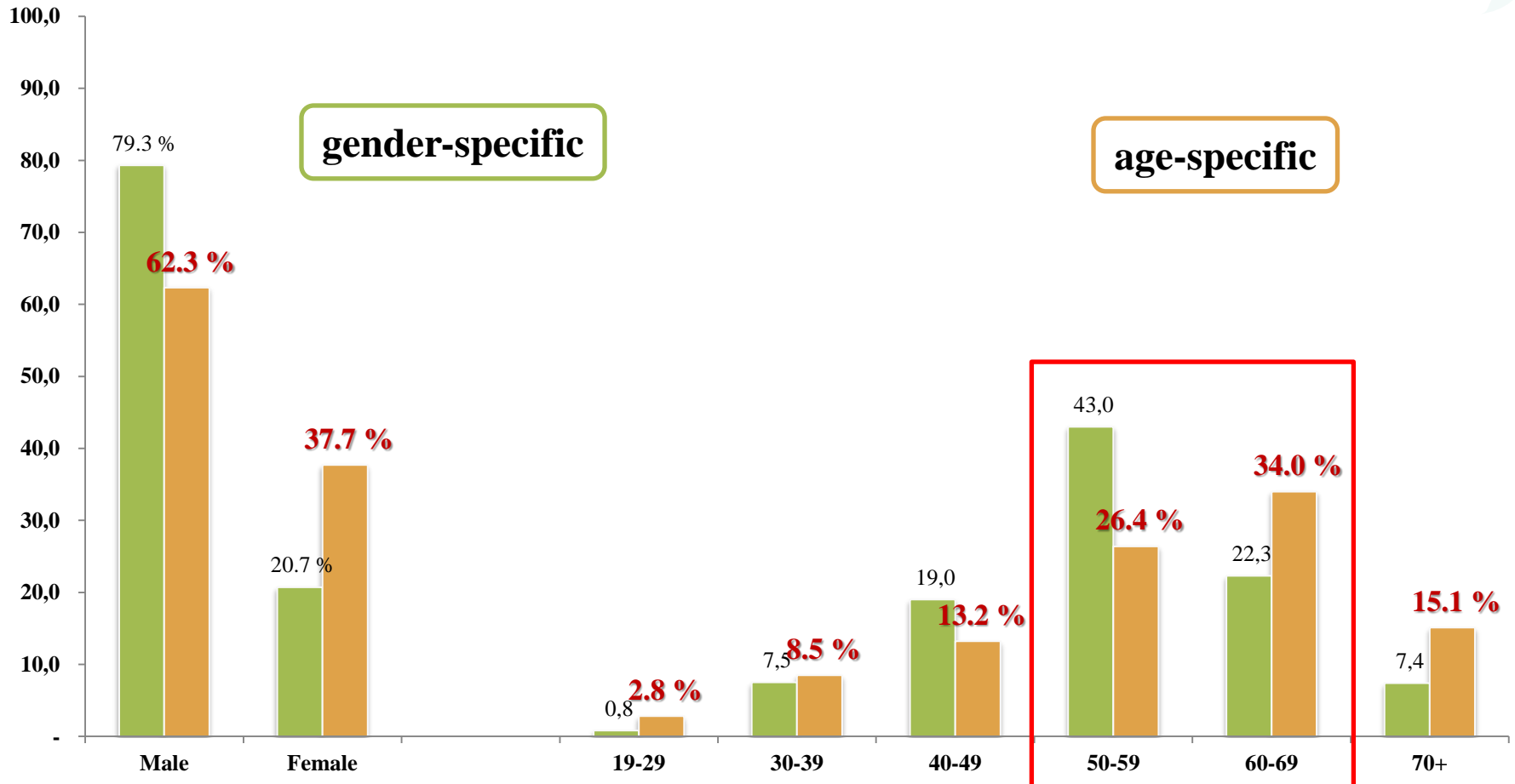


The Risk of Mercury Exposure

- Excess rate of HBM-II Level



■ 1st stage ■ 2nd stage





The Risk of Mercury Exposure

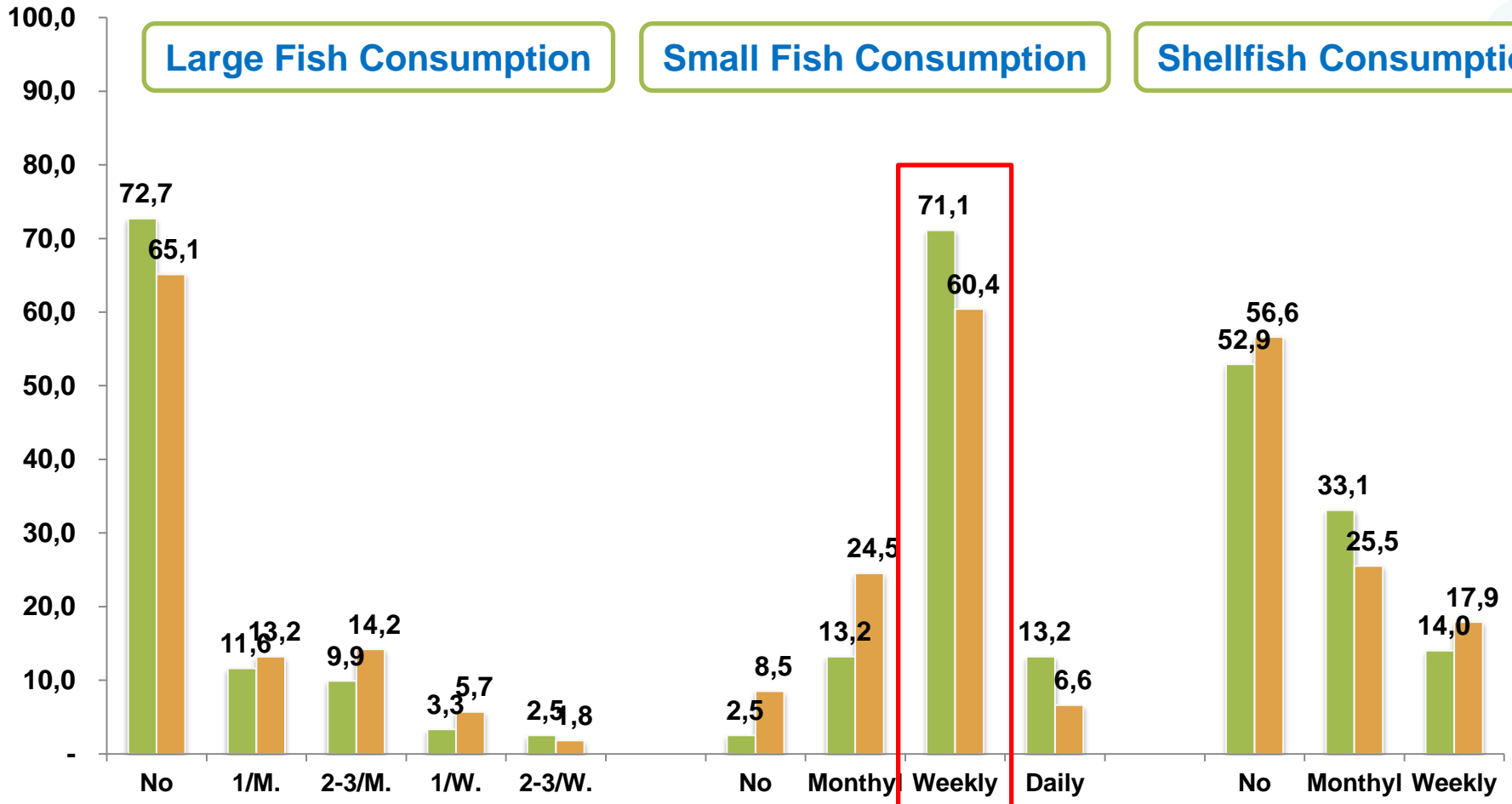
- Fish Consumption from Excess HBM-II Level participant

■ 1st stage ■ 2nd stage

Large Fish Consumption

Small Fish Consumption

Shellfish Consumption





Korean National Environmental Health Survey (KoNEHS) @ Start-up 3rd stage of KoNEHS





Pilot Study

- Korean Environmental Health Survey in Children & Adolescent

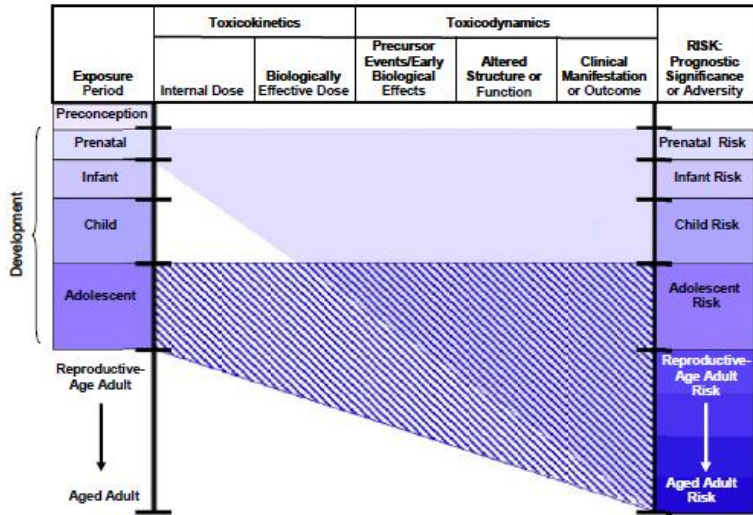


Figure 2-3. Life stages of outcomes after developmental exposure. This figure illustrates the different life stages during which developmental exposures may occur (before conception through adolescence). Exposure (shown on the left side of the figure) during a given life stage may result in outcomes observed during that same stage or later in life (shown on the right side of the figure). For illustrative purposes, the outcomes associated with exposure during two periods, prenatal and adolescence, correspond to the highlighted and hatched regions, respectively. Broad exposure intervals, e.g., "child," are shown here for illustration; divisions between all life stages are not precise. There is some reproductive age overlap between the adolescent and the adult periods.

A Framework for assessing Health Risks of Env. Exposures to Children. EPA. 2006.



Target : over 3 to 18 aged
(n= about 2,400)
9 Chemicals analysis



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

Prepared 3rd stage of KoNEHS

Pilot Study

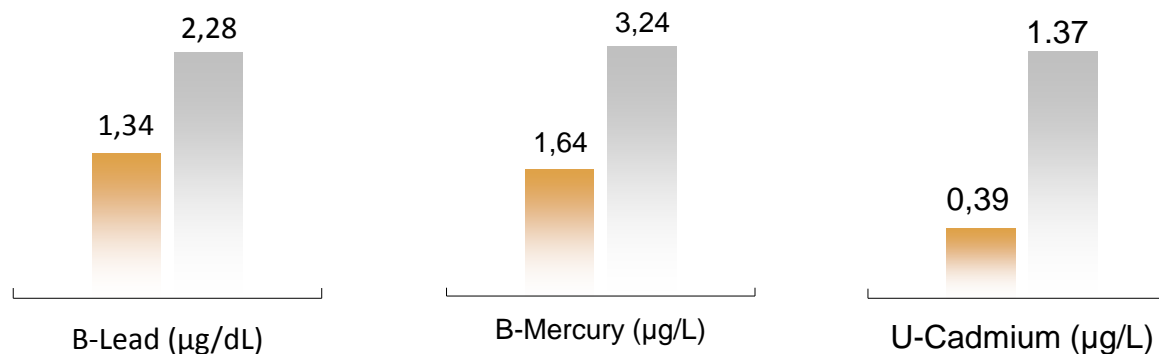
- Korean Environmental Health Survey in Children & Adolescent

I'm over 3~5 old



Geomean

Percentile 95th



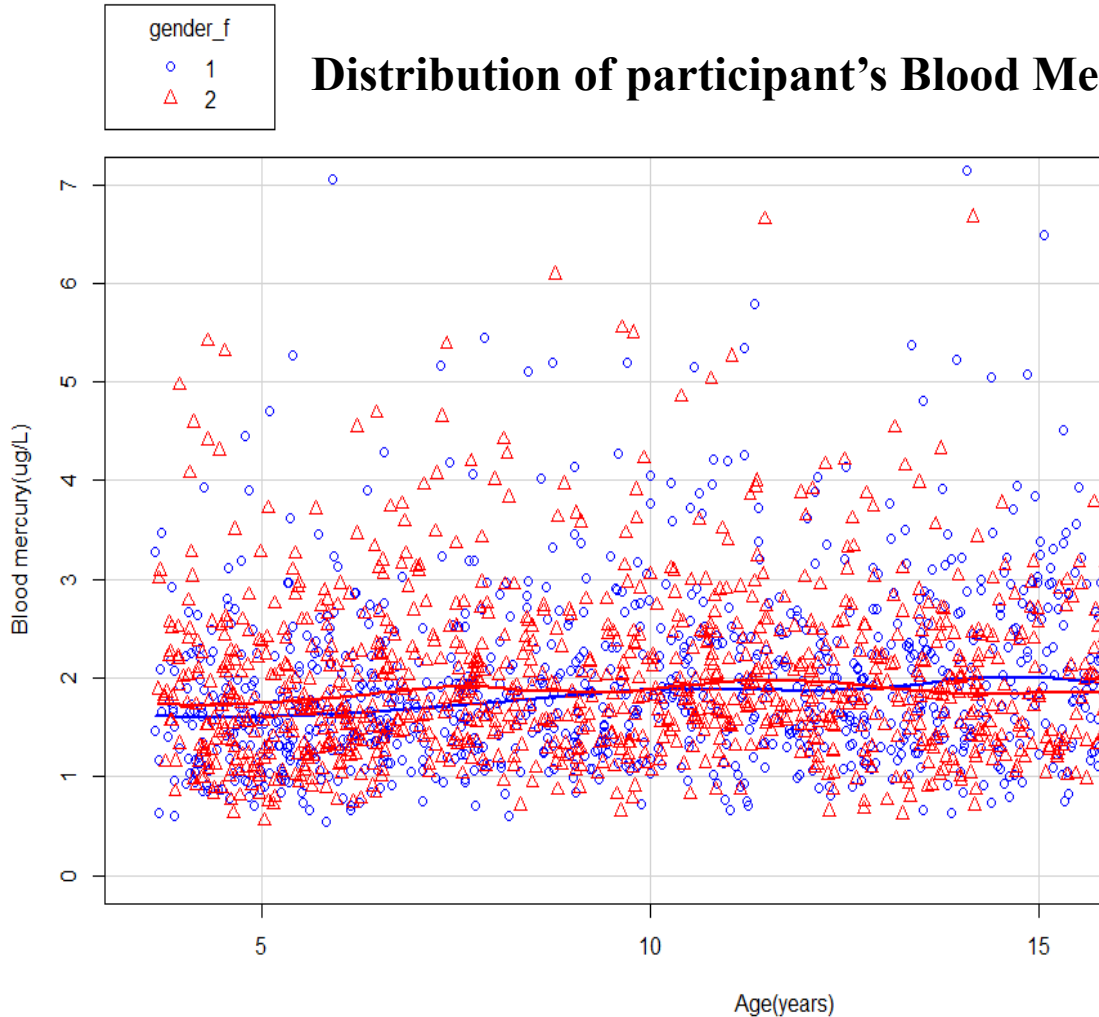
	Year	Age	B-Pb (µg/dL)	B-Hg (µg/L)	U-Cd (µg/L)	U-BPA (µg/L)	Metabolites of Phthalate (µg/L)					
							MEHHP +MEOHP	DEHP			DBP	BBP
								MEHHP	MEOHP	MECPP	MnBP	MBzP
KorEHS-C (Korea)	2014	Over 3-5	1.34	1.64	0.39	2.33	77.77	43.49	34.28	65.47	55.50	7.46
	2012	Over 6-12	1.26	1.93	0.31	1.50	64.29	34.47	29.82	59.39	68.26	7.58
	2013	Over 12-18	1.11	1.90	0.23	1.31	48.66	28.28	20.38	41.15	55.87	6.82
NHANES 4 th (USA)	2009	1-5	1.17	-	-	-	-	-	-	-	-	-
	2010	6-11	0.84	-	0.06	1.81	24.78	15.0	9.78	27.7	21.7	11.6
		12-19	0.68	0.53	0.08	2.11	25.3	15.3	10.0	26.2	18.9	10.6
CHMS (Canada)	2009	3-5	0.93	0.27	0.23	1.4	44	27	17	-	32	17
		6-11	0.79	0.28	0.25	1.4	39	24	15	-	36	19
		12-19	0.71	0.27	0.27	1.3	26	16	10	-	28	12
HBM	2015	I	-	5	0.5	100	500	-	-	-	-	-
		II	-	15	2	-	-	-	-	-	-	-



Pilot Study

- Korean Environmental Health Survey in Children & Adolescent

Distribution of participant's Blood Mercury Level ($\mu\text{g/L}$)



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Korean Environmental Health Survey in Children and Adolescents (KorEHS-C): Survey design and pilot study results on selected exposure biomarkers



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ABSTRACT

For the first nationwide representative survey on the environmental health of children and adolescents in Korea, we designed the Korean Environmental Health Survey in Children and Adolescents (KorEHS-C) as a two-phase survey and planned a sampling strategy that would represent the whole population of Korean children and adolescents, based on the school unit for the 6–19 years age group and the household unit for the 5 years or less age group. A pilot study for 351 children and adolescents aged 6 to 19 years in elementary, middle, and high school of two cities was performed to validate several measurement methods and tools, as well as to test their feasibility, and to elaborate the protocols used throughout the survey process. Selected exposure biomarkers, i.e., lead, mercury, cadmium in blood, and bisphenol A, metabolites of diethylhexyl phthalate and di-n-butyl phthalate and cotinine in urine were analyzed. We found that the levels of blood mercury (Median: 1.7 $\mu\text{g/L}$) and cadmium (Median: 0.30 $\mu\text{g/L}$) were much higher than those of subjects in Germany and the US, while metabolites of phthalates and bisphenol A showed similar levels and tendencies by age; the highest levels of phthalate metabolites and bisphenol A occurred in the youngest group of children. Specific investigations to elucidate the exposure pathways of major environmental exposure need to be conducted, and the KorEHS-C should cover as many potential environmental hazards as possible.

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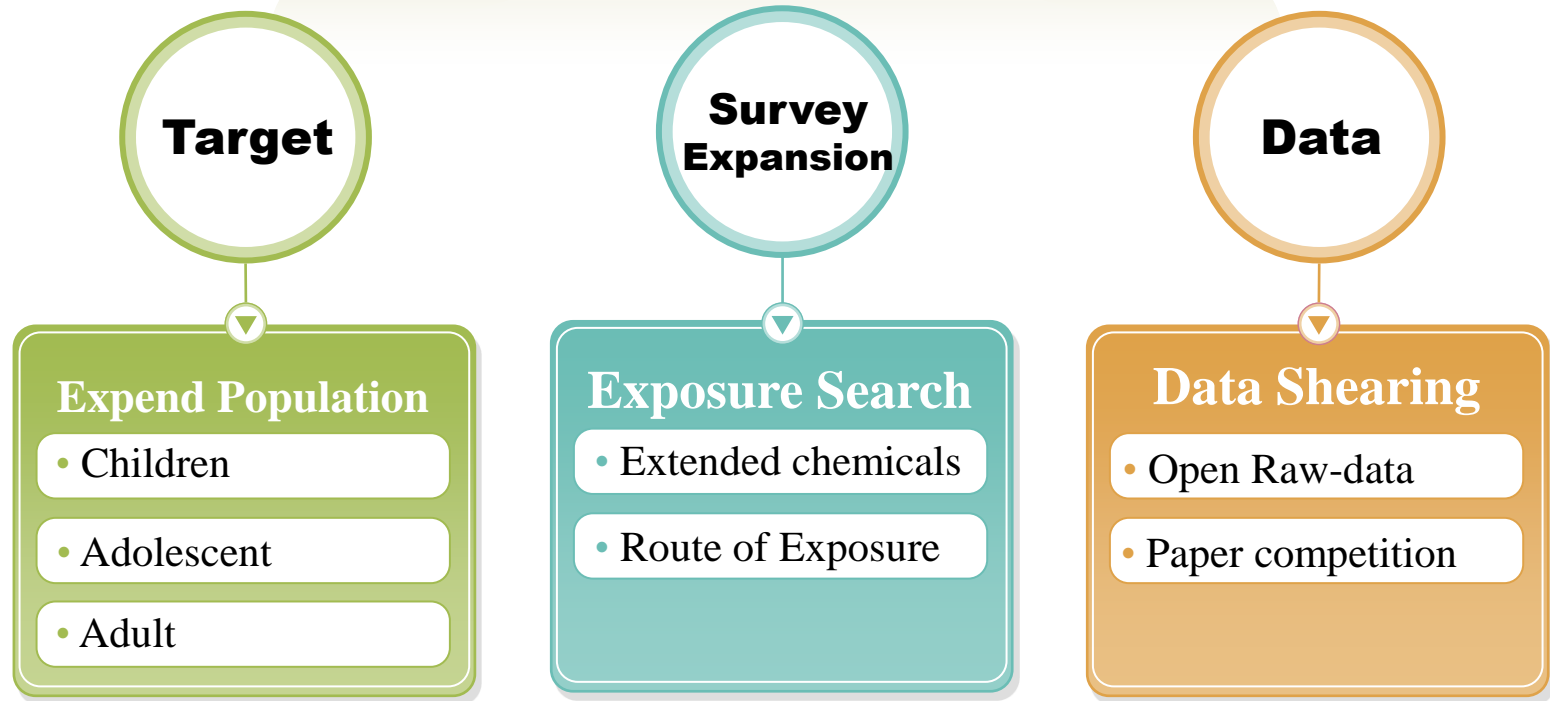
Need More data? - <http://www.sciencedirect.com/science/article/pii/S1438463913000771>



3rd stage of KoNEHS (2015-2017)

- Concept & Plan of 3rd stage

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 3years old)



(Adolescent) 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**



품목	증감률
항사 마스크	Sales growth(%)
Nonmedical Hand Washes	2,373 %
거품형 손세정제	1044%
물비누	199%
Hand disinfectants	66,583 %
Liquid hand soap	1,727 %

- **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-*)

위생

Group	Target Chemical or Metabolite	Specimen	1 st	2 nd	3 rd
Metals (3)	Lead	Blood	○	○	○
	Mercury	Blood/Urine	○	○	○
	Cadmium	Urine	○	○	○
PAHs (4)	1-Hydroxypyrene	Urine	○	○	○
	2-Napthol		○	○	○
	1-Hydroxyphenanthrene		×	○	○
	2-Hydroxyfluorene		×	○	○
Environmental Tobacco (1)	Cotinine	Urine	○	○	○
Environmental Phenols (7)	Bisphenol-A	Urine	○	○	○
	Bisphenol-F		×	×	●
	Bisphenol-S		×	×	●
	methyl-Paraben		×	×	●
	ethyl-Paraben		×	×	●
	propyl-Paraben		×	×	●
	Triclosan		×	○	○
Phthalate (8)	mono(2-ethyl-5-hydroxyhexyl) phthalate	Urine	○	○	○
	mono(2-ethyl-5-oxohexyl) phthalate		○	○	○
	mono(2-ethyl-5-carboxypentyl) phthalate		×	○	○
	mono-n-butyl phthalate		○	○	○
	mono-benzyl phthalate		×	○	○
	mono(2,6-methyl-6-carboxyhexyl) phthalate		×	×	●
	mono(2,7-methyl-7-carboxyheptyl) phthalate		×	×	●
	Mono(3-carboxypropyl) phthalate		×	×	●
Pyrethoid (1)	3-Phenoxybenzoic acid	Urine	○	○	○
VOCs (2)	t,t-Muconic acid	Urine	○	○	○
	N-Acetyl-S-(benzyl)-L-cystein		×	×	●

3rd stage of KoNEHS (2015-2017) - Poster & Leaflet (Ver. KOR)



당신은 우리나라 국민 10,000명을 대표 합니다

국민환경보건 기초조사

조사기간
2015.8~2017.12

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전 국민 대표로
표본선정된
어린이·청소년·성인
총 5,500명

조사내용

환경노출관련 설문조사
신체계측 및 16종 임상검사
환경오염물질 26종 농도 분석

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환경오염물질 분석 결과를 알려드립니다.
- 임상검사**
원래의 건강(기능, 신장기능, 혈액기능) 등을 검사하여
결과를 알려드립니다.
- 건강한 생활습관 안내**
신체계측에 따라 분석된 축적된 환경오염물질 농도에
맞게 건강한 생활습관을 알려드립니다.

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- 조사 장소에 오실 때 신변을 반드시 지참해 주십시오.
- 소변 재검사가 필요할 경우(2회 이하), 소변을 원본 상자에 조사에 참여하여 주십시오.
- 정확한 검사 결과를 위해서는 기밀적 조사가 끝나 후 식사를 해주세요.
- 여성의 경우 생리 중에는 임산부의 검사 결과를 얻을 수 없으므로 조사에 참여하실 수 없습니다.

조사구
조사일시
조사장소
담당자
연락처

국립환경과학원 환경보건연구과
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전 국민 환경오염물질 노출 수준 조사
국민환경보건 기초조사
Korea National Environmental Health Survey

조사기간
2015.8~2017.12

조사대상
전 국민 대표로 표본선정된
어린이·청소년·성인
총 5,500명

mev 환경부·국립환경과학원

국민환경보건 기초조사는 어떤 조사인가요?

참여자 한 명이 국민 10,000명을 대표합니다.
이 조사는 국가가 환경오염으로부터 국민의 건강을 보호하기
위한 정책을 수립할 때 기초 자료 제공을 목적으로
수행하는 법정조사입니다(환경보건법 제14조). 또한 이 자료는
국가 운영통계로 공표 됩니다.

우리나라 국민을 대표할 수 있도록 전국에서 만5세이상
어린이, 청소년, 성인 5,500명을 조사대상자로 선정하고
있습니다.

무엇을 조사합니까?

- 조사대상자의 인구, 사회, 경제학적 특성과 생활 환경 및
습관(외출 등) 등 다양한 오염원 노출에 대한 설문조사
- 신체계측을 통해 몸 고 몸 환경오염물질 영향과 건강상태
의학을 위한 체중의 임상검사
- 혈액 및 소 등 환경오염물질 노출에 대한 농도 분석으로 구성
되어 있습니다.

조사순서는 어떻게 되나요?

표본 조사구 선정	가구별 확인조사	대상자 선정 대상자 확인
결과물 분석	임상검사 및 유해물질 분석	설문조사 및 시료채취

국민환경보건 기초조사로 내 몸속 환경오염물질을 체크하시고 건강하세요!

환경오염물질 노출을 줄이기 위해 국민,
대중을 안심시켜, 아래 항목이, 확인되지
않을 경우 수거 및 건강한 생활습관 및
행동요령을 제시 할 예정입니다.

- 중금속류 (Pb, 수은, 카드뮴)**
납함구, 배터리, 잉크,
화장품, 축전지,
자동차용 부품 등
- 환경성당백연기 (Pb, Cd)**
자동차용 부품, 전선, 배터리,
전자제품 등
- 환경호르몬류 (BPA, 프탈레이트, 비스페놀A)**
플라스틱 용기,
페트병, 화장품,
안경테 등
- 농약류 (S-PSA)**
가정용 살충제,
농약
- 휘발성유기화합물류 (VOCs)**
유기용제, 가구의 접착제, 염료 등
- 다환방향족탄화수소류 (PAHs)**
담배, 석유, 자동차 배기가스, 담배

이와 같은 환경오염물질들은
소화기, 호흡기, 피부 등 다양한 장기를 통해 우리
몸속으로 들어오며 건강에 영향을 줄 수 있습니다.



3rd stage of KoNEHS (2015-2017)

- Questionnaire (Ver. KOR)

전 국민 환경오염물질 노출 수준 조사

국민환경보건 기초조사

BABY

[영유아용 설문지]



환경부·국립환경과학원

전 국민 환경오염물질 노출 수준 조사

국민환경보건 기초조사

CHILDREN

[초등학생용 설문지]



환경부·국립환경과학원

전 국민 환경오염물질 노출 수준 조사

국민환경보건 기초조사

TEENAGER

[중·고등학생용 설문지]



환경부·국립환경과학원

전 국민 환경오염물질 노출 수준 조사

국민환경보건 기초조사

ADULT

[성인용 설문지]



환경부·국립환경과학원

가 구 공 통 설 문 (성인용)

거주지 특성

1. 현재 살고 계신 집에서 가장 가까운 도로(시내버스가 다니는 정도의 도로)와의 거리는 어느 정도입니까?

- ① 50 m 미만(걸어서 1분 이내) ② 50 m~100 m 미만(걸어서 2분 이내)
③ 100 m~500 m 미만(걸어서 8분 이내) ④ 500 m 이상(걸어서 8분 이상)

1-1. 몇 차선 도로입니까?

- ① 왕복 2차선(편도 1차선) ② 왕복 4차선(편도 2차선)
③ 왕복 6차선(편도 3차선) ④ 왕복 8차선 이상(편도 4차선 이상)

2. 도로의 붐비는 정도는 어느 정도라고 생각하십니까?

- ① 매우 많다 ② 많은 편이다 ③ 보통이다 ④ 적은 편이다 ⑤ 매우 적다

실내 환경

3. 현재 살고 계신 집은 어떤 형태입니까?

- ① 단독주택 ② 연립주택/다세대주택
③ 아파트 □□층 ④ 기타()

4. 현재 살고 계신 집은 언제 지어졌습니까? □□□□ 년도

5. 현재 살고 계신 집의 주요 난방 형태와 사용 연료는 무엇입니까? (각 하나만 선택)

5-1. 난방	5-2. 난방연료	5-3. 취사연료
① 중앙	① 가스(LPG, LNG)	① 가스(LPG, LNG)
② 단독(개별)	② 석유	② 석유
③ 없음 (5.3번 문항으로)	③ 석탄, 연탄	③ 석탄, 연탄
	④ 나무	④ 나무
	⑤ 태양열	⑤ 태양열
	⑥ 전기	⑥ 전기
	⑦ 기타()	⑦ 기타()

01 국민환경보건 기초조사

- ① 유리 그릇 ② 금속 그릇(스테인리스) ③ 플라스틱 그릇
④ 지퍼 백, 비닐봉지 ⑤ 자기 그릇(자기 그릇) ⑥ 기타()

03 국민환경보건 기초조사

43-3. 현재 알레르기 비염으로 치료받고 있습니까?

- ① 아니오 ② 예

선택
①
②
③
④
⑤
⑥
⑦
⑧
⑨

나까?

생후 13~18개월
생후 37~60개월 (만 3~5세)

이전 적이 있습니까?

나오.

답 이 부

① 있음
② 있음
③ 있음
④ 있음
⑤ 있음

생후 13~18개월
생후 37~60개월 (만 3~5세)

차 등)를 구입하여

선택

)

만 선택

나까?

생후 13~18개월
생후 37~60개월 (만 3~5세)

Korean National Environmental Health Survey (KoNEHS)

@ Further study



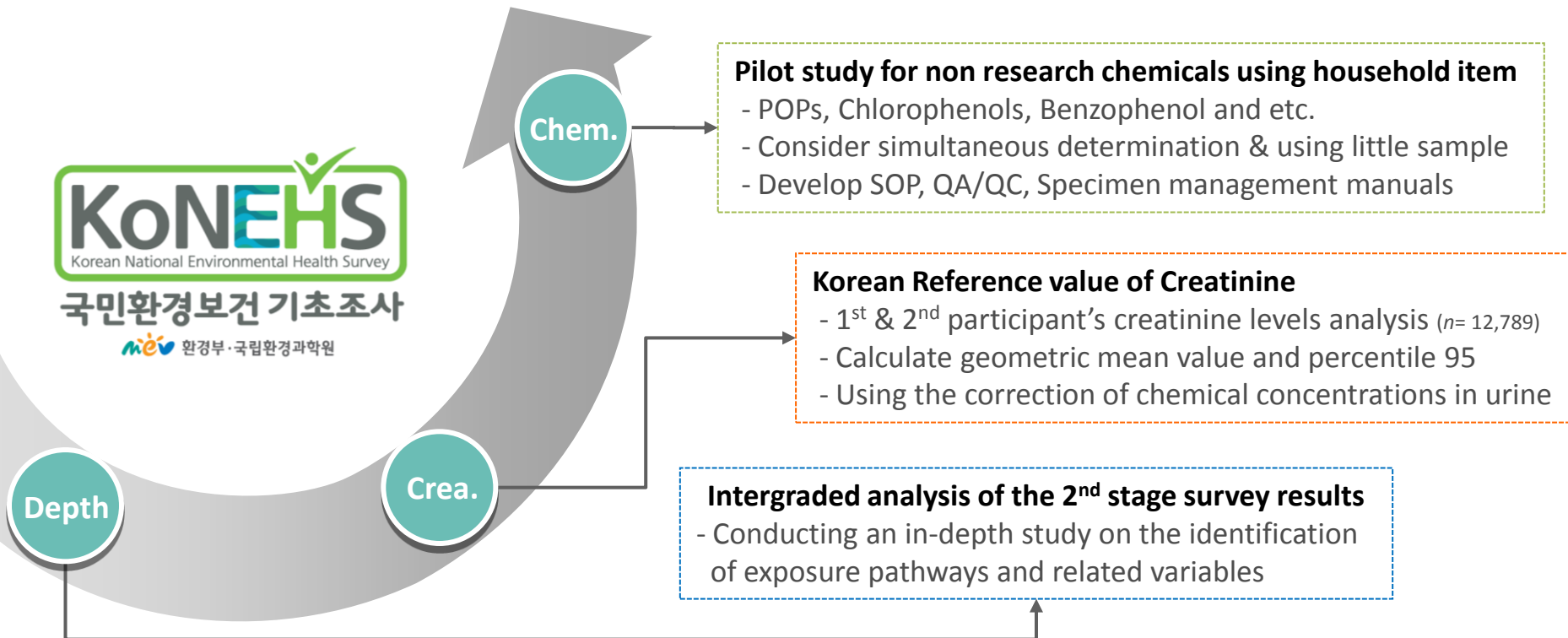
Further Study

- Thinking about Next Human Bio-monitoring

Guideline for chemical concentration levels in body

Necessary for establishing standard guideline of environmental harmful chemicals considering characteristics

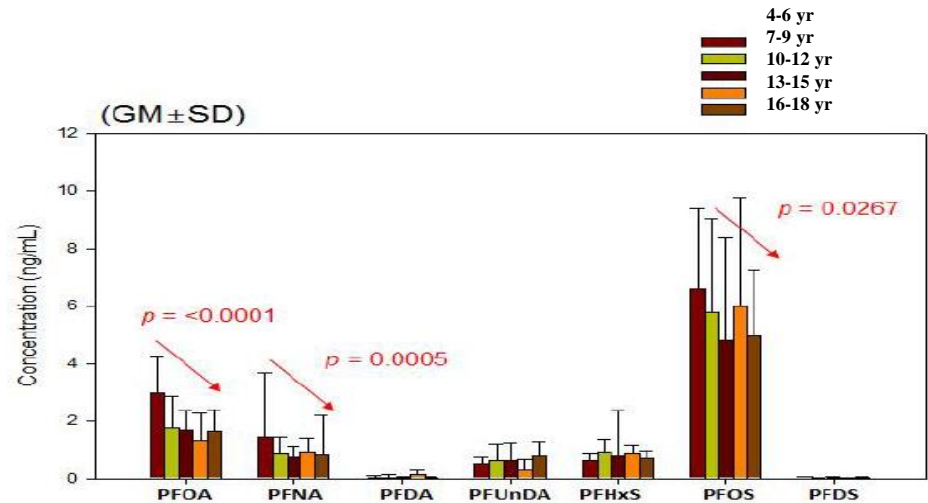
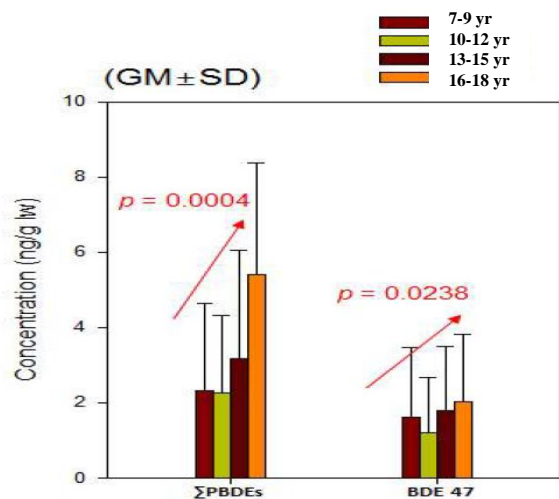
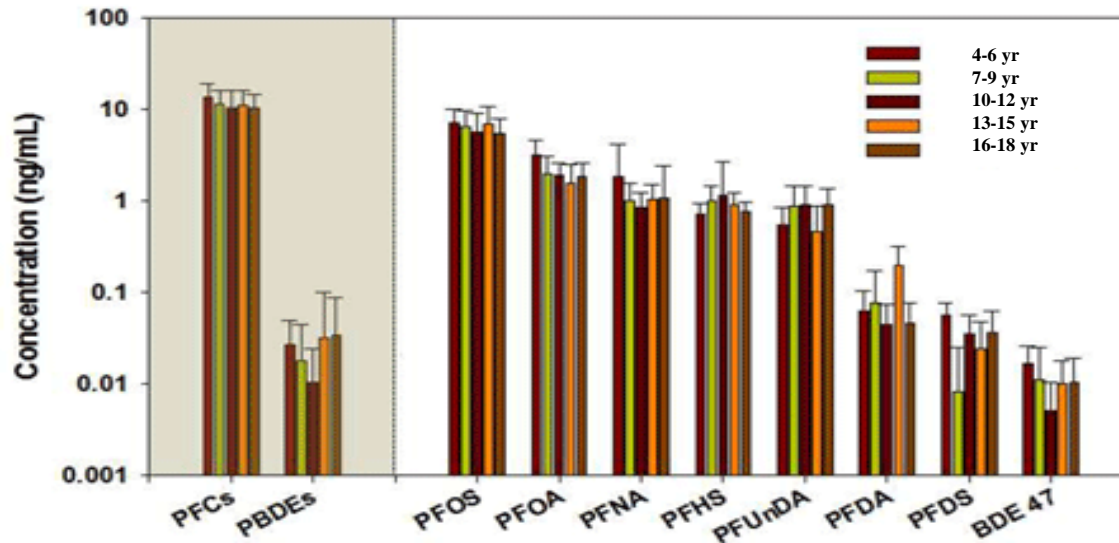
- ☞ Considering health impact of people who participated KoNEHS & standard of communication
- ☞ Considering necessary of site-specific environmental health survey when group size influence factors found





Further Study

- Prepare next survey, Evaluate POPs levels in our body





감사합니다

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



Ministry of
Environment

