국외출장 결과보고서

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- 기후변화 국제 연구/정책 동향 파악 -

2017.11.

KIHASA 한국보건사회연구원
Korea Institute for Health and Social Affairs

1 출장 개요

□ 출장목적

○ 2017 APHA 학회의 주요 테마는 기후변화(Theme: Creating the Healthiest Nation: Climate Change Health)임. 기후변화 위험, 기후변화적응 및 완화 대책을 사회 전반에 거쳐 논의하는 APHA에 참석하여 기후변화 의약품 적응연구를 포함한 기후변화 국제 연구 동향을 파악하고자 함.

□ 과제명

○ <수탁> 기후변화에 따라 수요증가가 예상되는 의약품 및 대응체계 조사 연구

□ 출장기간

○2017.11.4.~2017.11.10.

□ 출장지역

○ 미국 조지아주 애틀란타

□ 출장자

○ 이수형 부연구위원

□ 일정요약

출장일	국가	방문기관	주요 논의사항, 습득사항
2017.11.4.(토)		서울(인천)→미국/애틀란타	• 미국 애틀란타 도착/학회참석
2017.11.5.(일)	미국	APHA(American Public Health Association) 학회	• 학회참석, 국제 기후변화 연구, 정책 동향 파악
2017.11.6.(월)	미국	APHA 학회	• 학회참석, 포스터 발표 및 국제 기후변화 연구, 정책 동향 파악
2017.11.7.(화)	미국	APHA 학회	• 학회참석, 국제 기후변화 연구, 정책 동향 파악
2017.11.8.(수)	미국	APHA 학회	• 학회참석, 국제 기후변화 연구, 정책동향 파악, 미국 CDC 기후변화 연구팀과 교류
2017.11.9(목) ~11.10.(금)	미국/애틀란타 출발→대한민국(인천) 도착		

2 주요 논의 사항

가. 기후변화 국제 연구동향

□ 21세기 보건분야에 있어서의 기후변화 적응대책 방향

○ 리스크(risk)에 기반한 기후변화 적응대책
○ 건강편익(Health co-benefit) 강화를 위한 기후변화완화적응대책
○ 과학적 평가에 기반한 기후변화 적응정책
○ 기후변화 완화를 위한 국제적 활동(협력)
○ 취약계층 뿐만 아니라 인구집단의 회복력(resilience) 강화를 위한 보건분야 적응대책

□ 기후변화 건강영향과 건강 취약집단 적응대책

○ 기후변화 위험요인별 건강영향에 대한 평가연구를 넘어서 다양한 위험요인을 고려한 기후변화 건강영향 연구의 필요성 제시
- Climate Change and the Future of Racial and Ethnic Disparities in Health: 인종, 특히 유색인종
- Climate change and disaster preparedness as it relates to unstably housed and homeless population : 주거 불안자, 홈리스
- Climate change: Women's health imperative during times of climate and disaster support 특히 임신여성에 있어서의 기후변화 취약성을 강조함
- What's going on: the effects of climate change on women's health

□ 기후위험요인에 따른 지역단위 건강영향 적응대책

○ 지역단위 기반, 보건분야 기후변화 적응대책 수립 필요. 지역사회내 보건의료인력의 교육, 지역사회내 기후변화 resilience 강화 필요성 언급
- Creating Community Climate Frameworks
  Warming temperatures, thawing permafrost, rising sea levels, and spread of disease are among the climate change impacts that radically impact Alaska Native communities. Building community-led decision-making that honors traditional knowledge, access to traditional foods, tribal self-determination, and human rights are key

to the sustainability of ecosystems and human communities.

- Climate changes health addressing climate change through programs, initiatives and policies that create healthier communities : 기후변화 적응대책 수행의 기반은 지역사회. 지역사회에 기반한 건강적응대책 수립 및 이행 필요성 언급
- Resilience Dialogues: Connecting experts and communities to build resilience to a changing climate

○ 아리조나, 알라스카, 샌프란시스코, 뉴욕, 미네소타 등의 주에서의 보건분야 기후변화 적응사업 소개

- 4098.0. Climate and Health in Arizona : 아리조나 주에서의 미국 CDC의 BRACE의 적용사례, 아리조나 보건분야 기후변화 적응대책(ACT) 소개
- Climate and Health Adaptations and Mitigation Planning in New York State : 뉴욕 주에서의 미국 CDC의 BRACE의 적용사례, 기후변화 건강취약계층 정의, 주 정부의 취약계층을 위한 적응대책 제시
- Climate and Health in Minnesota : 미네소타 주에서의 Climate and Health Strategic Plan.

□ 기후변화 건강영향 대응에서의 보건의료 전문가의 역할

○ 의료체계와 기후변화(climate change and the medical care system)란 틀에서 보건분야 기후변화 적응 영역에서 의료체계가 담당해야 할 부분, 보건의료인력 역할의 중요성 강조. 따라서 보건의료인력에 대한 특히 간호인력에 대한 기후변화 건강 교육 필요성 제시

- Addressing the environmental impact of medical care in hospitals : 기후변화 병원내 의료체계에 미치는 영향, 역으로 병원내의 의료체계의 변화로 기후변화 완화와 적응 정책을 구현할 수 있음을 제시
- Education medical care consumers about the health effects of climate change : 효과적인 사업수행을 위해서 Moms Clean Air Force Member 대상 기후변화 건강 영향, 교육의 필요성 제시
- President Elect's Session: Health systems as climate innovators : 보건의료체계는 기후변화 영향에 대한 지역사회내 resilience를 향상시킬 수 있는 역량을 가지고 있어야 함을 제시. 의료체계내에서의 clean energy systems에 대한 투자 필요. 건강의 다차원적 관점하에서의 병원의 역할 강구 필요
- Physician's Role in Climate change innovation.: 기후변화 건강영향 적응을 위해, 기후변화 완화를 위한 병원내 의사들의 역할의 재조명 필요 언급

- Changing the climate of health through education and empowerment of nurse worldwide: Global health invited session : 간호인력 대상 기후변화 역량강화 교육 필요성 언급

□ 건강 공동편익 강화를 위한 적응대책 필요성

○ 기후변화의 영향은 다양한 경로를 통해, 다양한 형태로 나타남. 또한 궁극적으로는 기후변화 적응은 기후변화 완화 정책과 함께 갔을 때의 효과가 크기 때문에 건강공동편익을 강화하는 적응대책 강조

- Reducing risks from climate change and capitalizing on the health co-benefits.
- Quantifying the Health Co-benefits of Greenhouse Gas Reduction Transportation Scenarios : 신체활동 증진, 대기질 개선, 안전한 교통망 구축을 통한 공동편익 강화 기후변화 완화적응대책의 필요성 언급. 포르투칼 Oregon Health authority, the integrated transport health impact model(ITHIM)을 이용하여 이동행태 변화에 따른 사망과 이동성의 변화 연구. 연구결과 지하철 이용시 126명의 조기사망 피할 수 있으며, 신체활동이 증진되며, 대기질이 개선된다고 함. 따라서 다분야에서 건강증진을 위한 기후변화 적응대책(대중교통 이용을 통한 대기오염 물질(이산화탄소 등) 감소, 건강편익을 강화한 기후변화 완화 적응대책의 실효성 입증
- The role of trans-sectoral science in the regional response to climate change
- Regional policy as a public health strategy to adapt and mitigate adverse health effects of climate change.

□ 기후변화 건강영향 적응 및 기후변화 완화를 위한 다학제적인 연구 및 활동 필요

○ 기후변화는 다양한 형태로 인구 집단의 건강에 영향을 미치므로 건강적응대책 또한 보건(public health)과 의료시스템(clinical care systems)이 강조되는 기조하에 타분야(환경, 국토, 산림, 해양 등)와의 협력을 통하여 구축되어야 함을 강조

- Multisolving at the intersection of health and climate: Documenting and anlyzing success stories : Multisolving policies are have the potential to produce win-wins that improve health and climate with a single budget and align constituencies that might not otherwise see their common interests. However, our social, economic, and political

systems have not often been able to seize opportunities for these co-benefits because of barriers including disciplinary boundaries that limit communication and creativity, budgetary silos that limit the ability to invest health dollars in ways that are informed by potential climate outcome, and fears that progress on already complicated and urgent topics will be slowed down if advocates open up their processes and conversations to a wider group of stakeholders., This presentation will share the results of an international scan of bright spots where leaders were able to align investments in climate and health with particular focus on the policy instruments and leadership styles that contributed to the ability to maximize these win-win opportunities. The findings from interviews with US health system leaders which defined the most important questions, opportunities, and barriers facing the implementation of multisolving policies in the US. the tools, materials, and support that would help leaders in the health sector be better represented in climate change and energy policy making and investment decisions.

- All hands on Deck! Creating interprofessional partnerships to address climate change : 기후변화 건강영향 적응 또는 기후변화 완화는 전문가간 협력을 통해 가능함을 언급

□ 기후변화와 건강불평등에 관한 논의

○ 기후변화 건강취약성의 중요성과 맞물려 기후변화 건강형평성에 대한 논의 대두. 누구나 기후변화 영향으로부터 차별을 받지 말아야 한다는 기조. 이러한 기조 하에 과거 기후변화 취약계층 보호 중시, 최근에는 모든 이들이 기후변화 영향으로부터의 평등해야 한다는 기조로 정책 방향 변화

- Promoting health and equity through climate action: a guide for state agencies in california
- Climate change, equity and health: Key components of health in all policies
- Implementing a Health in all policies approach with health equity as the Goal

나. 기후변화 의약품 적응대책 연구동향

□ 기후변화 의약품 적응대책과 관련된 국제적 논의 미흡

○ 기후변화 건강영향과 관련된 국제 연구동향은 기상이변(폭염), 산불/태풍 등의 기상재해, 매개체, 수인성 및 식품매개 감염병에 의한 건강영향, 대기오염 악화로 인한 건강영향 중심으로 이루어지고 있음.

○ 최근 들어 기후변화 건강영향 적응과 완화에 대한 논의로 건강 공동편익(health co-benefit)을 강화하는 기후변화 완화적응대책의 필요성 대두

○ 본 학회에서는 건강공동편익을 강조하는 기후변화 완화적응대책의 필요성 이외에 기후변화 건강영향 대응에 있어서 보건의료인의 역할 정의 및 중요성에 대한 논의가 있었음. 또한 지역단위에서의 기후변화 적응완화정책의 필요성을 강조하며, 지역사회내 기후변화 건강영향에 대한 resilience 강조, resilience 강화를 위한 지역사회 구축의 필요성 강조

○ 기후변화 취약계층 보호를 위한 적응대책의 중요성을 강조할 뿐만 아니라 기후변화 적응대책에 있어서의 형평성 강조. 과거 기후변화 취약계층 보호라는 측면에서 모든 이들에 있어 기후변화 건강영향으로부터 안전한 삶을 영위하기 위한 적응대책 필요성 강조

□ 본 학회에서는 보건분야 기후변화 건강영향 적응대책, 적응방향에 대한 새로운 패러다임이 논의되었으나 기후변화로 인한 의약품 적응대책에 대한 논의는 없었음. 최근 Green Pharmacy란 기조하에 제약산업에서의 기후변화 완화를 위한 생산, 공급, 유통 시스템의 변화와 기후변화 의약품 적응대책의 필요성이 대두되고 있음을 고려할 때 빠른 시일내에 의약품, 제약산업쪽에서의 기후변화 적응, 완화정책의 필요성이 강조될 것으로 판단됨.

다. 미국 CDC(Center for Disease Control and Prevention) 기후변화 대응 전략

□ 이번 APHA 학회에서는 미국 CDC의 기후변화 적응대책 연구팀이 CDC 대응 전략을 소해하는 세션이 많았음. 또한 아리조나, 알라스카, 샌프란시스코, 뉴욕, 미네소타 등의 주에서의 보건분야 기후변화 적응사업을 소개하는 세션도 있었음.

- 4098.0. Climate and Health in Arizona : 아리조나 주에서의 미국 CDC의

BRACE의 적용사례, 아리조나 보건분야 기후변화 적응대책(ACT) 소개

- Climate and Health Adaptations and Mitigation Planning in New York State : 뉴욕 주에서의 미국 CDC의 BRACE의 적용사례, 기후변화 건강취약계층 정의, 주 정부의 취약계층을 위한 적응대책 제시
- Climate and Health in Minnesota : 미네소타 주에서의 Climate and Health Strategic Plan.

□ 기후변화 건강영향에 대한 CDC 대응 전략

○ CDC helps states and cities prepare for health challenges of climate change by

- Providing scientific guidance
- Developing decision support tools
- Promote inclusion of public health concerns in climate change
- Creating partnerships between public health and other sectors

○ CDC's Climate and health program – only federal investment in climate change preparedness for public health sector

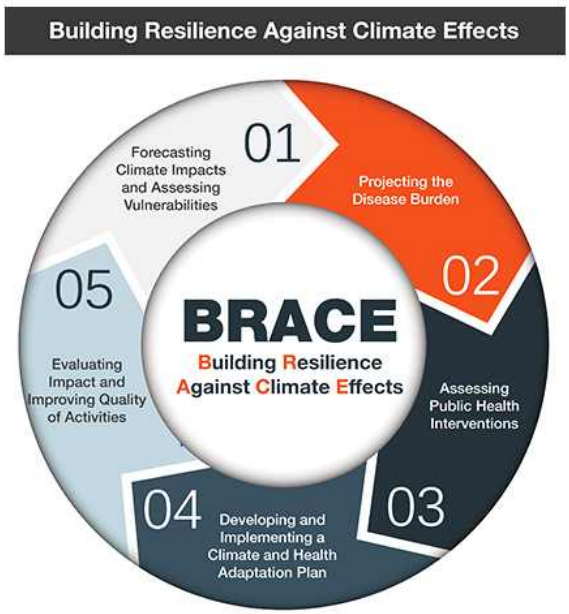
□ Climate-Ready states and cities initiative

○ CDC effort to enhance capacity of state and local health agencies to deal with health challenges associated with climate change

○ CDC accomplished this by

- Funding 18 state and local health departments (18개 주에 미국 인구의 50% 거주)

- Providing a framework (BRACE) and tools for planning, implementing and evaluating climate adaptation strategies
  - Tools to identify population and places vulnerable to climate impacts
  - Materials to help communicate climate and health issues to public health partners (e.g. extreme heat toolkit)



- The program does not address the caused of climate change-rather, it helps ensure that our communities are adequately prepared for health challenges, including those associated with
  - extreme heat and cold
  - severe storms, floods, and droughts
  - pollen and air quality
  - infectious disease

라. 연구자 발표 내용

□ 발표제목: Economic Effect of Cold Waves on Health

□ 발표일시: 2017.11.06. 14:30~15:30

□ Background

The health impact of cold waves is on the rise around the world. During the 21st to 24th of January 2016, there was an unusual cold wave in Southeast Asia such as Vietnam, Laos, Cambodia, Myanmar, northern India, Nepal as well as Southeast Asia including Japan, China and Hong Kong. From January 22nd to 24th, there was a strong winter storm in the eastern United States for the fourth time since 1950, and 70% of US territory went down to zero. On January 4, 2010, a heavy snowfall was observed in Seoul in 100 years. In February 2012, we recorded a record cold wave. In January 2016, a strong cold wave occurred nationwide.

It is expected that although winter temperatures rise due to global warming in South Korea, it continues to be influenced by the cold waves caused by extreme weather. The health damage caused by the cold wave is various, such as human injury, health damage and material damage. The study of cold waves focused on the health effects of cold waves. However, in order to prevent health damage caused by cold waves, it is important to estimate population's willingness to pay for health damage caused by cold waves.

□ Objective

The purpose of this study is to estimate the amount of willingness to pay (WTP) for adaptation policy to reduce the health damage attributable to cold waves using contingent valuation method(CVM).

□ Methods

1.Hypothetical Scenario

CVM is a method of evaluating the economic value of public goods and environmental goods, which is non-market goods and services . Therefore, the most important part of the CVM survey is the establishment of a virtual market (scenario). The scenario was constructed by presenting the policy that has strengthened current government policy to reduce the

health damage caused by the cold wave and asking the amount of payment for it.

The means of payment is the per capita contribution to be paid once a year for the next ten years, and the form of contribution shall be tax. The elicitation format employed in this study is a DBDC (double-bounded dichotomous choice) question according to the 'blue-ribbon CV panel' of Arrow et al.(1993).

A pre-test was undertaken with 30 people to determine the range of the bid amounts for DBDC WTP questions. The bid used in this study are 10,000KRW, 30,000KRW, 50,000KRW, 70,000KRW, 90,000KWR.(USD 1.0 = KRW 1,150) The face-to-face interview survey was conducted on total 1,500 people who are heads of households or housewives, whose age ranged from 30 to 75 by from January 25 to February 13, 2015.

2. Estimate Model

In the CVM Study, if the response rate of 0 (zero amount), which means that he/she is not willing to pay for the proposed scenario, is high, a negative WTP or a statistically insignificant WTP is often derived.

In this study, authors apply the mixed model to solve the zero response problem and estimate the WTP using the Bayesian method assuming the Weibull distribution. The proposed model is as follows.

$$G(x;\rho,\gamma,\alpha) = \begin{Bmatrix} 0 & if\ x<0 \\ \rho & if\ x=0 \\ \rho+(1-\rho)F(x;\gamma;\alpha), & if\ x>0 \end{Bmatrix} \quad (1)$$

$$F(x;\gamma,\alpha) = 1-e^{-\gamma x^{\alpha}} \quad (2)$$

$$\log(F(x)) = -(\alpha+\beta_1 sex+\beta_1 sex+\beta_2 age2+\beta_3 age3+\beta_4 edu+ \beta_5 income2+\beta_6 income3+\beta_7 coldarea+\beta_8 experience+\beta_9 frequency)$$

Equation (1) refers to the formula of the mixed model, and Equation (2) refers to the Weibull distribution.

The mean WTP and the median WTP are calculated as follows (An & Ayala, 1996).

$$\mu = E(WTP) = (1-\rho)\gamma^{-\frac{1}{\alpha}}\Pi(1+\frac{1}{\alpha})$$

$$m = \begin{Bmatrix} \left[\frac{1}{\gamma} log \frac{1/2}{(1-\rho)}\right]^{1/\alpha} & if\ \rho < 0.5 \\ 0 & if\ \rho > 0.5 \end{Bmatrix} \quad (3)$$

□ Results

The probability of 'no-no-no' value ρ which is zero response was 0.406, and the scale parameter (γ) and the shape parameter (α) for Weibull were 0.007 and 0.548, respectively.

Respondents' average WTP for the government's policy to reduce the health damage due to cold waves were 7.4 USD per household per year, and the median WTP was 0.3 USD per household

Node	Mean	SD	Median	95% CI
ρ^1	0.406	±0.009	0.406	0.388-0.424
γ^2(scale parameter)	0.007	±0.001	0.007	0.005-0.010
α^2 (shape parameter)	0.548	±0.017	0.548	0.515-0.581
Mean WTP	8,492 (7.4 USD)	16.8	8,487	8,459-8,525
Median WTP	363 (0.3 USD)	2.7	357,3	356.5-368

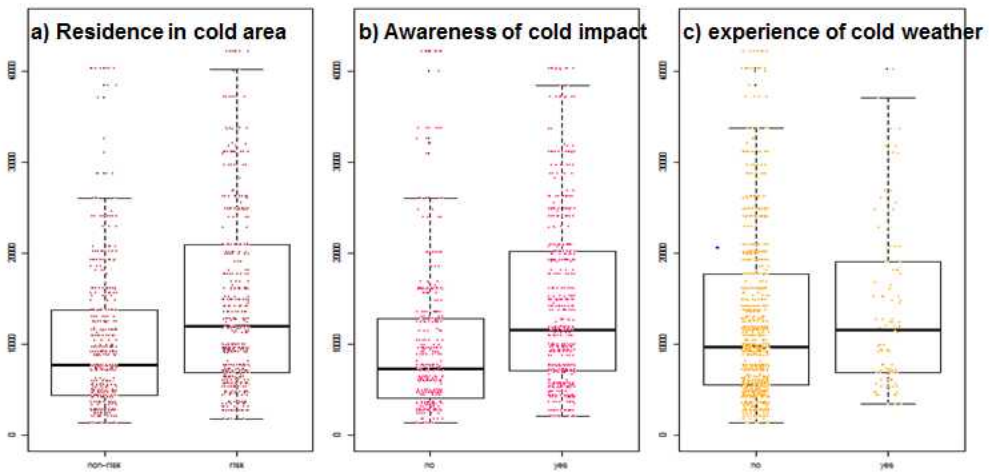
Man was more willing to pay than women, and those aged between 45-60, aged 60 and over were more willing to pay than men aged 30-45. Both education level and household income showed a positive correlation with the WTP for the health policy of the cold wave. Respondents living in the cold area were willing to pay 8% more than those living in the non-freezing area, and those who thought that the frequency of cold in the past 10 was higher WTP than those who did not. However, the experience of the cold wave did not show statistically significant in WTP for the cold wave adaptation policy.

Variables		Exo(β)	Coef(β)	SD	Median	95% CI
p		-	0.405	0.009	0.406	0.386-0.422
Constant		7.607	2.029	0.074	2.026	1.891-2.178
Sex	(Female)					
	Male	1.214	1.094	0.037	0.194	0.120-0.263
Age	(30-34)					
	45-59	1.285	0.251	0.044	0.252	0.158-0.337
	60+	1.256	0.228	0.058	0.228	0.113-0.334
Education	(†)					
	College +	1.375	0.318	0.045	0.315	0.228-0.413
Income	(<150)					
	150-244	1.283	0.249	0.044	0.249	0.164-0.338
	250+	1.390	0.330	0.051	0.328	0.235-0.429
Cold areas (CA)	(Non -CA)					
	CA	1.094	0.090	0.039	0.088	0.014-0.166
Experience (E)	(Non-E)					
	E	1.092	0.088	0.067	0.087	-0.004-0.275
Perception‡	(None)					
	Increase	1.161	0.149	0.042	0.150	0.068-0.233

Note: ( ) reference group, †Under high school graduation , ‡ the frequency of cold wave has increased in the past 10 years

The payment amount of WTP was different according to the characteristics of the respondents. The average WTP per respondents living in the cold areas is 14.4 USD per year, which is 4.9 USD more than those living in the non-cold areas.

Figure 1. WTP distribution by respondent's characteristics



Respondents who think that the frequency of the cold wave increased over the past 10 years were willing to pay an average of 13.6 USD per

household per year, which is 5.0 USD more than those who did not. Respondents who experienced cold waves had 1 USD more than respondents who did not, but the difference between the two groups was not statistically significant.

□ Conclusions

This study estimates the economic value of cold waves using CVM. In order to deal with the zero (0) response problem, Bayesian method assuming mixed model and Weibull distribution was used. The average payment amount for the health damage adaption policy due to cold wave was estimated to be 7.4 USD per household per year, and the amount of payment was different according to the experience and perception of the cold wave. The payment amount for WTP caused by cold waves was lower than those for heat waves and air pollution.