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The Impact of Household and Community Risk Factors on Labor Force Aged Mortality in Nang Rong, Thailand

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Introduction

The issue of influences of household and community risk factors on adult mortality have been investigated intensively since 1981 by Preston, Haines and Pamuk (1981). Many scholars found that social structure and household environment seems to have strong impact on individual probability of dying (Johannson & Mosk,1987; McKewon, Brown & Record, 1972). For example, in 1972, Alfred's research in developed countries found that mortality risks comprise exposure to disease components, e.g. non-hygienic sanitation environments in the family, inappropriate health behavior, community environmental problems, etc., as well as resistance to disease components, e.g. nutrition and standard of living (Ahlbom & Norell, 1990; Heinze & Ackernecht, 1994). Although mortality in Thailand has undergone an experience of mortality transition, from a crude death rate (CDR) of around 30/1,000 population in the year 1920 to 6/1,000 population in the year 2001 (Porapakkham & Prasatkul, 1986; Ministry of Public Health, 2002a). However, the causes of death in the labor force aged population, were still relatively high, the primary cause of death in the year 2001 being malignancy, followed by death from external causes, and disease of the

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cardiovascular system, with deaths from infectious and parasitic diseases following in succession (Ministry of Public Health, 2002a; Chancharuporn & Chedchuponglum, 2002).

In considering the population of Thailand, it was found that aged population has a tendency to increase, while child-aged population who would later become labor force age would decrease in the next 20 years (Wongbunsin & Wongbunsin, 2002). Thus, it is crucial to maintain our existing and limited labor forces, that is to say, efforts should be made to prevent labor force aged population from dying premature deaths due to illness and other major causes of death (Daniel, 2002; Aiken, 1995). This study therefore requires analysis of household components, as well as community components, in order to determine if and how they would affect the death in this age group. The result of the study would benefit in demonstrating the importance of mortality components in the labor force aged population in order to make plans for reduction in exposure to diseases and for increasing resistance to diseases, as well as for implementation of policies for health promotion and for prevention of preventable diseases. To explore relationships between social context and mortality, we selected Nang Rong district, which is located in the southern part of Buri Ram province, as the unit of observation. The chief characteristic of Nang Rong is that it is a mix between a primitive society, namely an intensive labor society; and a modernized development, namely households equipped with modern facilities, including agricultural machinery technology. Upon considering the crude death rate of Nang Rong district between the years 1994 and 2000, it was found that the crude death rate had increased from 5.06/1000 population in 1994 to 6.99/1,000 population in the year 1999 and, thereafter reducing to 4.44/1,000 population in the year 2000. When looking at age specific death rate, it was found that the aging population's (over 60 years) crude death rate was increasing and so was the crude death rate in age group 27-45 years. However, considering the data from the Basic Minimal Health Survey, Nang Rong has not reached the standard criteria, i.e. still eating half-cooked food, children aged 6-12 years having incomplete vaccination, inadequacy of clean water supply as well as disturbances in the household. This data reflects the types of diseases and sicknesses that people in that area were facing (Buri Rum Provincial Office, 1991; Buri Rum

Provincial Statistics Office, 2001). For these reasons, Nang Rong district was found suitable for a study along the issues stated above. For this analysis, accuracy of cause of death is quite important due to many studies which found that there were some data inaccurate appearing when examining cause of death information (Chuprapawan 2000; 2003). In order to obtain the actual causes of death, we employed a method called "verbal autopsy" as a means to investigate the cause of death in order to use the data obtained for analysis of the most immediate circumstances of death. This would make this study technically valuable and applicable, as well as useful for setting up public policies for prevention of exposure to disease conditions and for support of resistance to disease conditions.

Source of Data

This investigation focuses on people aged 13-60 years old in 1994; this group was kept in track up to the year 2000. The longitudinal data from Survey of Social Change and Migration in Thailand Project, a case study in Nang Rong district, Buri Ram province made by the Institute for Population and Social Research, Mahidol University in collaboration with the Carolina Population Center (CPC), University of North Carolina at Chapel Hill were employed. As a result, the unit of analysis is individual. The causes of death data derive from two sources, in cases in which the deceased died at the hospital we used data from medical records but if they died outside hospital we used Verbal Autopsy (VA) as a method to investigate cause of death. The VA is a technique of postmortem investigation to find out the cause of death by retrospective interviewing a relative or close person who has taken care of the deceased. The VA questionnaires cover the history of the deceased, train of events or circumstances preceding the death. Reports are to include complaints, signs and symptoms, duration of illness and treatment details of the illness prior to death, in order to identify the probable underlying causes of death. All of VA questionnaires were complied and verified by medical doctors and checked for validity through the use of sensitivity and specificity calculations before actual usage. Results of VA, in brief, such as there were 45.50% of the sample died from non-communicable diseases. Likewise,

there were about 22.51% who died from traffic accidents. And there were around 20.90% who died from communicable diseases.

Methods and Measurement

Event History Analysis is used to determine the hazard of death in the equation of the piecewise exponential hazard model, which determines the probability of death for each age group of labor force aged population. The basic idea of the piece-wise exponential hazard model is to split the time axis into time intervals (j) $0= \tau_1< \tau_2< \tau_3 <\ldots< \tau_n$ when τ_n is larger than the largest observation time, and possibly infinite. The hazard in interval j is given by (τ_{j-1} , τ_j) is λ_t , in which the baseline hazard in each interval is assumed to be constant, but the baseline hazards are allowed to vary across intervals. The hazard rate of piece-wise exponential model is calculated as follows: (Guo, 1993; Friedman, 1982; Blossfeld & Rohwer, 2002).

The piece-wise exponential hazard model;

$$\lambda(t_{ij} ; X_i) = \lambda_0(t) e^{(\beta_0 + \beta_1 p_{2i} + \beta_2 p_{3i} + \beta_3 p_{4i} + \ldots \beta_n p_{ji})}$$

Where λ_{ij} = Hazard for observation i and interval j

t_{ij} = Exposure for observation i and interval j

Since only labor force aged population has been selected, there is a possibility that this population group has contacted disease before coming into labor force age. In order to reduce problems stemming from sample selection bias, we used the "Left Truncation". Characteristics and descriptive statistics of the sample are as presented in Table 1.

Table 1: Descriptive statistics of demographic characteristics, household factors and community contexts in Nang Rong, 1994

Categorical Variable	Deceased		Survived	
	Number (634)	Percent	Number (27,664)	Percent
Demographic factors				
Age group				
13-19	29	4.50	5,937	21.50
20-24	72	11.36	8,819	31.90
25-29	80	12.62	3,294	11.90
30-34	78	12.30	2,891	10.50
35-39	73	11.51	2,149	7.80
40-44	59	9.31	1,705	6.20
45-49	54	8.52	1,389	5.00
50-54	59	9.31	1,204	4.40
55-67	130	20.50	276	1.00
Gender				
Male	461	72.70	13,794	49.90
Female	173	27.30	13,850	50.10
Occupation				
Unemployed	35	5.50	2,513	9.10
Agricultural & animal husbandry	447	75.20	18,038	65.60
Labor	121	19.1	6,931	19.50
Commerce & others	31	4.9	1,564	5.70
Migration history				
Never migrated	153	24.10	16,967	61.30
Used to migrate	481	75.90	10,697	38.70

Table 1: (Continued)

Categorical Variable	Deceased		Survived	
	Number (634)	Percent	Number (27,664)	Percent
Education				
Never attended school	21	3.30	597	2.20
Primary school	562	88.60	23,718	85.90
Secondary school	39	6.10	2,503	9.10
Diploma or higher	12	1.90	792	2.90
Household Density				
1 – 4	72	11.40	4,397	16.90
5 – 9	413	65.40	17,065	61.70
10 – 14	141	22.20	5,491	19.80
>15	8	1.30	441	1.60
Air ventilation				
Poor air ventilation	266	42.00	11,592	41.90
Good air ventilation	368	58.00	16,072	58.10
Ethnicity				
Thai Korat or central Thai	470	74.10	19,871	70.70
Cambodia/Suay/ Laos/others	164	25.90	7,793	29.30
Debt				
No debt	254	40.10	11,011	39.80
Have debt	380	59.90	16,653	60.20
Number of vehicles				
0	419	66.10	17,930	64.80
1 – 2	207	32.70	9,318	33.70
3 - 4	33	5.70	319	1.40
≥ 5	1	0.20	21	0.10

Table 1: (Continued)

Categorical Variable	Deceased		Survived	
	Number (634)	Percent	Number (27,664)	Percent
Environmental problems				
No environmental problem	152	15.00	6,295	22.80
Having environmental problem	482	85.00	21,369	77.20
Drinking-water quality				
No problem	95	24.00	23,266	84.10
Having problem	539	76.00	4,398	15.90

Continuous variable	Deceased			Survived		
	Min	Max	Mean	Min	Max	Mean
Household factors						
Economic status	0.00	42,969	7,602.15	0.00	66,149	7,806.80
Community contexts						
Population density (per Rai)	0.08	558	51.31	0.08	558	41.23
Distance from house to health care facility (k.m.)	2.00	56	22.26	2.00	56	23.00
Number of health personnel	5.00	21	12.54	5.00	21	12.48

Results and Discussion

To explore the impact of household and community risk factors on labor force aged mortality, we divided the causes of death into four groups: all causes of death, death from non-communicable diseases, death from communicable disease and death from external causes i.e. accident and suicide. The study found that survival rate of death from non-communicable disease was the highest followed by communicable disease, while the lowest was external causes. This explain that probabilities of dying from external causes are high due to the suddenness of death event. By contrast, probabilities of surviving due to communicable and non-communicable diseases are high. As a result, it seems like household and community risk factors may have influence on this adult mortality (Figure 1). So that, to explore these influences, models of piece-wise exponential hazard model with left truncated were used, under the cutoff point five years. Relative risk estimate from piece-wise exponential hazard model was present in Table 2.

Figure 1

Survival curves of three causes of death

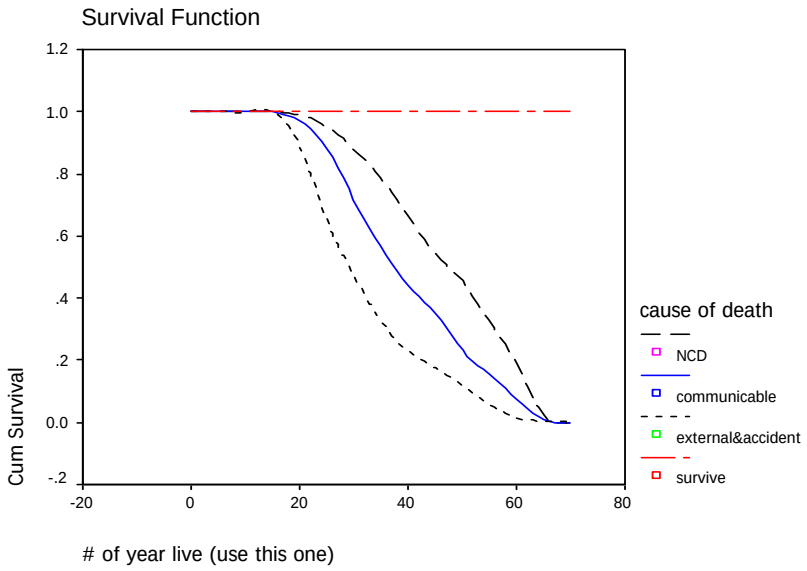

Table 2: Relative risk estimate from piece-wise exponential hazard model when examined influence of household and community risk factors on labor force aged mortality

Variable	all causes of death		non-communicable disease		communicable disease		External causes	
	Exp	(S.E.)	Exp	(S.E.)	Exp	(S.E.)	Exp	(S.E.)
Intercept	***	(0.37)	***	(0.70)	***	(0.91)	***	(0.64)
p5 (Age 20-24)	6.69***	(0.20)	13.33***	(0.56)	8.67***	(0.52)	5.42***	(0.23)
p6 (Age 25-29)	8.06***	(0.20)	21.12***	(0.54)	17.46***	(0.49)	4.44***	(0.25)
p7 (Age 30-34)	10.70***	(0.20)	36.60***	(0.54)	20.91***	(0.50)	5.21***	(0.26)
p8 (Age 35-39)	12.43***	(0.21)	67.36***	(0.53)	23.34***	(0.52)	3.19***	(0.33)
p9 (Age 40-44)	17.46***	(0.21)	117.92***	(0.53)	22.42***	(0.56)	3.35***	(0.37)
p10 (Age 45-49)	31.82***	(0.21)	159.17***	(0.53)	72.97***	(0.51)	7.54***	(0.32)
p11 (Age 50-54)	43.38***	(0.21)	311.06***	(0.53)	67.36***	(0.55)	5.70***	(0.41)
p12 (Age 54-59)	71.52***	(0.21)	572.49***	(0.53)	86.49***	(0.57)	8.50***	(0.41)
p13 (Age 59-67)	112.17***	(0.22)	1022.49***	(0.53)	145.47***	(0.58)	5.53**	(0.61)
Demographic factors								
Male	2.05***	(0.09)	1.42**	(0.13)	1.54**	(0.19)	4.90***	(0.20)
Agricultural	0.83	(0.18)	0.96	(0.26)	1.40	(0.53)	0.59**	(0.30)
Labor	0.88	(0.20)	0.70	(0.30)	2.80*	(0.54)	0.53*	(0.31)
Commerce	0.61**	(0.25)	0.50*	(0.41)	1.46	(0.65)	5.05	(0.39)
Migration history	16.61***	(0.10)	16.12***	(0.17)	12.68***	(0.22)	1.00***	(0.16)
Primary school	0.96	(0.22)	0.90	(0.31)	0.81	(0.47)	0.95	(0.43)
Secondary school	0.90	(0.28)	0.89	(0.42)	0.86	(0.59)	0.84	(0.50)
Higher than secondary school	0.61**	(0.21)	0.63	(0.63)	0.79*	(0.14)	0.93	(0.60)
Major dialect is Khmer, Lao & Suai	1.09	(0.11)	1.13	(0.15)	1.14	(0.23)	0.61*	(0.19)
Household factors								
Number of animals	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)
Household density	1.03**	(0.01)	0.92**	(0.02)	1.08**	(0.03)	1.03	(0.00)
Air ventilation	0.93	(0.08)	0.97	(0.11)	0.80*	(0.13)	0.81	(0.13)
Debt	1.02	(0.08)	1.35**	(0.12)	1.21	(0.17)	1.02	(0.14)
Number of vehicles	0.97	(0.07)	0.96	(0.10)	0.92	(0.16)	1.01	(0.12)
Economic status	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)

Table 2: (Continued)

Variable	all causes of death		non-communicable disease		communicable disease		External causes	
	Exp	(S.E.)	Exp	(S.E.)	Exp	(S.E.)	Exp	(S.E.)
Community factors								
Population density	1.00**	(0.00)	1.00**	(0.00)	1.00**	(0.00)	1.00	(0.00)
Environment problem	1.00	(0.04)	1.12*	(0.07)	1.16*	(0.08)	1.06	(0.06)
Drinking water quality problem	1.02	(0.11)	1.02	(0.16)	1.58*	(0.26)	1.04	(0.19)
Health accessibility (kms.)	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)
Number of health personnel	0.98**	(0.01)	0.97**	(0.02)	0.94**	(0.03)	0.95**	(0.02)
Loglikelihood	-3507.30		-1554.21		-949.73		-1,510.10	

Note: * p value < 0.10, ** p value < 0.05, *** p value < 0.001

Reference group: age < 20 year, female, unemployed, never migrated, never attended school, major dialect in household was Thai or Thai-Korat, no debt, no drinking water quality problem.

Considering mortality from different causes of death which appeared in Table 2; it was found that all demographic factors in this analysis have influence on mortality i.e. all causes of death, death from non-communicable diseases, death from communicable disease and death from external causes. In the same way, the relative risk of dying increases as age increases, which is in conformity with the epidemiological concept that deterioration in physical conditions is caused by increase in age, and the older one gets, the more severe the disease becomes, as well as caused by decreasing immunity, due to weak physical conditions (Aiken, 1995). It also conforms to Makeham's theory of partial forces of mortality, which states as a primary principle that "the hazard of death in older age groups is higher than in younger age groups". Makeham has classified the causes of death into two factors, namely “Intrinsic mortality” where death occurs due to abnormality of the genes, and abnormality of the morbidity physical condition; the second factor is called “Senescent mortality” where death occurs from physical senility (Makeham, 1867). The risk of increased death due to age could stem from unsuitable health behavior at younger ages, i.e. hard work,

insufficient rest (MacMahon &Trichopoulos, 1996). Besides age, when looking at gender perspective, males are more likely to die than females. This outcome may relate to risk behavior theory such as males seem more likely to have more risky behavior than females, e.g. smoking, food consumption and hormonal differences (Nathanson, Constance & Alan, 1987). For demographic component, migration is an important behavior that could lead to contracting disease. With regard to the migration phenomena, those who have history of migration have more risk of dying than those who do not, meaning that the probability of their contracting external disease is higher than those who have not migrated. Moreover, from the characteristics of Thai society, when migrants become ill and realize that they could die, they usually return to their places of birth (Jongaudomkan, 2004).

Two other significant socioeconomic components affecting mortality for all causes of death are education and occupation, both of which reflect the social status. The hazard of death for those who had jobs were less than for those who were jobless, and hazard of death for those who were educated were less than for those who were uneducated. Richard (1992) found that the mortality risks for those who are jobless and uneducated are high. In a study made by Johnson, Sorlie and Backlund (1999) on the impact of specific occupation on mortality in the United States, mortality risks for professional technical groups are less likely than those who are jobless; this being due to jobless have a lifestyle which has more risk of death. For example, construction workers have more risk from accidents at work; coal miners are susceptible to air pollution in coal mines, or farmers have more risk from pesticides. While those who are highly educated would have more interest in their health and are likely to take more appropriate health care as well. At the same time, the educational level would affect income, which would improve living conditions which is mostly related to resistance to disease factors. With regard to the ethnic variable it was found that this has a positive effect on mortality as well. A comparison was made for ethnic variables in two groups, namely those of Thai or Thai-Korat race with other races such as Laos, Khmer, Suay, Tribe and others. The relative risk for those of Thai race is less likely than those who are not of Thai race. One observation that could explain this phenomena is that, Thai Korat have a better economic situation when compared to Lao, Khmer and Suay (Entwisle et al., 1996).

When considering household components, number of animals in household, density of household population, ethnicity, debt and economic status have a positive relationship to labor force aged probability of dying. Meaning that when living in households with poor sanitation, hazard of death would increase since raising of animals in household area would lead to increase in germ breeding places, especially in animal droppings. Moreover, animals could become disease-carriers, resulting in increased disease and illnesses, such as cholera and diarrhea (Ahlborm & Norell, 1990). Household density has a positive effect on mortality, which conforms to the theory on epidemiology (Raj, 2002), which states that environmental components, which include population density have positive effects on mortality. This could be explained that an increase in household population would increase the probability of air-borne diseases, such as tuberculosis, respiratory tract infections. Besides, it would lead to a decreased dispersion of resources, especially food, all of which would weaken the physical condition, easily leading to sickness and increasing mortality risk (MacMahon & Trichopoulos, 1996), and conforms to the concept of Maller (1992), which explained about environments which affect health, that an increase in the household population would increase mortality risk. Persons who live in households which are in debt increase mortality risk since indebtedness is an indicator of the household economic level. Households with debts have less reserved funds for health care and do not usually pay attention to health care maintenance and prevention, regarding it as something still far from happening. Besides, the probability of accessibility to continuous health care would lessen since they would pay more attention to making a living in order to pay off their debts (Ministry of Public Health, 2002a).

For household context, air ventilation and number of vehicles have negative effects on mortality. The relative risk for those who live in houses with bad air ventilation is greater than for those who live in houses with good air ventilation. Air ventilation is measured by the number of windows and number of windows impenetrable by insects. This point out that the probability of spreading of diseases would lessen if the house has good air ventilation. This study is in conformity with the finding of Mckeown, Brown and Record (1972) in their study of industrial society, it was found that the production department with several workers sharing limited space

and without a good ventilation system brought about the spread of air-borne diseases which were easily contracted because of the high density of the population. While an increase in the number of vehicles would lessen mortality risk, which could be due to the fact that vehicles would facilitate journeys to health care facilities.

Consideration of community context, the density of the population in the community, living in communities with environmental problems or drinking-water quality problems as well as living in communities which are a long distance away from health care facilities have positive relationship to probability of dying. With regard to the concept that higher population density would increase mortality risk, this could be explained by the fact that as the population in a community increases mortality risk would also increase, which could be due to the fact that the population density would speed up the spread of diseases, especially communicable diseases in the respiratory system. Communities with environmental problems would increase mortality risk as it would increase germ-breeding places and facilitate the spread of diseases (Maller, 1992). Poor-quality drinking water would lead to certain diseases such as calculus, intestinal diseases and stone. Communities, which suffer continuous drinking-water quality problems, would increase the risk for occurrence of such diseases (Robert, Suzanne & Edward, 1997).

Accessibility to health care facilities measured by the distance from village to said facilities has a positive relationship to mortality, which means that hazard of death increases, the further a community is situated from a health care facility; which is in conformity with the study of Barker, Nathangeni and Millard (2002) who found that the distance from home has a positive relationship to death from tuberculosis; which is also similar to the study made by Jones, Bentham and Horwell (1999) who studied health service accessibility and death from asthma in England during 1985 to 1995 and found that when the confounding factors are under control the accessibility to health care service measured from traveling time has a relationship to death from asthma in that the longer it takes to travel mortality risk increases. For health care facilities factors, it was found that if the number of health care personnel increases, the hazard of death would reduce, since the increased number of personnel would better be able to provide health

care service in promotion, prevention and cure as well as being better able to rehabilitate the patients which would decrease mortality risk (Ministry of Public Health, 2001a). This conforms to the concept of epidemiological transition, which states that the medical and public health determinants have a reverse effect on mortality risk. Thus, if there is qualitative or quantitative medical development, the mortality risk of the population in those areas would lessen (Omran, 1971)

Conclusions

Base on the analysis, the labor force aged population of Thailand is still under the double burden of disease period, that is to say, there is still a high number of deaths from communicable diseases, which is the characteristics of developing countries. At the same time, death from accidents and from external causes, which is the characteristic of developed countries, is high as well. This is in conformity with the concept of Omran (1971; 2001) which states that there would be a long transition period of change in the pattern of mortality and morbidity, as the spread of infection which leads to illness and is the main cause of death would gradually be replaced by degenerative and man-made diseases. In comparing the mortality situation of Thailand with Omran's concept, it could be said that mortality of the labor force aged population of Thailand is at the transition between the 2nd (The Age of Receding Pandemics) and the 3rd stages (The Age of Degenerative and Man-made Disease), that is to say, it is an age when death from contagious diseases has lessened; pandemics which lead to a great number of deaths occur less and less; at the same time death from degenerative diseases, such as disease of the organs, for example, liver, kidney, heart, etc., and from inappropriate behavior, increases; while the average life span gradually increases. From this result, it could be suggested that prevention on premature deaths should be directed at the accident and external cause of death group as the first priority group because it is a major cause of death of the labor force aged group. However, the communicable disease group should not be omitted, as it is still an important cause of death,

Although mortality in Thailand had a tendency to decline, the results show that the death rate in adults is still high with a tendency to increase. The Thai

government has launched a policy to reduce risk factors that would cause premature death, focusing on individual behavior such as the non-smoking project, promotion of exercises for the public, etc. According to the result of this examination, household and community factors have both positive effects e.g. household sanitation and community density, and negative effect e.g. air ventilation and number of health personnel on mortality. That is to say, it should be noted that besides adjusting household environmental quality, the environmental quality in the community should also be adjusted as well. In order to improve community environmental quality, every partner in the community such as the local people, governmental officers, teachers, monks, etc. should also cooperate at all stages of environmental development. With regard to the public health components, that is the number of health personnel and distance to health facility. The health care personnel dispersing strategy to villages and community levels should be developed in suitable proportions to the number of population in the areas. Moreover, there should be zoning responsibilities for health facilities at village and community levels in proportion to the number of population living in that area, in order to lessen the severity of preventable diseases and in order to obtain appropriate capacity for the care of patients.

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