

# Urine Phenol And Blood Eosinophil Count: An Observation In Benzene Exposed Subjects

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## Abstract

Benzene is a volatile hydrocarbon pollutant. Some allergic symptoms have been reported for association with excretion of benzene metabolites. Potential mechanisms underlying the benzene- induced allergy are not well demonstrated. There have been no previous correlative studies between the levels of phenol, urine benzene metabolite, and eosinophil counts. Here, the correlation between the urine phenol and eosinophil count was studied in 30 Thai subjects occupationally exposed to benzene. Of interest, The regression analysis show no significant correlation between urine phenol levels and eosinophil counts ( $r = 0.07$ ,  $P = 0.67$ ). In conclusion, we did not demonstrate the correlation between the standard biomarker for benzene exposure, urine phenol level and the basic blood marker for allergy, eosinophil count.

## INTRODUCTION

The effects of airborne pollutants on the immune system have been most widely studied [1]. Entry may occur as a volatile gas (ozone, benzene), as liquid droplets (sulfuric acid, nitrogen dioxide), or as particulate matter (diesel exhaust, aromatic hydrocarbons) [1]. The subsequent interaction with the immune system may result in local and systemic responses, and studies have shown examples of disease occurring from both overactive immune responses and immunosuppression [1].

Benzene is a colorless poisonous air pollutant [2]. Breathing extremely high level of benzene can result in death while chronic benzene exposure brief many adverse systemic reactions. Recently, a study was performed to assess the correlation between average daily pollution and acute asthma admissions in Northern Ireland [3]. In this study, they concluded that benzene level was the only variable associated independently with asthma emergency-department admissions in children.

Although the mechanisms underlying benzene-induced allergy are not yet fully understood, they are likely to be complicated by various pathways, especially those of metabolism and cytokine pathway [4]. Obstructive bronchitis was observed more frequently in children exposed to increased concentrations of benzene, as well as toluene, styrene, and m,p-xylene [4]. In addition, atopic symptoms

were associated with excretion of those volatile hydrocarbon metabolites [4]. Rolle-Kampczyk et al found an association between eczema and exposure to toluene and between eczema and increased excretion of the benzene metabolite [4]. They suggested that evaluation of external biomarker for volatile hydrocarbon exposures could supplement the knowledge on internal process for volatile hydrocarbon allergy [4].

This aim of this work is to study the correlation between urine phenol, metabolite of benzene, and eosinophil count in the subjects occupationally exposed to benzene.

## MATERIALS AND METHODS

### 1. SUBJECTS AND SPECIMEN COLLECTION

Thirty Thai male volunteers without previous history of underlying hematological disorder and occupationally exposed to benzene in their daily work as traffic wardens were included in this study. The dosage of benzene exposure in these subjects was  $0.15 \text{ mg/m}^3$  (ambient air sampling by Mini Pump SKC 224 PCK R8, gravimetric analytical method NIOSH), higher than the reference level established by the California Environmental Protection Agency (CalEPA) ( $0.06 \text{ mg/m}^3$ ). After obtaining informed consent, each subject provided a urine sample for phenol level determination (reference value:  $0 - 10 \text{ mg/gCreatinine}$ ) using the extracted colorimetric method [5]. In addition, an EDTA blood sample was collected for eosinophil counts by

the automated hematology flow cytometry analyzer, Technicon-H\*3.

## 2. STATISTICAL ANALYSIS

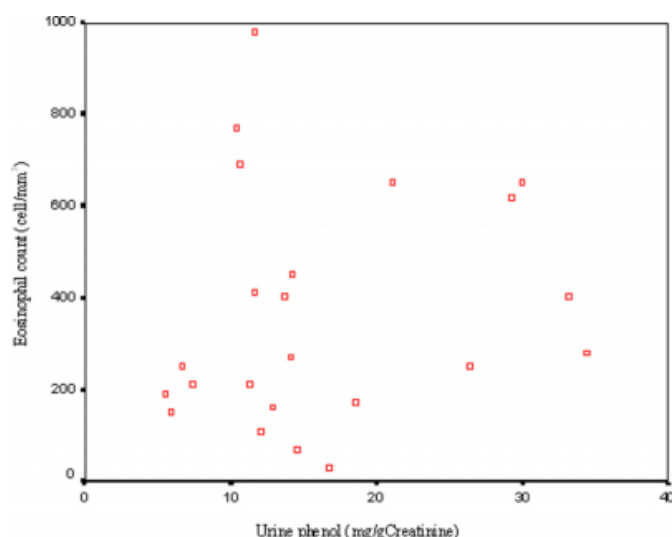
Data were collected for statistical analysis using SPSS 7.0 for Windows Program [6]. The correlation between the urine phenol level and the eosinophil count was assessed by regression analysis. A statistical significant level was accepted at P-value equal to or less than 0.05.

## RESULTS

The averages (mean  $\pm$  SD) of urine phenol level and eosinophil count of the volunteer subjects were  $13.3 \pm 3.2$  mg/gCreatinine and  $129.9 \pm 18.7$  cells/mm<sup>3</sup>, respectively. The regression analyses show no significant correlation between urine phenol level and eosinophil count in volunteer subjects ( $r = 0.07$ ,  $P = 0.67$ , Figure 1)

**Figure 1**

Figure 1: Scattergram for the correlation between urine phenol levels and eosinophil counts in volunteer subjects.



## DISCUSSION

Lehmann et al performed a study to investigate the association between indoor exposure to volatile organic compounds (VOC), prevalence of allergic sensitization and cytokine secretion profile of peripheral T cells in 3 year old children [7]. They noted that exposure to benzene was associated with higher percentages of IL-4 producing CD3+ T cells [7]. Both an increase in IL-4 producing type 2 T cells and a reduction of IFN-gamma producing type 1 T cells may contribute to a type 2 skewed memory in response to allergens [7]. There is also a previous report, which found correlation between benzene concentration in the air at work places and the change in the polymorphonuclear enzymes

levels[8]. In addition, Lee et al noted that hydroquinone (HQ), a major metabolite of benzene, might enhance allergic immune responses by enhancing IL-4 mRNA expression, IL-4 gene promoter activity and also immunoglobulin E from eosinophil [9]. However, there have been no correlative studies between the level of benzene metabolite, phenol in urine and the eosinophil. Here, we performed the study to answer that question. The author designed the study to examine the subjects, traffic wardens [10], who would possibly be at risk for such an effect.

According to our study, we detected no significant correlation between the urine phenol and eosinophil counts in our volunteers. This result agrees with the finding of Nicolai et al that no volatile hydrocarbon pollutant was associated with allergic sensitisation when monitored by measurements of specific immunoglobulin E [11]. Although some recent epidemiologic studies indicate correlations between existing of allergic symptoms and the exposure to benzene [3,4, 6], we did not demonstrate the correlation between the standard biomarker for benzene exposure, urine phenol level and the basic blood marker for allergy, eosinophil count.

However, some discussion on the limitations of this study should be made. Firstly, the small number of subjects can limit the generalization of the data. Secondly, it should concern the lack of eosinophil counts on the same patients in the absence of exposure to phenols. This point may be important if "baseline" eosinophil counts vary from patient to patient. Therefore, further studies with larger sample size focusing in the details of pathogenesis of white blood cell disorders and allergogenesis are necessary. The long-term pre-post benzene exposure following up is also recommended.

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**References**

1. Albright JF, Goldstein RA. Airborne pollutants and the immune system. *Otolaryngol Head Neck Surg* 1996;114:232-8
2. Agency for Toxic Substances and Disease Registry (ATSDR). (1997) Toxicological Profile for Benzene. Atlanta, G.A.: U.S. Department of Health and Human Services, Public Health Service
3. Thompson AJ, Shields MD, Patterson CC. Acute asthma exacerbations and air pollutants in children living in Belfast, Northern Ireland. *Arch Environ Health* 2001; 56: 234-41
4. Rolle-Kampczyk UE, Rehwagen M, Diez U, Richter M, Herbarth O, Borte M. Passive smoking, excretion of metabolites, and health effects: results of the Leipzig's Allergy Risk Study (LARS). *Arch Environ Health* 2002;57:326-31
5. Umberger CJ, Fiorese FF. Colorimetric method for hippuric acid. *Clin Chem* 1963; 9: 91-96
6. Ludbrook J. Update: microcomputer statistics packages. A personal view. *Clin Exp Pharmacol Physiol* 1997; 24: 294-6
7. Lehmann I, Rehwagen M, Diez U, Seiffart A, Rolle-Kampczyk U, Richter M, Wetzig H, Borte M, Herbarth O; Leipzig Allergy Risk Children Study. Enhanced in vivo IgE production and T cell polarization toward the type 2 phenotype in association with indoor exposure to VOC: results of the LARS study. *Int J Hyg Environ Health* 2001; 204: 211-21
8. Moszczynski, P. and Lisiewicz, J. Enzymes of neutrophils in workers occupationally exposed to benzene, toluene and xylene. *Rev Esp Oncol* 1984; 31: 435-41
9. Lee MH, Chung SW, Kang BY, Kim KM, Kim TS. Hydroquinone, a reactive metabolite of benzene, enhances interleukin-4 production in CD4+ T cells and increases immunoglobulin E levels in antigen-primed mice. *Immunology* 2002; 106:496-502
10. Carere A. Benzene exposure among urban traffic wardens in the City of Rome: preliminary results of a pilot project. *Ann Ist Super Sanita* 2000;36:291-5
11. Urban traffic and pollutant exposure related to respiratory outcomes and atopy in a large sample of children. *Eur Respir J* 2003; 21:956-63

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