play a key role in explaining exposure variation along with the level of pollutant in microenvironments. The purpose of this paper was to present time activity patterns of Korean and to characterize the exposure according to similar time-activity group.

Methods: Time-activity pattern was analyzed with 31,634 subjects from 12,651 households, provided by the Korea National Statistical Office (KNSA) survey. The activity pattern survey was initially collected for social and economical purposes in 2004. Detailed study population method was presented in KNSA web site (kostat.go.kr). We classified participants into similar time-activity groups using cluster analysis, and measured time activity pattern and personal volatile organic compounds (VOCs) and nitrogen dioxide (NO_2) exposures of about 400 subjects with 3 similar time-activity groups (workers, housewives, university students), along with microenvironmental concentrations such as residential indoors, residential outdoors, and workplace indoors.

Results: Korea population spent the majority of their time indoors (87%), outdoors (5%) and in transportation (7%). Specially, residential indoor time (59%) in Korea was different from those of western countries (about 65%–75%). By cluster analysis of time-activity pattern, about 10 similar time-activity groups were classified. Among 10 similar time-activity groups, 3 similar time-activity groups were worker, housewife, and university student. Exposures to VOCs and NO_2 for 3 similar time-activity groups were different.

Conclusion: Similar time-activity group may cause different exposure and risk to air pollutants such as VOCs and NO_2. This exposure study can provide valuable information to understand population exposure and impact from exposure related behaviors.

O-31A6-5

Assessment of the Contribution of Indoor Dermal Pathways to Exposure to Svocs

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Background/Aims: Increasingly available biomonitoring data provide evidence of widespread human exposure to large numbers of chemicals. In some cases, dominant exposure pathways are evident. However, in the case of nonoccupational exposures to chemicals found in consumer products, multiple exposure pathways may be relatively important contributors. Although attempts to parse aggregate exposures are becoming common, data sets that actually permit use of a mass balance approach remain relatively rare. Even where mass balance is possible, use of uncertain or conservative estimates may conceal a gap between the sum of predicted inputs and observed outputs. Aggregate assessments often contain component estimates that vary dramatically in quality. Dermal exposures in particular are often dismissed on the basis of calculations that are not well considered.

Methods: Prior experience with selected pesticide data (chlorpyrifos, 2,4-D, pentachlorophenol) from CTEPP suggests that dermal exposure contributed non-negligibly to children's exposures to those compounds in that study. Building on that work, we have constructed a fugacity-based indoor fate and transport model that includes a multi-compartment human with a credible skin barrier.

Results: Application of the fate and transport model to indoor exposure scenarios for multiple chemicals for which appropriate environmental and biomarker data are available is proceeding in pursuit of mass-transfer-related factors that lead to consistent explanations for dermal phenomena across a range of chemicals.

Conclusion: In the case of SVOCs that persist in indoor environments, chronic dermal exposures are inevitable. This is especially true for chemicals present in bulk quantities in building materials such as plasticizers and flame-retardants. Credible estimates of the magnitude of those inevitable exposures are needed to inform future consumer product regulations.

O-31A6-6

Long-term Monitoring and Source Estimation of PCDD/F Near Municipal Waste Incinerators

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Background/Aims: The emission of PCDD/F (Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans) is a serious issue in many countries. Previous references indicated that human activities are major sources of PCDD/F, including from waste incineration, power generation, energy industries, and other high-temperature emission sources. Several studies in England and the United States reported that waste incinerator was one of important contributors to the ambient PCDD/F concentration. In Taiwan, municipal waste incinerators were founded in 1991. It is important to assess the long-term exposure to PCDD/F. The objective of this study is to compare the PCDD/F concentration differences among 3 municipal waste incinerators in Taipei and identify the major sources, using long-term environmental monitoring data.

Methods: The atmospheric PCDD/F concentration data (N = 284) in the neighborhood of 3 municipal waste incinerators (Beitou, Neihu and Mucha) in Taipei from 2003 to 2008 were collected. Each sample was collected for 3 days by using PS-1 high volume samplers. The procedure of sample collections followed the Taiwan EPA Method NIEA 809.10B, and 17 compounds were analyzed with HRGC/HRMS. Principle component analysis was used to identify the major sources of PCDD/F.

Results: The averages of toxic equivalents at Beitou, Neihu, and Mucha from 2003 to 2008 are 0.067, 0.024, and 0.028 pg I-TEQ/Nm³, respectively, and the standard deviations are 0.281, 0.014, and 0.029. OCDD has the highest percentage among these 17 compounds at the 3 municipal waste incinerators. For principle component analysis, 2 factors explained 87.2%, 80.3%, and 86% of the variance. Municipal waste incinerations and traffic were the main PCDD/F sources at Beitou and Neihu.

Conclusion: However, only traffic emissions were correlated with PCDD/F at Mucha. Traffic was identified as a common source in this study. Further modeling is needed to quantify the contribution from each source.

PP-30-086

Research on Evaluation of the Pipeline Direct Drinking Water Quality With Improved Comprehensive Index Method

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Background/Aims: To establish a comprehensive index methodology applicable to the water quality comprehensive evaluation against pipeline direct drinking.

Methods: Common methods of comprehensive index were improved, through adopting flexibly the methods of Nemerow index, minimum operator, and weighted average; the direct drinking water quality in 10 residential areas in some district of Shanghai in December 2008 was evaluated comprehensively using this improved methodology.

Results: The comprehensive index values of water samples of direct drinking water were in the range of 0.32–1.23, significantly lower than

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O-29A1-1

Heat-related Mortality and Heat Watch-warning Systems in the United States: Recent Developments

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Background/Aims: Heat watch-warning systems have increased in coverage, and in some US locales, have now been operational for over 15 years. Heat-related mortality has decreased over the last few decades, partially as a result of increased awareness, but it is still statistically significant in many locations. We present recent research results on several projects that assess these changes as well as projected future changes, and the spatiotemporal variability in heat-related mortality across the United States.

Methods: Trends are assessed using both the synoptic climatological methodology, utilized in the authors' heat watch-warning systems, and the Heat Stress Index, a numerical quantifier of the severity of heat relative to location. Estimates of heat-related mortality are developed for 40 large US cities, using climate models for 3 decades over the next hundred years and various emissions scenarios.

Results: Over the past 30 years, the heat-mortality relationship has tended to converge across the United States, with areas in the warmer climates experiencing generally slight increases in mortality response, and areas in colder locations, which were historically more sensitive, experiencing more significant decreases. On a seasonal level, there is an asymmetry in heat-related mortality, with most cities exhibiting the largest increases before the summer solstice; in some cases in the southern United States, the hottest days in late summer exhibit a mortality decrease. Heat-mortality relationships are much more consistent across larger cities than smaller cities.

Conclusion: The impacts of an anticipated climate change will vary among urban areas. The results show an increase in excessive heat event days and increased heat-attributable mortality across the cities with the most pronounced increase in the Southeast and Northeast. An evaluation to determine how various intervention activities would ameliorate this rise shows that public health responses and a nationalization of heat warning systems can dramatically lessen the increase posed by a climate change.

O-29A1-2

Mortality Related to Temperature and Persistent Extreme Temperatures—A Study of Cause-Specific and Age Stratified Mortality

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Background/Aims: High and low ambient temperatures cause large numbers of deaths annually. Many studies show higher mortality rates during heat waves, with mortality increasing with heat wave duration. However, such effects have not been explicitly incorporated in models of temperature and mortality; while from a physiological basis, dehydration followed by cardiovascular stress is more likely to occur in such conditions.

Methods: We established time-series Poisson regression models based on cause-specific mortality and age stratified mortality in Stockholm County, 1990–2002, adjusting for time trends and potential confounders. We studied the effects estimates as functions of time within summers and winters.

Results: Warmer temperatures increase all natural causes of death, while decreasing colder temperatures increases the risk of cardiovascular deaths. Moreover, persistent extreme heat exposure is associated substantially with additional deaths, and the risk of death increase significantly with longer heat exposure. Extreme exposure to heat is associated with higher death rates in people with lower age, compared to a rise in temperature. Furthermore, the impact of warm and cold temperatures decreases within the season, while the impact of persistent extreme heat exposure remains similar throughout the summer.

Conclusion: This study is the first to show that additional impacts of persistence of extreme heat exposure are important to account for in models of mortality related to ambient temperatures to avoid negatively biased estimates of the associated effects. Moreover, it appears that the impacts of temperature depend on the size of the pool of fragile individuals, while persistent extreme heat exposure increases the influx of new individuals to the pool and, thus, remain large throughout the season.

O-29A1-3

Diurnal Temperature Range and Cause-specific Cardiovascular Hospital Admission in Seoul, Korea—Time-series Analysis and Temperature-Matched Case-crossover Design

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Background/Aims: Rapid temperature change within a day may increase blood pressure, clot, or cardiovascular work load. Hence, diurnal temperature range (DTR) may cause higher risk of cardiovascular disease (CVD) for population vulnerable to thermal stress. In this study, we hypothesized an increase of DTR which was associated with cardiovascular-related hospital admission in Seoul, South Korea.

Methods: Data of daily hospital admission counts of 6 cause-specific CVD diseases in Seoul were collected from Korea National Health Insurance Corporation during 2003–2006. CVD diseases were arrhythmia, cardiac disease, cardiac failure, ischemic heart disease, myocardial infarction, and stroke. Results of time-series analysis and temperature-matched case-crossover design were compared. Associations in time-series analysis were evaluated using generalized linear model (glm) adjusted for confounding factors. In temperature-matched case-crossover design,