PM_{10} and $PM_{2.5}$ air pollution in Chinese village homes in the Xuanwei region

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Objective: Xuanwei is a county in the northeast of Yunnan province, China. It is rich in coal resources and well known for the high morbidity and mortality caused by lung cancer in some places in this region. Previous studies indicated that this high lung cancer mortality could not be attributed to smoking or occupational exposure. Instead, it was highly associated with indoor air pollution (Lv et al., 2009). High level of particulate matter (PM_{10}) and toxic organic compound, such as polycyclic aromatic hydrocarbon (PAHs) from coal or wood combustion in the unvented fire pit, was suggested to be the reason for the high lung cancer morbidity and mortality (the highest mortality in china among none-smoking women) in these places. Recently, high concentration of quartz present in the coal has also been proposed to be involved in the cancer development. In spite of many studies, none of them can fully explain the high lung cancer rate in this area. The objective of this study is investigation of the present status of the particulate matter and chemical compound pollution after stove improvement, and what could be the possible difference regarding the indoor particulate matter composition between villages with high and low cancer rate in Xuanwei.

Methods: Seven PM_{10} and 3 corresponding $PM_{2.5}$ samples were taken in four houses in Hutou village with high lung cancer rate, and two houses in Xize village and one house in Luoshui village with low cancer rate in Xuanwei. Organic molecular markers, including PAHs, alkylated PAHs, and biomass burning tracer substances, in these samples were simultaneously analyzed by in-situ derivatisation thermal desorption gas chromatography coupled with time of flight mass spectrometry (IDTD–GC–TOFMS). Elements were determined by inductively coupled plasma mass spectrometry (ICP-MS). Elemental and organic carbon component (EC/OC) was analyzed by thermal-optical analysis IMPROVE-A protocol.

Results: As can be seen from Table 1, our result indicates that the indoor air pollution due to PM and PAHs is somehow alleviated with the ventilation of chimney, yet it is still problematic. As for Benzo[a]pyrene (BaP), it is much higher than the Chinese national standard (GB/T18883-2002) 1.0 $ng.m^{-3}$ with regard to daily average. The other PAHs levels, which are not included in the standard, are also very high. We also found that there was relatively low $PM_{2.5}$ fraction in the PM_{10} (29%, 55% and 32% in Hutou, Luoshui and Xize, respectively), as well as even lower percentages of PAHs in $PM_{2.5}$ (21% ±9%, 18% ±3% and 24%±4% in Hutou, Luoshui and Xize, respectively) as well as some elements of extremely low percentages in $PM_{2.5}$ in Hutou. This indicates that the re-suspended particulate matter plays an important role in the indoor air pollution in these rooms. The alkylated-PAHs are detected to be higher than or comparable to their mother PAHs in different samples from Hutou and Luoshui, where coal is burned in fire-pit or stand stove. However, few types of alkylated PAHs and lower ratio compared to the mother PAHs are detected in Xize village, where wood is burned in different stove, as is shown in fig 1. Biomass tracer compounds are found to abundantly exist in samples from Xize, where wood is burned.

Table 1. PM_{10} and BaP concentration comparison of our measurement with data from literature

Study	Our study			Study 1		Study 2		Study 3	Study 4	
Ventilation	Vented			Unvented		Unvented	Vented	Vented	Unvented	Vented
Region	Hutou	Xize	Luoshui	Laibin	Luoshui	Xuanwei	Xuanwei	Xuanwei, Fuyuan	Xuanwei	Xuanwei
BaP	92	105	87	679.7	437.6	1660	250	95.7	901.3	143.0
PM_{10}	355	227	401			2080	710		1600	500

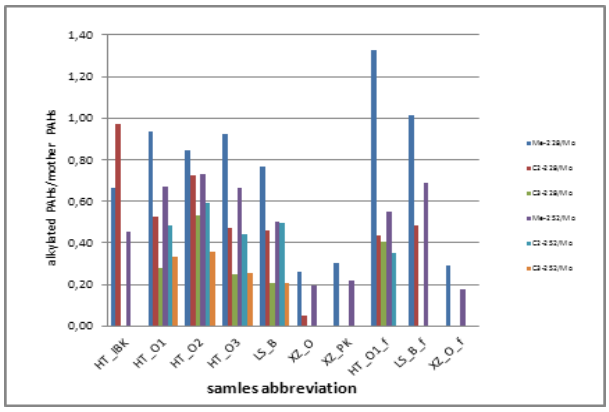

Fig 1. Ratios of alkylated PAHs to their mother PAHs. Me-228/Mo, C2-228/Mo, C3-228/Mo refer to the ratio of Methylated, two carbons or three carbons alkylated PAHs to their mother PAHs with molecular weight of 228. The same for PAHs molecular weight 252.

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