

MORTALITY OF POPULATION EXPOSED WITH THE DIFFERENT POLLUTED ENVIRONMENT

Tran Thanh Ha, Ta thi Tuyet Binh, Tran Van Dai

Vietnam National Institute of Occupational and Environmental Health

A study is carried out on mortality of the population, which are living near factories and are exposing polluted environment (1481 household with 4813 capita of TS Ward as study group) and have the population, which are living far from the factories (1453 household with 3967 capita of GC Ward as control comparison group). Method of the study is surveillance of deaths in last 3 years (8/2004 – 8/2007) by questionnaire in the population.

The study showed that, the crude average fatal rate in a year of TS Ward is 3,12‰ and of GC Ward is 1,51‰. In the causes of the death, the fatal rate from cancer in TS Ward is highest (40%) among this 20% is from lung cancer; the fatal rate from cardiovascular diseases is 17,8%. In GC Ward, the fatal rate from cardiovascular diseases is highest (27,8%), and then from cancer (22,2%). The mortal burden with Years of life lost because of premature death (YLLs) of TS Ward population is higher in comparison with GC Ward population in all 3 disease groups (I group: communicable, maternal perinatal and nutritional diseases, the II group: noncommunicable diseases and the III group: injuries). In TS Ward, the YLLs are highest (YLLs/1000 capita = 498.5) in the age groups of 20-30 years; in GC Ward, the YLLs are highest (YLLs/1000 capita = 93.5) in the age groups of 30-40 years.

The above results showed that population, who are living in more polluted environment have higher mortal burden (crude average fatal rate, YLLs) in comparison with the population, who are living in less polluted environment.

1. INTRODUCTION

Recently many studies in the world and in Vietnam showed that environmental pollution from manufacturing of different industries have caused bad affects not only on the health of workers, but also on the health of population, who lived near these factories. We know that, environmental pollution is becoming a global serious problem. According to WHO (2006), 24% diseases and 23% deaths were from polluted environment; and 85/102 diseases were caused by polluted environment; prevalence of death from environmental diseases was 25% in developing countries and 17% in developed countries (WHO, World Health Statistics),.

In Vietnam, environmental pollution also is a big problem. Environmental hazards are the new form of health risks in society. According to Vietnam country profile [7], deaths per year caused by environmental pollution are 126000 cases. This estimates were based on data of regional exposure according to the National Health Statistics (WHO, 2007).

To day, in Vietnam there are rather many studies on environmental pollution and the health of population, who are living around factories and industrial zones. But there are very fewer studies on the mortality in community, caused by environmental pollution. So, the project on “ *The investigation, statistics and assessment of effects of environmental pollution on community health and recommendation for solution to minimize and warning to the community*” were established from 2007 by the Center for Environmental consultancy, training and technology transfer (belong to Vietnam Environmental Protection Agency - VEPA). In the project, Vietnam National Institute of Occupational and Environmental Health took part the Pilot programme on “*The method of investigation, statistics and establish of EHIA profile caused by industrial chemicals’ effects*”.

According to the document No 720/Environmental Protection, 30 Mae 2006 of General Office for Environmental Protection, Thoson Ward in Viettri City, Phutho Province was one of 22 “hot point” of environmental pollution of Vietnam. Thoson Ward is located in South Viettri Industrial Zone, where there are 16 factories and enterprises and 5 home/craft cooperatives, in this many factories are the source of pollution such as chemical factory, paper factory, VN Miwon factory, plastic factory, etc. Especially Viettri chemical factory is a source of air chemical pollution for Thoson population. So, Thoson Ward was one of the places, which was influenced by many environmental pollution chemicals.

To assess the influence of chemical air pollution to the community’s health, we carried out the study on Mortality Rate and on Burden of Mortality of

Thoson ward population (as exposed population) and then, compared with the Mortality Rate and on Burden of Mortality of Giacam ward population as a control population.

2. METHOD

2.1. Subjects: population of 2 Wards

+ Exposed group: almost all population of Thoson Ward, consist 1481 households with 4813 capita

+ Control group: population of Giacam Ward, consist 1453 households with 3967 capita

2.2. Method

To carry out the mortality surveillance of household in last 3 years (from 2005 to 2007), using structured questionnaires.

The household surveillance was conducted by health staff and volunteers of Commune Health Station of 2 Wards. Before the survey, a training course and pilot surveillance was held for all persons, who would take part the survey.

First, the General household questionnaire was asked to collect information as name, age, gender, and level of education, profession, and the health/diseases state of total persons in the family. If there were any persons, who had died in 3 recently years, we collected information of each case, using Mortality questionnaire. The Mortality questionnaire consisted detail information about name, age, gender, profession, the year of death and the causes of death.

For assessment of the Burden of mortality, we calculated the the following mortality criteria

- The crude death rate and distribution by causes, by age, by gender.

- Year of life lost due to premature mortality (YLLs), which were created by WHO and The World Bank [2].

YLLs is calculated by Life Expectancy Age minus the Age of Death. We use Life Expectancy of Japanese of female as 82,5 year old and of male as 80 year old.

$$\text{YLLs (male)} = (80 - a) I$$

$$\text{YLLs (female)} = (82,5 - a) I$$

In this:

a: the death age of the people

I: number of death cases of a population in a time period

YLLs - Year of life lost due to premature mortality was calculated for 1000 capita per 1 year

All data were analysed, using the SPSS version 10.0 for Windows software program.

3. RESULTS AND DISCUSSION

Table 1. Demographic information of study population

Ward	N of household	N of capita	Gender (%)	
			Male	Female
Thoson	1481	4813	48,6	51,4
Giacam	1453	3967	52,1	47,9

Table 2. Distribution by age groups of study populations

Age groups	Thoson ward N of population=4813		Giacam ward N of population=3967	
	n	%	n	%
< 5	359	7.1	232	5.9
5 – 9	296	6.2	217	5.5
10-14	288	6.0	278	7.0
15 – 19	297	6.2	377	9.5
20 – 29	776	16.1	570	14.4
30 – 39	739	15.4	533	13.4
40 – 49	681	14.2	669	16.9
50 – 59	804	16.7	693	17.5
60 – 69	399	8.3	289	7.3
>= 70	172	3.6	109	2.8

Table 3. Distribution by occupations of study populations

<i>Occupations</i>	<i>Thoson ward N of population=4813</i>		<i>Giacam ward N of population=3967</i>	
	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>
Farmers	11	0.2	29	0.7
Workers	937	19.5	416	10.5
Service occupations	1085	22.5	1587	40.0
Retirement person	1266	26.3	877	22.1
Pupils/students	974	21.0	1053	26.2
Others	486	10.5	152	3.8

In Thoson ward, proportion of workers, who works in factories, in private workshop were rather higher and proportion of service occupations as clerical staff, teachers, etc were rather lower than in comparison with Giacam ward. Other occupation groups are rather similar proportion in both wards.

Table 4. Mortality information in 3 years (8/2004 - 8/2007)

	<i>Thoson Ward N=4813</i>	<i>Giacam Ward N=3967</i>
Total deaths in 3 years	45	18
<i>In this:</i>		
+ Male	34 (75,6%)	12 (66,7%)
+ Female	11 (24,4%)	6 (33,3%)
Mortality rate/1000 capita/ 1 year	3.12‰	1.51‰
<i>In this:</i>		
+ Male	4.83‰	1.93‰
+ Female	1.47‰	1.07‰
Age of deaths (mean ±SD) (Min – Max)	52.2 ± 21.19 (23-95)	60.1 ± 19.47 (24-88)
<i>In this:</i>		
+ Male	46.4 ± 17.45 (23 – 86)	62.4 ± 17.32 (36-84)
+ Female	70.1 ± 22.58 (23-95)	55.5 ± 24.30 (24-88)

Table 4 showed that the mortality rate of Thoson ward was higher (3.12‰) in comparison with Giacam ward (1.51‰). In both wards, the death rate of male was higher than of female. Average age of deaths of Thoson population was lower (52.2 ± 21.17) in comparison with Giacam population (60.1 ± 19.47). In Thoson ward, the average death age for male (46.4 ± 17.45) was lower than of female (70.1 ± 22.58), but in Giacam ward the average death age for male was higher (62.4 ± 17.32) than of female (55.5 ± 24.30).

To compare with the result of a study about the mortality rate from 1999 – 2005 of population of the Thachson commune, (belong to Lamthao district, Phutho province), where there were many industry caused air and water pollution, we detected that mortality rate of Thoson population in general was rather similar the mortality rate of Thachson commune (2,56‰ – 5,24‰). The study in Thachson commune showed that the mortality rate of Thachson population was as the some Mortality rate in Vietnam, but which had the trend to increase from 1999 to 2005 [2].

Table 5. Mortality rate by causes (per 1000capita/year)

<i>Death causes</i>	<i>Thoson Ward</i> <i>N of population=4813</i>		<i>Giacam Ward</i> <i>N of population: 3967</i>	
	<i>N of deaths per 3 years</i>	<i>Death rate per 1 year</i>	<i>N of deaths per 3 years</i>	<i>Death rate per 1 year</i>
Respiratory diseases	0	0	1	0,08
Circulation system diseases	8	0,55	5	0,42
Cancer	18	1,25	4	0,34
Infectious diseases	4	0,28	0	0
Accident, injury	7	0,48	2	0,17
Others causes	8	0,55	6	0,50
Total	45	3,12	18	1,51

Table 5 showed that, the death rate caused by cancer of Thoson population was highest (1,25 per 1000 capita/1 year); meanwhile in Giacam population the death rate caused by circulation system diseases was highest (0,42 per 1000 capita/1 year).

Table 6. Distribution of death by causes in 3 years (2005-2007)

<i>Death causes</i>	<i>Thoson</i> <i>N of death=45</i>		<i>Giacam</i> <i>N of death=18</i>	
	<i>N</i>	<i>%</i>	<i>N</i>	<i>%</i>
Respiratory diseases	0	0	1	5,6
Circulation system diseases	8	17,8	5	27,8
Cancer (In this: <i>lung cancer</i>)	18 (9)	40,0 (20,0)	4 (0)	22,2 (0)
Infectious diseases	4	8,9	0	0
Accident, injury (traffic accident, suicide, drowning)	7	15,6	2	11,1
Other causes	8	17,8	6	33,3
Total	45	100	18	100

Table 6 showed that, the death rate caused by cancer, especially lung cancer in Thoson population was very high among all other causes, but in Giacam population the death rate caused by by circulation diseases and other causes such as the death due to too old etc ... was highest.

The results of retrospective analysis of fatal data from the Community Heath Stations in 2002 to 2006 showed that the average death rate of Thoson population was higher (3,52 ‰) in comparison of Giacam population (3.16%).

To compare with the criteria of crude death rate (CDR) in Vietnam (Health Statistics Yearbook 2004, 2006 [5]) from 1998-1999 in whole country was 5,6‰ (urban area 4.2‰, rural area 6.0‰), from 2004 in country was 5.4‰ (urban area 4.5‰, rural area 5.8‰), from 2005, 2006 in country is 5.3‰, so the CDR of Thoson population from 2002 – 2006 (2,4‰ – 5,5‰) was rather similiar in comparison with CDR in urban area of country.

The study about the mortality of adult population (≥ 5 year age) in Lamthao district, Phutho Province in 2005 [2] showed that, among the fatal causes, the death due to cancer was 26.4%, due to circulation diseases was 14.72%, due to respiratory diseases was 11.0%. In Thachson commune, the death due to cancer was 23.53%, due to circulation diseases was 23.53%, due to respiratory diseases was 8.82%. To compare the results of our the study we founded that the death caused by cancer of Thoson population was higher (40%), and circulation diseases was near the same in comparison with population in Lamthao district and Thachson commune. In Giacam population, the death caused by cancer, circulatory and respiratory diseases were the same as Lamthao and Thachson population.

Some study in the world on urban air pollution and mortality in cohort of Norwegian men [6] to estimate associations between exposure and total and cause-specific mortality during the follow-up time showed that the corresponding adjusted risk ratios for dying from respiratory disease were 1.16, from lung cancer 1.11, from ischemic heart diseases 1.08 and from cerebrovascular diseases 1.04. Other studies showed the relationship of air pollution and lung cancer, cardiovascular diseases [1,4]. So the results of our study also indicated that the death rate caused especially by cancer of respiratory system was very high in population living in air pollution area.

Table 7. Mortality distribution per 3 years by age groups. n (%)

<i>Age group</i>	<i>Thoson Ward</i>	<i>Giacam Ward</i>
<5	0	0
5 - 9	0	0
10 - 14	0	0
15 - 19	0	0
20 - 29	9 (20,0)	1 (5,8)
30 - 39	3 (6,7)	2 (11,1)
40 - 49	8 (17,8)	2 (11,1)
50 - 59	6 (13,3)	3 (16,7)
60 - 69	7 (15,6)	2 (11,1)
≥ 70	<u>12 (26,7)</u>	<u>8 (44,4)</u>
Total	45 (100)	18 (100)

The results of table 7 showed that all death cases of 2 Wards during 3 years were in the ages > 20 year old. The death rate was highest at the age ≥ 70 year old in both Thoson ward and Giacam ward. At the age ≥ 70 year old, the death rate in Giacam Ward was higher (44%) than in Thoson Ward (26.7%), meanwhile in the age group 20 – 30 year old, the death rate of Thoson population was higher (20.0%) in comparison with Giacam population (5.8%).

Table 8. Mortality rate by 2 age groups

Age group	Thoson Ward			Giacam Ward		
	<i>N of capita</i>	<i>Number of death per 3 years</i>	<i>Death rate per 1000 capita per 1 year</i>	<i>N of capita</i>	<i>Number of death per 3 years</i>	<i>Death rate per 1000 capita per 1 year</i>
< 40 year old	2824	12	1,42‰	2443	3	0,41‰
≥ 40 year old	1989	33	5,53‰	1524	15	3,28‰

Mortality rate of age group ≥ 40 year old was much higher in comparison with the age group < 40 year old in both 2 wards.

The results about mortality rate of population of Lamthao district, Phutho province [2] in the age group < 40 year old was 0.98‰, in the age group ≥ 40 year old was 17.86‰, so the results of our study showed that the mortality rate of Thoson population was higher and of Giacam population was lower than the results of Lamthao population in both age groups.

Table 9. Death rate due to Cancers by 2 age groups

Age group	Thoson Ward			Giacam Ward		
	<i>N of capita</i>	<i>Number of death per 3 years</i>	<i>Death rate per 1000 capita per 1 year</i>	<i>N of capita</i>	<i>Number of death per 3 years</i>	<i>Death rate per 1000 capita per 1 year</i>
< 40 age old	2824	Lung cancer: 1	0,12‰	2443	Lung cancer: 0	0‰
		Other cancer: 1	0,12‰		Other cancer: 2	0,27‰
		Total: 2	0,24‰		Total: 2	0,27‰
	1989	Lung cancer: 6	1,006‰	1524	Lung cancer: 0	3,28‰

≥ 40 age old	Other cancer: 7	1,173‰	Other cancer: 2	0,437‰
	Total: 13	2,18‰	Total: 2	0,44‰

Mortality rate caused by total cancer and by lung cancer of age group ≥ 40 year old was higher in comparison with the age group < 40 year old in both 2 Wards.

Mortality rate caused by total cancer in population of Lamthao district, Phutho province [2] of age group < 40 year old was 0.10‰, of age group age ≥ 40 age old was 4.92‰. In the study, the mortality rate caused by total cancer of age group < 40 year old of Thoson population was 0.24‰ and of Giacam population was 0.27‰, and mortality rate of age group ≥ 40 year old of Thoson ward was 2.18‰ and Giacam ward was 0.44 ‰. So the results of our study about total cancer in Thoson and Giacam Wards were higher in the age group < 40 year old, but were lower in the age group ≥ 40 year old in comparison with the Lamthao population.

So, it's showed that mortality rate of Thoson ward was in the more young age in comparison with Lamthao district, Phutho province.

Table 10. Distribution of YLLs of 2 wards

<i>Ward</i>	<i>N of population</i>	<i>YLLs /1000capita/year</i>
Thoson	4813	83,4
Giacam	3967	32,1

To assess the Mortal burden with Years of Life lost because of Premature Death (YLLs), which were created by WHO and The World Bank [2], we use Life expectancy of Japanese (for female 82,5 year old and for male 80 year old).

The results of table 10 showed that the Mortal burden YLLs of Thoson population is higher in comparison with Giacam population

To compare with the YLLs in 2005 of population of Lamthao district, Phutho Province with YLLs =82.3 per 1000 capita/year, we found YLLs of Thoson population was rather similiar, but YLLs of Giacam population was lower in comparison with the population of Lamthao District, Phutho Province [2].

Table 11. Distribution of YLLs by groups of diseases causing death

Wards of Group diseases	Thoson (N= 4813)	Giacam (N= 3967)
	YLLs /1000capita/year	YLLs /1000capita/year
I group	13,37	0
II group	36,7	18,23
III group	20,05	5,04
Others	13,23	8,11

The group of diseases:

- + I group: communicable, maternal perinatal and nutritional diseases etc
- + II group: noncommunicable diseases as cancer, endocrine, cardiovascular diseases, etc.
- + III group: injuries, poisoning, accident, suicide, etc.

Table 11 showed that the mortal burden YLLs of all 3 disease groups of Thoson population was higher in comparison with Giacam population. The mortal burden criteria YLLs/1000 capita/year caused by the II disease group was highest in both 2 Wards, and then was the III group.

To compare with the mortal burden criteria YLLs of Lamthao district population, which have highest YLLs belong to the II disease group with YLLs/1000 capita/year = 21.65, then the III group with YLLs/1000 capita/year 12.85, last the I disease group with YLLs/1000 capita/year = 9.31, we found the same distribution of diseases in our study, meanwhile YLLs of all 3 disease groups of Thoson population was higher and Giacam population was lower in comparison with Lamthao district population.

Table 12. YLLs/1000 capita per year by age groups

Age groups	Thoson ward	Giacam ward
< 5	0	0
5 - 9	0	0
10 - 14	0	0
15 - 19	0	0

20 - 29	498,5	58,5
30 - 39	142	93,5
40 - 49	281,5	77
50 - 59	143	86,5
60 - 69	109,5	40,5
≥ 70	27,5	26,5

The results of mortality surveillance of household during 3 years (from 2005 to 2007) showed that YLLs of all age groups of Thoson population were higher in comparison with Giacam population. In Thoson Ward, the YLLs were highest (YLLs/1000 capita = 498.5) in the age group of 20-30 year old; in Giacam Ward, the YLLs were highest (YLLs/1000 capita = 93.5) in the age group of 30-40 year old.

4. CONCLUSION

From this study, it was found that population, who are living in more polluted environment have higher mortal burden (crude average fatal rate, YLLs) in comparison with the population, who are living in less polluted environment.

The study results also showed that the data from death record in Health Station of Wards can only let me know about general Crude Death Rate, but the death record have not full information about the fatal causes of people. To aim to have the health data of population as the indicators of environmental pollution, it's necessary to strengthen and improve the data record system and statistics of the fatal cases in order to have confident data about the health, morbidity and mortality of population.

Acknowledgments

The authors would like to thank all the colleagues staff at Department of Psycho-physiology at work and Ergonomics, and grateful to Prof. Truong Viet Dung in Dept. of Community Health, Hanoi Medical School and all others offices in Vietnam as:

- *The center for consulting and training on technological transfer*
- *Vietnam General Office for Preventive Medicine*
- *Vietnam National Institute of Occupational and Environmental Health*
- *Center for Env. Technology, College of Construction*
- *Dept. of Community Health, Hanoi Medical School*

- *Dept. of Health in Phutho Province*
- *Center for Preventive Medicine in Phutho Province*
- *Dept. of Natural Resources and Environment of Phutho Province*
- *The Env. Observation in Phutho Province*
- *Local authority of Thoson Ward, and Giacam Ward*

REFERENCES

1. A J Cohen (2000)

Outdoor air pollution and lung cancer. Environ Health Perspect. 2000 August; 108 (suppl 4): 743-750.

2. Truong Viet Dung (2007)

Study of Mortality in Lamthao district population. Phutho province. – Scientific study research of Ministry Level, Hanoi, 2007.

3. Truong Viet Dung (2007)

Methods to assess Environmental Burden of Diseases (EBD) – Application of assessment for EBD in Environmental Health. Workshop “ Environmental Burden of Diseases Country Profile. Vietnam” Hanoi, 17 oct 2007.

4. Kristin A. Miller, M.S. David S. Siscovick, et al. (2007)

Long – term Exposure to Air pollution and Incidence of Cardiovascular Events in Women. The New England Journal of Medicine. Volume 356:447-458, February 1, 2007.

5. MOH

Health statistics yearbook 2004, 2006.

6. Per Nafstad, Lise Lund Haheim, orbjorn Wisloff, Frederick Gram, Bente Oftedal, Ingar Holme, Ingvar Hiermann and Paul Leren (2004)

Urban air pollution and mortality in cohort of Norwegian men. Environ Health Perspect. 2004 April; 112 (5): 610-615

7. WHO (2007)

Workshop “ Environmental Burden of Diseases Country Profile. Vietnam” Hanoi, 17 oct 2007.

