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A HOUSEHOLD SURVEY OF THE COST OF ILLNESSES DUE TO AIR POLLUTION IN BEIJING, CHINA

Y. POPP JIN, M.QUAN, C. RAVETTI, Z. SHIQIU, T.SWANSON

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Popp Jin* , Y., M. Quan*, C. Ravetti †, Z. Shiqiu*, T. Swanson †

Abstract

This paper examines with a case study of Beijing, China, the health benefits that could be reaped from urban air quality improvements. The study implements a household survey to collect information about the yearly medical expenditures and lost days of work, to estimates the total costs of illness (COI) borne by a typical individual due to airborne diseases. The results of this survey provide a lower bound for the health costs borne by the urban population of Beijing due to air pollution. We find that the average individual COI in our sample is more than 3000 yuan per year, corresponding to almost one month of the average wage (slightly more than 500 US$ per year). This is quite sizeable, considering that it represents just the minimum benchmark for the damages caused by pollution to health. This result indicates that Beijing could benefit quite substantially from reducing air pollution in terms of health costs: if it could completely eliminate pollution, the savings in terms of COI would range in an order of magnitude of 21 million yuan per year only from hospitalized cases.

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* Peking University, College of Environmental Sciences and Engineering, , Beijing, China.
† Centre for International Environmental Studies, Graduate Institute of Geneva (IHEID), Maison de la Paix, Ch. Eugène-Rigot 2,CH-1211, Geneva, Switzerland

Introduction

In developing countries, global environmental problems such as climate change might be perceived as second order concerns, compared to more urgent developmental needs. Even local problems, such as urban air pollution, are rarely considered to be among the top priorities by governments in such countries, despite potentially large health costs imposed upon the population. A typical example is the case of China, a country that suffers from air pollution to a particularly large extent: according to the Asian Development Bank, 7 out of 10 of the most polluted cities in the world are in China, and 70% of the total urban population (more than 360 million) live in areas with hazardous air quality (ADB 2007). In China local environmental problems are imposing substantial costs on that society.

Moreover, these local environmental problems can be linked to global issues as well. Many of the same production processes and congestion problems result in both local and global pollutants. It could be therefore argued, in line with the literature on ancillary benefits of climate change mitigation policies (Ravetti et al. 2014), that China could benefit from lowering these emissions, both for the health of its current population and for the welfare of future generations everywhere.

This argument requires some estimates of the local values that are to be obtained from generating cleaner air. One of the main impacts of poor air quality is its effects on health, both acute and chronic. Many respiratory complaints and illnesses can be linked to the pollutants flowing into local air supplies. Efforts to reduce these health effects may target the same production processes that generate global problems as well as these local problems. To persuade authorities to take these environmental problems seriously, some measure of the local impacts may be necessary.

This study pursued this objective by means of attempts to quantify the health impacts of local air pollutants in Beijing. We conducted a survey, consisting of a computer-based questionnaire provided to approximately one thousand five hundred residents of the city, in which individuals were questioned about the incidence of respiratory illness, and the costs of these illnesses (both in terms of lost days and also in terms of

self-protective measures) across these households. This survey provides a "cost of illness" (COI) approach to measuring the real impacts of air quality in Beijing (El Fadel and Massoud 2000). This approach is of course subject to caveats regarding the respondents' abilities to recollect or respond accurately for the surveyor, and in terms of the types of costs considered -. These benefits from management of air pollution problems are demonstrated here to be significant and real.

Household Survey

The first survey reported here was conducted jointly by Peking University and IHEID in order to measure the cost of respiratory illnesses potentially linked to air quality problems in Beijing. For purposes of this study, we focused on securing data on actual health problems in the city, and the costs flowing from these health problems (in terms of averting behaviour and avoided work).

One of the key difficulties in estimating the cost of illness in China is data limitation: hospital data are very imprecise, and household surveys are rarely representative in terms of sampling, as they are usually based on street interviews and so-called "typical sampling". This survey tries to overcome these problems by collecting health characteristics from a sample that was carefully designed to be representative of the whole of Beijing. Obtaining authorization for collecting such data is quite complex in Beijing, but the resulting dataset has many important characteristics for analysis. First of all, it can ensure that the sample is representative of the three districts sampled (unbiased) and, as long as other districts in Beijing are not too different, results for this sample could be extended to the entire urban area (external validity). Moreover, collecting data door-to door rather than interviewing in the streets allows for longer and more detailed questionnaires. Therefore, even without hospital data, we can approximately apply the estimated COI the city level, to get a broad sense of the magnitude of gains that a reduction in air pollution would imply for individual costs of airborne disease.

1 - Survey and Data

1.1 Survey period

The survey interviews were conducted under the supervision of the College of Environmental Science and Engineering of Peking University (PKU). Pilot studies and extensive training for interviewers were done in the initial month of the study in order to ensure the clarity and effectiveness of the survey.

1.2. Questionnaire

The household survey consisted of different sections, comprising:

- Personal characteristics: age, education, income and financial information, smoking status, extended family support, location and past migration, division of tasks in the house.
- Health and airborne diseases: symptoms, acute, chronic, other diseases, self-rated health, insurance expenditure, direct and indirect cost of illness.
- Exposure to air pollution: transportation, time of commuting, daily time outdoors.
- Information on pollution: how the household accessed information on daily pollution levels.
- Averting behaviours in normal or extreme times, and use of air purifier.

In addition, at the end of the interview the investigator annotated the length of the interview, how willing to respond was the interviewed person and whether anyone disturbed the respondent. Interviews were registered and a random sample of registration was checked for any systematic mistakes by an interviewer.

1.3 Sampling

We obtained a sample of 578 respondents (1672 individuals) in three districts of Beijing, Haidian, Dongcheng and Chaoyang applying the following sampling procedure:

- District
- Street

} Probability Proportional to Size (PPS)

- Community
- Household

} Random sampling

We wanted to ensure that every household in Beijing had the same chances of being chosen for our survey, a priori. Given the different steps of selection, the complete probability of a household being interviewed was:

$$p_0 * \frac{[N_H]_{D1}}{[N_H]_{TOT}} * p_1 * \frac{[[N_H]_{S1}]_{D1}}{[N_H]_{D1}} * \frac{p_2}{[[N_{C1}]_{S1}]_{D1}} * \frac{x}{[[[N_H]_{C1}]_{S1}]_{D1}} = c$$

W0 - Choice of district (PPS)	W1 - Choice of street (PPS)	W2 - Choice of Community (Random)	Choice of household (Random)

For any given person, this was the product of the probability that *his/her* district was chosen, then *his* street, then *his* community, and finally *his* household, all together. It assumes that the choice of District and Street was done based on its population, i.e. giving larger chances to bigger units. This is done by Probability Proportional to Size (PPS) selection.

$\boldsymbol{N_H}$ is the number of households, the subscript indicates where.

$[\boldsymbol{N_H}]_{\boldsymbol{TOT}}$ is the total number of households in the Beijing population, 220.5

$[\boldsymbol{N_H}]_{\boldsymbol{D1}}$ is the total number of households in District 1

$[[\boldsymbol{N_H}]_{\boldsymbol{S1}}]_{\boldsymbol{D1}}$ is the total number of households in Street 1, District 1

$[[[\boldsymbol{N_H}]_{\boldsymbol{C1}}]_{\boldsymbol{S1}}]_{\boldsymbol{D1}}$ is the total number of households in Community 1, Street 1, District 1

$\boldsymbol{N_H}$ ***chosen in C1*** is the number of *chosen* households in Community 1, Street 1, District 1. It is the key variable we can change to make probabilities match, which we can call X.

$\boldsymbol{p_0}$ is just 3, the number of districts we are choosing out of the total ones

$\boldsymbol{p_1}$ is the number of streets we are selecting in a district, given total number of streets in that district (e.g. in DC is 2)

$\boldsymbol{p_2}$ is the number of selected communities chosen in a given street for a given districts. Probably will be given to us by the Street leader.

$\boldsymbol{c}$ is the final probability, which we want to be constant for all households.

The above equation illustrates the probability for a household in District 1, in Street 1 and in Community 1 to be selected. We have many of such equations, indicating the probability of households in all other districts, streets and households being selected.

In order to guarantee that this probability is constant across all households (c is the same for all equations), we set X as an arbitrary but reasonable number for the first of these equations, then we solve in all others for X so to guarantee that the equality always holds. In this way, every household chosen has the same probability of selection, c (and so would have had any other household in Beijing, if it had undergone the same selection process):

$$x = c * [[[N_H]_{C1}]_{S1}]_{D1} * \frac{1}{\left[p_0 * \frac{[N_H]_{D1}}{[N_H]_{TOT}} * p_1 * \frac{[[N_H]_{S1}]_{D1}}{[N_H]_{D1}} * \frac{p_2}{[[N_{C1}]_{S1}]_{D1}}\right]}$$

The resulting sample is structured as follows:

District	Total agents	Total households	Community	Individuals	Households
Haidian	628	215	fuyi	44	16
			dongnan	61	21
			hualian	40	16
			hejianlou	63	25
			zefengyuan	72	21
			huangzhuang	45	18
			taiyangyuan	78	25
			dongyingfang	88	27

			xiaonanzhuang	68	23
			daoxiangyuannan	63	22
Dongcheng	455	156	jingtai	46	16
			taoyanglu	105	32
			xigexinli	78	30
			jinbaojiebei	117	40
			zhaojialou	103	36
Chaoyang	500	185	yuhuili	36	13
			xibahexili	57	22
			guangximenbeili	51	20
			balizhuangnanli	48	18
			chenguangjiayuan	58	23
			shilipunanli	26	10
			liulitunbeili	55	19
			xibahenanli	46	17
			huizhongli2	81	27
			huizhongbeili1	54	19
Total	1583	556		1583	556

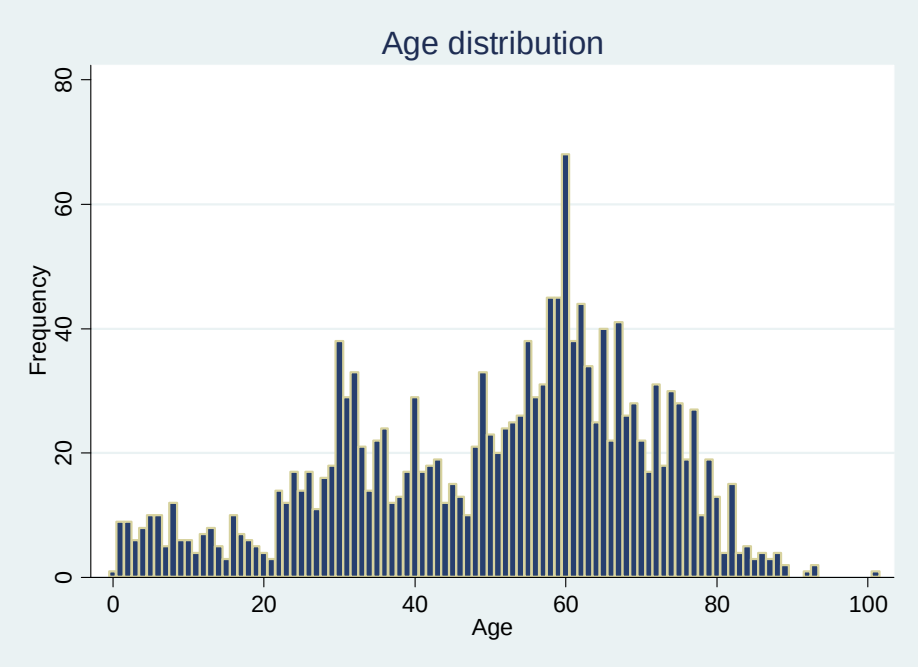
1.4. Stylized facts

In terms of age, gender, education and income characteristics of our surveyed individuals, these reflect quite accurately the characteristics of the overall population, as described in the Beijing Statistics Bureau. In some cases a direct comparison is possible with data from the Bureau (see gender) and the survey results in line with official figures.

1.4.1 Age, gender, education

District	Average age
Dongcheng	50.9
Haidian	50.8
Chaoyang	49.8

The age distribution is shown below: the distribution is slightly skewed to the right, indicating that older respondents were more likely to be at home to respond to the interviews. However, since this problem of age bias is well known in door-to-door interviews, the time and days of visits were greatly varied to ensure that different people could respond to the questionnaire.



Averages by district and by gender group are well representative of the districts and are very close to the official statistics of the National Census.

Age by gender group				
	Survey		**6th national census**	
	Female（%）	Male（%）	Female（%）	Male（%）
Dongcheng	52.7	47.4	50.6	49.4
Haidian	51.1	48.9	48.3	51.7
Chaoyang	52.4	47.6	48.5	51.5
Average	51.8	48.2	-	-

In terms of education, Beijing has relatively high levels of literacy:

District	Average education[2]
Dongcheng	3.5
Haidian	3.7
Chaoyang	3.6
Average	3.6 (between middle school and high school/technical school)

Given the characteristics of the population in these districts, it is reasonable that the average education level in Haidian is higher than in the two other districts. However these values are not directly comparable with Statistical Yearbook averages, since their definition differs from the one used in the survey.

1.4.2 Income and monthly wage

Also household income is comparable to the official statistics, but only for past years. Since we asked for information about income also 2 and 5 years in the past, these are then comparable.

	Survey			Statistical Yearbook	
Districts	Total household income (year)	2 years ago	5 years ago	2 years ago	5 years ago
Dongcheng	84'135	91'200	53'878	85'491	----
Haidian	147'756	112'246	103'379	109'078	----
Chaoyang	117'804	105'368	82'185	93'256	68'701
Average	119'931	105'673	79'814	95'942	----

In our survey, the comparable values are slightly higher, but this is aligned with

[2] The education levels correspond to: 1. Just basic literacy/kindergarten 2. Primary 3.Middle school 4 High school /Technical school 5 University 6 Master and above (PhD, Postdoc)

the literature that identifies a downward bias in the household income declared in the Census interviews reported in the Statistical yearbook (Bramall 2001).

Net Monthly Wage(yuan/month)			
District	Average	Female	Male
Dongcheng	3918	4014	3844
Haidian	5651	4279	6671
Chaoyang	4899	4095	5504
Total	4883	4140	5441

2 - Analysis

2.1 Airborne diseases

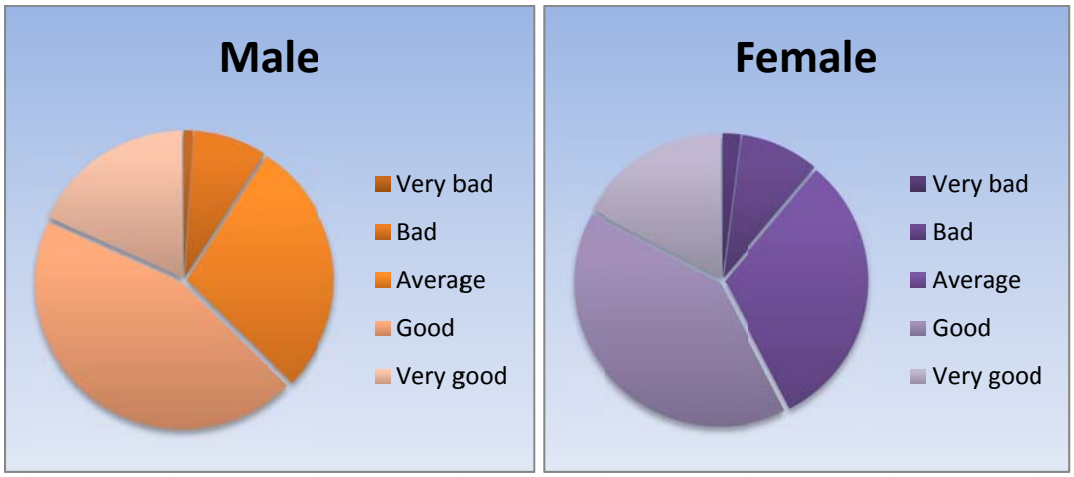
The survey asks a detailed set of questions about the health status of the interviewees and their families, especially in relation to airborne illnesses that can be connected to pollution and exposure. Below are summarized some of the characteristics of these variables.

2.1.1 Self-rated health

How do you consider your health compared to the same age group and same gender?

Self-rated health	Total
1 - very good	18 %
2 – good	42 %
3 – average	30 %
4 – bad	9 %
5 - very bad	2%
Average rating	2.3

By gender, there are no striking differences in health perception:



2.2.2 Symptoms

We proposed a list3 of respiratory symptoms that the literature connects with air pollution and ask respondents to indicate if they suffer from any of these, and if so when.

Suffering from air-pollution symptoms	Frequency	Female	Male	Total months with symptom episodes in a year (average)
No	46 %	43%	49%	1.9
Yes but they are not so bad, I can go on with my daily life	42 %	44%	40%	7% of sample has symptoms during the entire year.
Yes and they are bad, they affect what things I can do in my daily life, I have to take some medicines	11 %	11%	10%	
Very bad, I often take medicines, sometimes I have to stay in bed, they hurt a lot.	1 %	1%	1%	

[3] Symptoms considered are : Eye/nose/throat irritation; Runny nose/Cold; Flu/Fever; Skin infection/ rash; Asthma attacks; Shortness of breath; Respiration allergy to dust; Dry scratchy throat; Chest pain; Cough with phlegm; Dry cough; Drowsiness; Headache; Whistling and wheezing in the chest.

2.2.3 Acute, chronic and other disease

For chronic diseases, 90% of cases are diagnosed by doctor. On average, in our sample individuals have been suffering from the chronic disease for previous 14 years.

These chronic airborne diseases…	Compared to 2 years ago	Compared to 5 years ago
Didn't have them	7 %	20 %
It improved	17 %	13 %
It got worse	15 %	16 %
Stayed the same	60 %	51 %

For acute episodes of airborne illnesses, only 55% were diagnosed by a doctor. In fact, when asked what they do when in pain, almost half of our sample declared that they only adopted self-care measures.

Acute airborne illnesses episodes: how many months	Percentage
0	70 %
1	12 %
2	11 %
> 2	6 %
All year	1 %

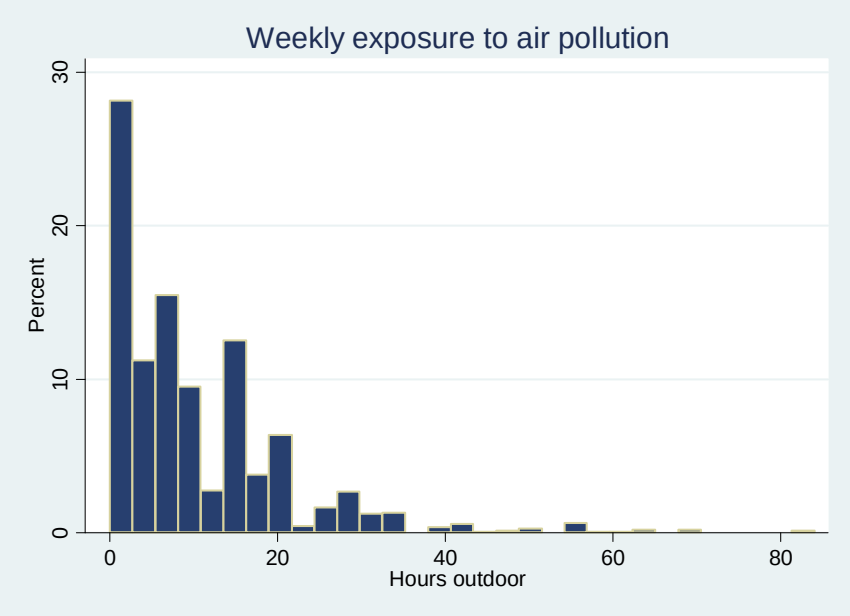
2.2 Exposure (time outdoor)

The survey collects information about weekly exposure to air pollution, in the form of time spent outdoor for leisure or for work, during weekdays and weekends, during two different parts of the year, hotter and colder months. This information is then aggregated to obtain weekly exposure, by averaging these

values over the whole year and then summing for weekly exposure the daily hours out (multiplying by 5 the weekday exposure and by two the weekend one).

Summer (April –Oct)				**Winter (Nov-March)**			
Weekday		Weekend		Weekday		Weekend	
Leisure	Work	Leisure	Work	Leisure	Work	Leisure	Work
1.5 hours	0.1	1.7	0.1	1.2	0.1	1.3	0.1
Average (weekly)	10 hours outdoor a week						

But with great heterogeneity, as illustrated in the histogram below.



3 -Results

3.1 Correlations: health expenditure and illnesses

Instead of simply correlating the yearly cost of illness with pollution, which is invariant for individuals, we look at the correlation to individual exposure. Cost

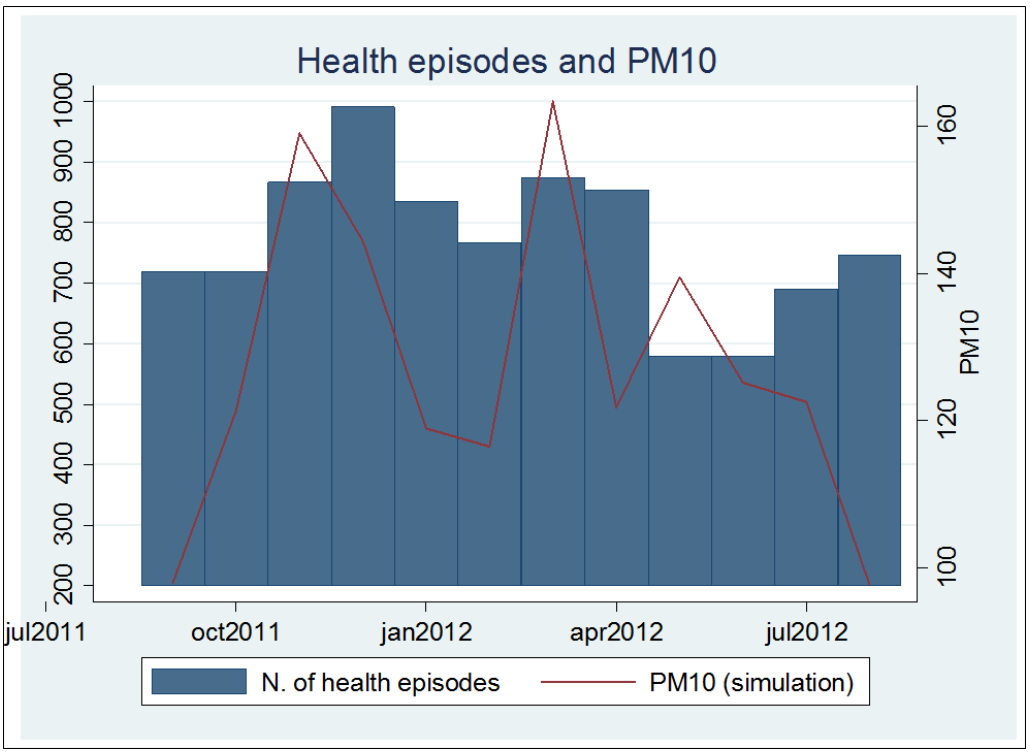
of illness does not have a time dimension, as we only have the total spending for the whole year, direct and indirect costs, see Paragraph 3.3, while for acute, chronic and symptoms we ask to recall the monthly variation of illness episodes.

	Exposure	COI	Acute	Chronic	Symptoms	Self-rated
COI	**0.0761** 0.0086	1.0000				
Acute	0.0124 0.6297	0.0125 0.6581	1.0000			
Chronic	**0.1186** 0.0000	0.3093 0.0000	0.0054 0.8280	1.0000		
Symptoms	**0.0539** 0.0355	**0.1247** 0.0000	**0.1297** 0.0000	**0.2036** 0.0000	1.0000	
Self-rated	-0.0061 0.8123	**0.3009** 0.0000	0.0108 0.6633	**0.3519** 0.0000	**0.1686** 0.0000	1.0000

Highlighted in bold are the significant correlations. Acute diseases are somewhat different: they do not significantly correlate with hours of exposure, or with cost of illness.

3.2 Exposure and illness episodes

Using air pollution data on particulate matter from Beijing monitors and the monthly variation of illness episodes, we can see that the total airborne diseases in our sample tent to move together with the pollution levels. We are not trying to estimate here dose-response functions, since there is a much more accurate epidemiological literature doing it, but at least we can observe that air pollution peaks tend to come together with more episodes of airborne disease.



3.3 Cost of Illness (COI)

The COI represents a lower bound on how much people would gain from reduced airborne diseases: it only takes into account direct costs, and gives no value to pain, inconvenience and non-monetary damages caused by the illness. It is however a good benchmark to estimate the minimum level of benefits that the population would enjoy from reduced air pollution.

3.2.1 Direct and indirect costs

In our sample, airborne illnesses appear to be a substantial component of total medical expenditure, making up for more than half of total direct costs of sickness over the year. This might be overestimated, given that our survey gave much more importance to airborne diseases than to all sickness, but it gives an indication that airborne diseases are not an irrelevant component of the medical expenditure of a Beijing resident. However people tended not to take days off because of these airborne diseases, nor remain inactive (more than 90% of respondents indicated zero work days lost because of airborne diseases).

	Direct cost of airborne illness	Days of work lost	Paid sick leave	Days of inactivity
Average (only airborne diseases)	2514 yuan	1.4	0.5	9
Average (including other illnesses)[4]	5184 yuan	18	13	53

We can calculate the indirect costs of illness as foregone wage, which was not earned due to the illness nor compensated as sick leave. From this, we get the total cost of illness experienced by the individual.

	Indirect cost of illness = wage* (days lost-sick leave days)	Total cost of illness
Average (only airborne diseases)	812 yuan	3326 yuan
Average (including other illnesses)	305 yuan	5489 yuan

Again, results are much more accurate for airborne diseases than for total illnesses. It is in fact somewhat puzzling that, even if more days are lost for total illnesses than for airborne ones, the foregone wage should be smaller for the former than for the latter (around 800 versus 300 yuan). This could be due to the very specific sample of people who declared also other illnesses beyond airborne ones, probably those who suffer from some other very invalidating disease which correlates with a much smaller wage anyways.

Nonetheless, looking at these results, we can see that airborne diseases are quite costly on average for the Beijing population: more than 3000 yuan per year, corresponding to almost one month of the average wage (a bit more than 500 US $ per year).

[4] Note that we have a much smaller sample of respondents for all other illnesses: for the lost days of work, we have only 86 responses. This might be due to the fact that our survey did not focus on the overall health costs for an individual, but rather on airborne diseases.

3.2.2 Preventive medical consultations and insurance

Furthermore, we asked how many preventive health checks they took in the previous year and how much they had to individually pay for them (i.e. not covered by the insurance, employer, etc.).

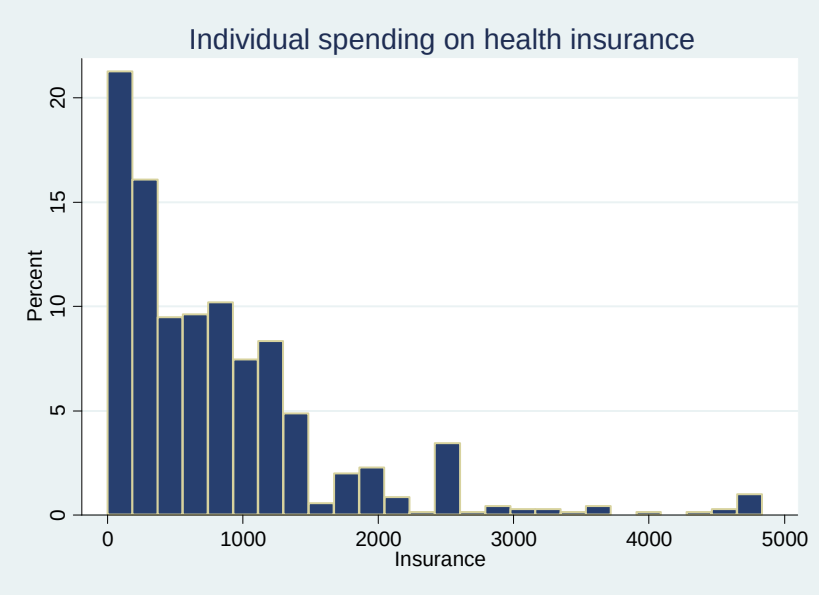
Number of preventive medical checks	Frequency	Expenditure	Yuan
0	27 %	Average	102
1	70%	Min	0
> 1	3%	Max	15 000

For insurance, the respondents used several different strategies of coverage:

Insurance type	Frequency
No insurance	4 %
Urban employee medical insurance	75%
Urban resident medical insurance	12%
New cooperative medical insurance	0.4%
Other social medial insurance	1 %
Commercial medical insurance	1%
More than one insurance	2.6%
Missing	4%

Average individual spending on insurance is 1063 yuan per year, with few outliers spending much more (up to a maximum of 48 000 yuan) and the majority actually spending very little and relying on what is covered by the government or their employer (see histogram below[5]).

[5] For graphical purposes, the 13 largest expenditure, above 5 000 yuan per year are omitted.



3.2.3 COI and air pollution

An important related policy question is how much a decrease in pollution could reduce this health expenditure. This cannot be answered directly using our survey data, but dose-response functions from the existing literature can be applied in order to understand broadly the order of magnitude of the benefits of pollution reduction. Since our sample was designed to be representative of the Beijing population, COI should as well loosely represent the typical cost faced by an urban resident of the capital,[6] composed of circa 20 million people.

The epidemiological literature produced a number of estimates for China, related mostly to hospital admission caused by air pollutants, both for mortality and morbidity - for instance Aunan and Pan (2004) finds that the hospital admissions related to respiratory diseases attributable to changes in particulate matter (PM10) had a coefficient of 0.12%. Given that we have a no hospital admission data, we use the factors of change imputed to PM10 in causing acute airborne episodes.

In our sample, over the year there were 1065 acute episodes, of which 544 were cured by a doctor or a nurse in a clinic or a hospital. We can roughly extrapolate these results from our sample to the whole Beijing population, knowing that the

[6] In order to apply the results to the entire country, more complex benefit-transfer methods should be implemented, adjusting at least for different levels of income in other cities or, even more importantly, in rural areas. We leave this for further research.

results will be far from accurate: if the proportions in the total Beijing population are similar to those in our sample, there would be around 13 million episodes of acute airborne disease last year, out of which 6 million would lead to a hospital visit.[7] Therefore a 10 micrograms decrease in PM10, according to the values of the epidemiological literature, would translate into a fall of around 7000 cases of hospitalized acute airborne episodes, or more than 15'000 cases of airborne illnesses, if the coefficient was still valid not only for hospital admissions but for all disease episodes (probably it would be underestimated then). These are very imprecise estimates, but they indicate what order of improvement could be expected from reducing air pollution.

To calculate the monetary value of such a reduction in illness episodes, further assumptions are needed. If we apply the calculated COI of 3326 yuan to every episode, since a person has on average one acute episode per year, we find that the individual saving for the Beijing population from reducing air pollution ranges around 21 million yuan only from hospitalized cases, and more than double for all cases. These are only indicative values, which give very approximate values for the costs of illness to urban residents, however they already provide a general sense of the magnitude of benefits that could be reaped by a single city, should it reduce its pollution emissions.

4 – Conclusion

The results of this survey provide the lowest possible bound for the health costs to the urban population of Beijing of air pollution. Simply accounting for medical expenditures and foregone wage due to airborne diseases, we see that the average cost of illness is sizeable at the individual level, and becomes very large when aggregated and scaled up at the city level. These results exist, even without taking into consideration public costs, e.g. costs to the health system (hospital beds, medicines covered by the state, public insurance, etc.), and ignoring all intangible private costs (discomfort, pain, other costs not stated in the survey).

[7] With a population of 20 million people, if the relationship is stable we have that: 1639:20 000 000=1065:Y1 and 1639:20 000 000=544:Y2. Y1 solves to 12 995 729 (episodes of acute airborne diseases). Y2 solves to 6 638 194 (episodes of acute diseases that require to go to the hospital)

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Appendix - Sample of questionnaire I

A. Personal Characteristics

How many people live **in the same house**? Do you share your money with all of these people for everyday expenses (food, clothing, car, etc)?®

Mark as R the respondent person, M1, M2...MX the members of the family who live in the same apartment and share the same money.

For every question, ask first about the **respondent R**, then about family **members M** who live with him
(Unless the cells are covered for other family members).

ID	Relation to respondent (Father/mother/Son/daughter/ Brother/Sister/Wife/husband/ Other)	A0. How many months did this person spend in this same house in the last year (past12 months)? Drop those who spend less than 6 months	A1. Gender 0 M 1 F	A2. age (or Year born if preferred)	A3.Place of birth 1. Same district in Beijing 2. Other district in Beijing 3. Outside Beijing (rural) 4. Outside Beijing (urban)	A4. Highest education level completed 1. Just basic literacy/kindergarden 2. Primary 3.Middle school 4 High school /Technical school 5 University 6 Master and above (PhD, postdoc)	A5. What best describes your current position? 1. Student 2 Retired and not working 3.Stay at home 4 Retired, still working 5 Worker
R					_	_	
	_				_	_	_

B. Health

Insurance								
ID	B1.What is the current medical insurance type (for 2012)? (can be multiple choice) 0 none(skip to C2) 1 urban employee medical insurance 2 urban resident medical insurance 3 new cooperative medical insurance 4 other socail mecial insurance 5 commercial mecical insurance	B1.1 Were the types of medical insurance in 2011 the same with this year? 0 yes 1 no，the different types are___(	B1.2 What was the wage one year before retirement? Yuan/month (for the retired who choose 1 in B1/B1.1)	B1.3 What should you pay for the insurance each year? Yuan/year (for the ones who choose 3/4 in B1/B1.1)	B1.4 What should you pay for the commercial medical insurance each year? Yuan/year (for the ones who choose 5 in B1/B1.1)	B2. If the answer is no (0) medical insurance, why not? 1 I do not need insurance, I am healthy. 2 It is not worth because insurance reimburses only small amount of total medical costs. 3 The premium is too high for me to afford 4 Other (specify)	B3. Do you have any other types of insurance (consider those you have to pay for)? 0. Property insurance 1. Life, accident insurance 2. none	B3.1 What is the main purpose of buying the insurance? 0 averting risk/protecting life 1 investment 2 others
R								

ID	B4 How do you consider your health compared to same age group and same gender? 1 Very good 2 Good 3 Average 4 Bad 5 Very bad	B4.1 How do you consider your health of 2 years ago? 1 Very good 2 Good 3 Average 4 Bad 5 Very bad	B4.2 How do you consider your health of 5 years ago? 1 Very good 2 Good 3 Average 4 Bad 5 Very bad	B5. How many cigarettes do you smoke per day? (0 if non-smoker)	B5.1. How many years have you been smoking (include if was smoker in the past and stopped less than a year ago)?	B6. How many preventive health service/ visits did you do last year?	B6.1 How much did this service cost every time you did it? 0. Nothing, the govt/my company paid for it I paid _____	B7. Do you suffer from any of the following symptoms (see list in Appendix)? 0 no 1 yes but they are not so bad, I can go on with my daily life 2 Yes and they are bad, they affect what things I can do in my daily life, I have to take some medicines 3 Very bad, I often take medicines, sometimes I have to stay in bed, they hurt a lot.	B7.1 In which month do they manifest most? (Multiple answers possible)	B7.2 Do you have them frequently ? 0 no 1 yes
R	_									
	_									
	_									

Airborne Chronic Diseases									
ID	B8. Did you suffer from any airborne chronic disease in the last year? 0 No 1 Chronic Asthma 2 Chronic Bronchitis 3 COPD 4 Other chronic respiratory infection (Chronic Rhinitis, Pharingitis and similar diseases)① 5 Cardiovascular 6 Hypertension	B8.1 How many years have you been suffering from it②?	B8.2 severity of your chronic disease compared to 2 years ago? 0 Did not have it at that time 1 now better 2 now worse 3 basically the same	B8.3 severity compared to 5 years ago? 0 Did not have it at that time 1 now better 2 now worse 3 basically the same	B8.4 Was it ever diagnosed by a doctor? 0 no 1 yes	B8.5 In which months did you have it last year? Indicate as many as needed If all year, write 13	B8.5.1 During those months, how would you rate the pain it causes you? 0 Not painful or disturbing, I can cope with it 1 Painful and disturbs a bit my daily life 2 Very painful, usually disturbs my life any time I have it	B8.6 What is the main thing you did when you felt a lot of pain? 1 self-care 2 asked for help to family/friends 3 Saw a doctor/nurse (hospital, clinic)-jumt to G11 4 Nothing	B8.6.1 If did **not** answer 3 what was the main reason? 1. Sickness was not so bad/I can take care just myself or with family help 2. Do not like the service of doctors /hospitals 3. Could not afford cost 4 Too busy/ no time 5. Other (specify)
R									

Airborne Acute Illness Episodes									
ID	B9. Did you suffer from any acute illness episode last year? 0 No 1 Asthma 2 Bronchitis 3 Acute respiratory infection (Rhinitis, Pharyngitis and similar diseases) 4 Other___	B9.1 Was it diagnosed by a doctor? 0 no 1 yes	B9.2 In which months did the illness occur? Indicate as many as needed If all year, write 13	B9.2.1 How would you rate the pain it causes you in those months? 0 Not painful or disturbing, I can cope with it 1 Painful and disturbs a bit my daily life 2 Very painful, usually disturbs my life any time I have it	B9.3 What is the main thing you did when you felt a lot of pain? 1 self-care 2 asked for help to family/friends 3 Saw a doctor/nurse (hospital, clinic)-jumt to G11 4 Nothing	B9.3.1 If did **not** answer 3 what was the main reason? 1. Sickness was not so bad/I can take care just myself or with family help 2. Do not like the service of doctors /hospitals 3. Could not afford cost 4 Too busy/ no time 5. Other (specify)
R						

Cost of airborn illness												
ID	B10. How much did it cost for the illness mentioned above **in total** in the past 12 months? If unclear, can move to D3.1	B10.1 How much did you **pay individually** for the illness mentioned above for health in the past 12 months? If still unclear, move to 3.2	B10.2 How much did **pay individually for health** in the past 12 months?	B10.2.1 What **percentage** of it was for the illness mentioned above?	B10.3 How much was paid by insurance for the illness mentioned above? If unclear, move to B10.4		B10.4 what is rule for health insurance reimbursement?		B10.5 For how many days were you unable to carry out normal activities due to the illness you mentioned above?	B10.6How many days of work did you lose due to the illnesses you mentioned above?	B10.6.1 Out of those that you missed, how many days of paid sick leave did you use?
					B10.3.1 govt(public insurance)	B10.3.2 commercial insurance	B10.4.1 **minimum amount of cost**	B10.4.2 **proportion**			
R								%			
								%			
								%			

Other illnesses and cost												
ID	B11.Did you suffer from any **other** major disease (chronic or acute) last year? 0 No 1 Yes (please specify)	B11.1 Was any of them diagnosed by a doctor? 0 no 1 yes	B11.2 Severity of these illnesses compared to 2 years ago? 0 Did not have it at that time 1 now better 2 now worse 3 basically the same	B11.3 Severity of these illnesses compared to 5 years ago? 0 Did not have it at that time 1 now better 2 now worse 3 basically the same	B11.4 In which months did you have these diseases ? Indicate as many as needed If all year, write 13	B11.4.1 How would you rate the pain these diseases causes you in those months? 0 Not painful or disturbing, I can cope with it 1 Painful and disturbs a bit my daily life 2 Very painful, usually disturbs my life any time I have it	B11.5 How much did you **pay individually** in the past 12 months for these other illnesses?	B11.6 How much was paid by **govt (public insurance)**	B11.7 How much was paid by **commercial** insurance?	B11.8 For how many days were you unable to carry out normal activities due to these illnesses?	B11.9 How many days of work did you lose because of these illnesses?	B11.9.1 Out of those that you missed, how many days of paid sick leave did you use?
R												

C. Exposure

Means of transportation

ID	C1. During weekdays, how do you commute? 0 Drive a car or by taxi 1Subway 2Bus 3 Motorcycle 4 Bicycle or on foot 5 Stay Indoor	C2. Frequency 0 every weekday 1 occasionally	C3. If they answer every day, how much time do you spend on commute every day of the week (minutes) when difficult to answer, write the time when leave home and the time when arrive your work place, and vice versa	C4. During weekends, how do you move around? 0 Drive a car or by taxi 1Subway 2Bus 3 Motorcycle 4 Bicycle or on foot 5 Stay indoor	C5. Frequency 0 every weekend 1 occasionally	C6. If they answer every weekend, how much time do you spend on this mean of transport in the weekend (total minutes) when difficult to answer, write the time when leave home and the time when arrive your destination place, and vice versa
R						

Time use over the day

		C7 Summer (April –Oct)		C8 Winter (Nov-March)	
ID		How much time (hours) do you spend outdoor for leisure, exercise and other activities?	If has a job, how much time (hours) do you spend at work outdoor?	How much time (hours) do you spend outdoor for leisure, exercise and other activities?	If has a job, how much time (hours) do you spend at work outdoor?
R	Weekdays	C7.1	C7.1	C8.1	C8.2
	Weekend	C7.3	C7.4	C8.3	C8.4
	Weekdays				
	Weekend				
	Weekdays				
	Weekend				
	Weekdays				
	Weekend				

D. Information about pollution

ID	D1. Where do you check for air pollution information? 1.TV, broadcasting, newspaper and magazine 2.internet2a.cell phone 2b PC 3 self-perception, relatives, friends, neighborhood and colleges 4 Other 5 Don't know or don't care_	D2. Do you think this info is enough for you or would you like more of it? or specify the channel you would like to use more 0 enough 1 TV, broadcasting, newspaper and magazine 2.internet2a.cell phone 2b PC 3 Other___	D3. Did you notice that during the last year there was very bad days of air pollution/haze? 0. No 1. Yes	D3.1 If yes, do you remember when it was? 1.2011, Jan-June 2.2011, July-December 3.2012, Jan-June	D4. Did you know that afterwards the government in Beijing started releasing information about PM2.5? 0. No 1. Yes	D5. If yes to D3 or D4 or both, what did you do after this event (the debate or the government releasing information)? 0. I did nothing 1. I started worring more about air pollution 2. I look at more information 3. I worry more about air pollution, looked at information about it more often 4. Other (please specify_____)
R						

E. Averting behaviour

Table 1 – Reasons for not adopting averting behaviour	
Reason	Example
0 Misunderstanding	Although the air is haze, the air quality is not bad Haze air doesn't hurt health Should exercise more to improve their physique in haze air. Think this behavior doesn't help to avert effectively
1 Low elasticity of behaviour	Difficult to change long-standing habit Hope to change, but cannot to The time outdoor is already very little, cannot reduce more Uncomfortable to wear a mask
2 Good health	Health is good, so don't worry about the haze air
3 Not applicable	During that time no plan for go out for exercise or leisure Already the best way (e.g. by car or taxi)
4 Other	

Under extreme circumstances (ask only if they noticed them, see question D3 D4) Assume those who do not know will behave same as in normal times.

ID	Did you ever do the following **during the extreme air pollution days** this year.		E2.1 (all no for E1 E2) the reason for not taking any of the two (see table 1 above):	E3. Did you change mean of transportation during extreme air pollution this year? 0 No 1 Yes	E3.1 If yes, specify below from which to which (e.g. bus to car) 0 Drive a car or by taxi 1Subway 2Bus 3 Motorcycle 4 Bicycle or on foot 5 Stay indoor	E3.2 If no, why not(see table 1 above)?	E4. Did you wear masks during extreme air pollution this year? 0 No 1 Ordinary 2 Sophisticated	E4.1 if no, why not(see table 1 above)?
	E1 cancel leisure activities outdoor 0 No 1 Yes	E2 cancel excercise outdoor 0 No 1 Yes						
R					from to			
					from to			
					from to			

Under normal circumstances (all the rest of the year)

ID	Did you ever do the following because of air pollution the rest of the year?		E6.1(all no for E5 E6) the reason for not taking any of the three (see table 1 above):	E7. Did you change mean of transportation because of air pollution the rest of the year?	E7.1 If yes, specify below from which to which (e.g. bus to car)	E7.2 if no, why not?	E8. Did you wear masks **because of air pollution** the rest of the year?	E8.1 if yes, which months (not need to wear everyday, but often)?	E8.2 if no, why not?
	E5 cancel leisure activities outdoor 0 No 1 Yes	E6 cancel excercise outdoor 0 No 1 Yes		0 No 1 Yes	0 Drive a car or by taxi 1Subway 2Bus 3 Motorcycle 4 Bicycle or on foot 5 Stay indoor		0 No 1 Ordinary 2 Sophisticated	13 = all year long	
R					from____ to__				
					from to				
					from to				

F. Air purifier ◎

ID	F1. How many air purifiers (air conditioner with air purifying function) do you have in your family (include gifts to other people)? 0 None (ask only K1.1) 1 One 2 More than one	F2 If no, why have you never bought one? 1 Don't know there is such thing in market 2 Air quality (indoor or outdoor) is not bad 3 All are healthy in home, don't need that 4 Don't believe it help to avert effectively 5 Too expensive, can't afford 6 Other reason (specify)	F2.1 If yes and you (or a member of your family) bought it, when did you buy it? (year and month)	F2.2 How much did it cost (in case you bought it)? (If not known, ask the brand-show cards)	Where do you keep it?			F4. How often do you use it at home? 1 almost all time, 2 only when the air is bad, 3 seldom use it		
					F3.1 place 1 bedroom 2 Common room (kitchen, living room, bathroom) 3 Other	F3.2 1 Specific person's room,				

G. Financial Information

ID	G1 If working (4-5), what is your job? See categories in appendix	G2 Is your job in one of the following categories (see list at the end)?	G3 Do you work in government, state enterprises / private or foreign companies? 0 Government, state enterprises 1 private or foreign companies	G4 Are you ever exposed on the workplace to dusts, sprays, gases, mists, smokes and fumes? 0 Never 1 Rarely 2 Often	G5.1 How many hours did you work this year per day?	G5.2 How many days per Week?	G5.3 How many months in th whole year?	G6 What is your net income per month through working[1]? If does not want to answer, say roughly.	G7. Do you have other sources of income (pension, scholarship, lodgers, financial)? 0 No Yes > If yes, how much is it in total per month? _____	G8. What is the total yearly income[2] of your household?	G9 How much was your family income 2 years ago?	G10 How much was your family income 5 years ago?
	_											
	_											

ID	G6. Does your family own house property? 1 Yes 2 No, public / collective 3 No, commercial rent 4 Yes, other	G6.1 (Only if owned) How many meters squared is the house?	G6.2 how much is the house(s) worthy [3]	G6.3 are there any other house owned by your family?	G6.4 What is their Approximate value?	G6.5. How much is your morgage per month? 0 No morgage ____ if morgage	G7. If applicable, how much do you pay in monthly rent? 0 No rent ____ if rent	G8. Did your family ever buy a car? 0. No ___ Specify how many if yes	G8.1 If yes, how much were they when you bought it? (sum if more than 1 car)	G8.2 If yes, how much do you spend on your car per month?
H[4]	_		___ __	____		___	___	_		

H. Extended family support

H1 Do you have your spouse or young, dependent children living somewhere else?	H2 If yes, specify where.	H3 Do you have any family members who do NOT live in your house who help you and your family financially (money or goods)? Or you help them financially?①		H4 Do you have any family members who do NOT live in your house who regularly help you and your family in other non-financial ways (cook for you, take care of children, house chores, etc.)? Or you help them non-finacially?		H5. Do you have any PAID external helper in your family (baby-sitter, cleaning lady or carer for the old ones)? 0 No 1 Yes
0 No 1 My spouse (wife/husband) 2 Childern (1 or more) 3 Both wife and children	1 Beijing, same district 2 Beijing, other district (specify____) 3 rural areas 4 Other cities	H3.1 amount received last year	H3.2 amount send last year	H4.1 get help 0 no 1 yes	H4.2 give help 0 no 1 yes	
		____yuan/year	____yuan/year			

I. Household Location

ID	I.1What is the Hokou status of your family①? 0 Beijing downtown 1 Other city 2 Rural 3 Unified	I1.1 If Beijing Hokou (0), when did you get it (year)? 0. Always had it (skip to C2) 1. Obtained in _____	I1.2 If 1, what was the previous one? 1 Other city 2 Rural 3 Unified	I2. When did you move to the current location (house where you live)? (Year → if 2011-2012, ask month)	I3. Where did you live before? 0 Beijing downtown (same district) 1 Beijing downtown (other district _____) 2 Other city 3 Rural	I4. What was the main reason for your family to move to this location? 0 Job 1 Studies 2 Quality of life 3 Cost of living 4 Replacement house (no location choice) 5 Born here 6 Marriage 7 other Ask for household first, then for each member	I5. How many days do you spend on holiday outside Beijing in the last 12 months?
						_	
						_	

J. Division of tasks

ID	J1. Who does the **main** house chores (cleaning, grocery shopping, washing up...)? 1 if the person does more than 1/3 of it, 0 otherwise. E if external person②	J2. Who does most of the caring of children? 1 if the person does more than 1/3 of it, 0 otherwise. E if external person, write E for all household members	J3. Who does most of the care of the elderly? 1 if the person does more than 1/3 of it, 0 otherwise. E if external person, write E for all household members
	_	_	_
	_	_	_
	_	_	_

K. Filled by the investigator

K1. Was there anybody beside the respondent: 0 no 1 family members 2 other people

K2. Was there anybody to impede the respondent to answer the questionaire 0 no 1 yes, occasionally 2 yes, often

K3. Rate the williness to responce, the understanding and concentration of respondent (tick at the score number from bad(1 2 3 4 5) middle(6 7 8) good (9 10))