THE CHANGES OF PREMATURE MORTALITY IN THAILAND BETWEEN 1997 AND 2006

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ABSTRACT: The study was a new initiative to reconstruct national death registration data by the modeled structure from the verbal autopsy study and use both standard demographic method and indirect demographic technique to correct for under-registration of death. The objective of the study is to monitor progress toward premature mortality between 1997 and 2006. The results reveal that the distribution of three broader categories causes and the changes among age groups of premature mortality indicate Thailand is in median of industrialization and encountering triple burden of premature mortality (21:55:21). The primaries lost of premature mortality have been HIV, road traffic injury, and cerebrovascular disease over the period of 1997 through 2006. The overall burden of premature mortality has slightly improved in age-adjusted year of life lost rate by 7.54% mainly causing by decreases in premature mortality from HIV infectious among the aged 1-44 year. Meanwhile the growing of mortality burden among the aged 45-59 years as risk-target group and elderly at aged 60 years and over have addressed the evolving epidemic of non-communicable diseases. The dynamic trends of specific causes of premature mortality provide important clues to the success of ongoing health services and the need for development of interventions.

Keywords: the changes in premature mortality, Thailand

INTRODUCTION

Premature mortality reduction is one of the ultimate goals of public health. The health problems that cause a large premature mortality burden need to priority, to facilitate comparison between different periods, and to standardized the way that decision are made in the health sector. However, Thailand's cause of death data are of limited use because the quality of these data are often inadequate both underreporting and misclassification. Although the coverage of recording by age, sex, and place at death has steadily improved nearly 95% [1] as the result from Civil Registration's Act with effective since 1991, the content validity of causes of death report through medical certificate raises solely to 35% in the present [2]. Consequently, cause-of-death data in Thailand is vague and increasing demands of verbal autopsy study and demographic technique are inevitably critical for access to the valid health information.

This work was initiated with an attempt to correct two fundamental problems and to provide more genuine and credible mortality data by using both standard and indirect demographic techniques to enhance the efficiency of the data. The modeled structure of the two verbal autopsy studies in Thailand was also used to validate the cause of death as well as useful operating statistics for explanation of health problems. The premature mortality measure is better than mortality rate by weighting causes of death occurred among young people more significant than those among elderly people. Moreover, the person-year of life lost calculated contributes to expressing burden of premature mortality on the social and human aspects. The aim of the present study is to monitor the progression toward premature mortality in term of year of life lost between 1997 and 2006.

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MATERIALS AND METHODS

This study was conducted using national vital registration data composed with annual death database in 1997 and 2006. The cause of death was consequently translated into the 10th Revision International Classification of Diseases (ICD-10) code by Ministry of Public Health in both years. The mid-year populations in 1997 and in 2006 were used as primary data. Additionally, relevant data were used for enhancing the quality of annual cause-of-death data including the Survey of Population Change in round 4 (1995-1996) and round 5 (2005-2006) to correct completeness of the data, followed by the study of Cause of Death in Thailand during 1997-1999 [3] and the Burden of Premature Mortality in Thailand 2005 [4] used as modeled structure to validate causes of death data.

Table 1 Summary the number of year of life lost, YLL rates and age-adjusted rate by gender, Thailand, between in the year 1997 and in the year 2006

Year/ gender	1997		2006		Age-adjusted YLL rate 1997 (per 1000)
	Number of YLL (%)	Crude YLL rate (per 1000)	Number of YLL (%)	Crude YLL rate (per 1000)	
Male	7,358,135 (66.96)	244.18	7,229,459 (63.69)	233.89	260.20
Female	3,630,471 (33.40)	119.69	4,120,891 (36.31)	129.95	132.09
Total	10,988,606 (100)	181.73	11,350,350 (100)	181.25	196.04

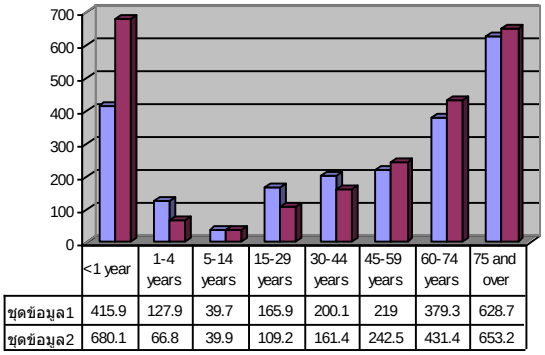
*Direct standardized YLL rates by using the population in 2006 as reference population

Appendix 1 The percentage of death registration coverage of Thailand in 1997 and in 2006

Age groups	1997		2006	
	Male	Female	Male	Female
Less 1 year[/1]	67.6	62.3	96.5	85.4
1-4 years[/1]	75.0	72.7	86.6	100.0
5-9 years[/1]	85.7	80.0	95.6	100.0
10 -69 years[/2]	85.0	95.0	85.0	95.0
70 years and over[/2]	85.0	95.0	85.0	95.0

Source:
[/1] National Statistics Office, Survey of Population Change 1995-6 and 2005-6
[/2] Preston and Coale Method calculated from 2000 population census data

Figure 1 Year of Life Lost Rates (per 1000) by age group Thailand, 1997 and 2006



In Thailand, the recent mortality database stands approximated at 400 000 records each year. The annual death data used for estimation were classified into specific disease groups according to the Global Burden Disease system [5]. The first order has three broad categories: Group I comprises of communicable diseases, maternal, perinatal and nutrition disorders, Group II includes noncommunicable diseases and chronic diseases, and Group III covers external causes of injuries. These categories are extracted into 135 diseases and 18 causes from injury.

The process for reconstruction data needs to adjust 100% completeness of death registration data by the percentage of death registration coverage which directly generated from the Survey of Population Change round 4 (1995-6) and round 5 (2005-6) for specific child group under 10 years. There is an evident suggested that the percentages of death registration from these reports are likely over-estimated. The Preston and Coale Method (1980) [6], an indirect demography technique providing more precise degree of death registration completeness (after 10 years) and more sensitive in case of age misreporting than other methods was used. The 2000 population census was calculated for percentage of death registration during study period to correct completeness at age 10 year and over (Appendix1). Then these complete mortality data sets would be redistributed the observed number of death for specific cause by age group from vital registration data equivalent to the expected number of death calculated from modeled structure of two verbal autopsy studies in defined year. Ill-defined would reduce to 12.37 % in 1997 and 5.43 % in 2006.

The study employed premature mortality analyses by calculating the real duration of life lost from premature death. The measurement bases on standard model life table West 26 the same predetermined criterion as the Global Burden of Disease study (2005) [7] to ensure comparability with two periods study. Thus deaths at all ages will be considered as year loss from mortality when female is expected to live with life expectancy at birth 82.5 years and male's 80 years. For the reason of accurate portrait of premature mortality, the absolute person-year calculated regardless of discount rate and age-weight was used for comparison. The general formula to calculate YLL is $\Sigma D_x .e_x$ where e_x is life expectancy at each age, D_x is death at age. When premature mortality is compared with different years, it is usually done by direct standardization technique using population structure in 2006 as reference. The age-adjusted YLL rate is obtained from $\Sigma D_x .e_x .C_x$, where C_x is the age-correction factor defined for age group x

RESULTS

Overall premature mortality in Thailand between 1997 and 2006

The premature mortality in Thailand was the major cause for 10.98 million lost years of life in 1997 with male losing 66.96% more years than female 33.40%. Comparatively, in 2006 years of life lost were approximately 11.35 millions, of which 63.69% were males and 36.31% were females

Figure 2 Comparison sex-age specific YLL rate, Thailand, in 1997 and 2006

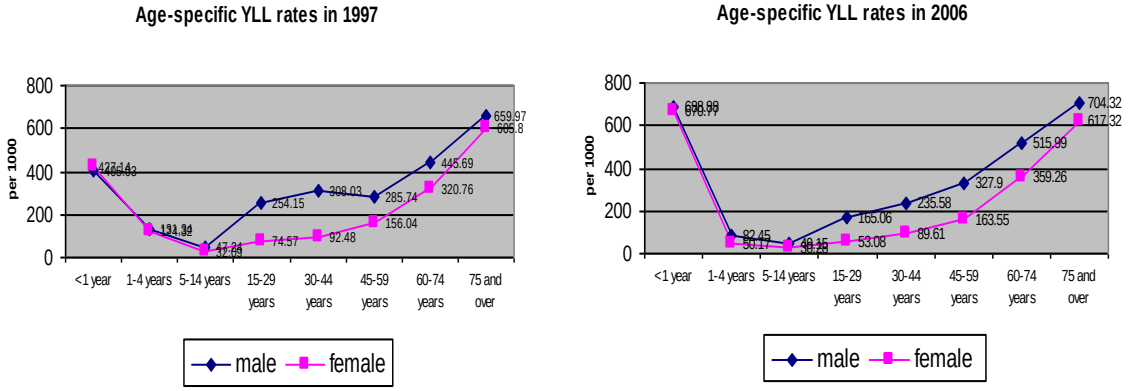


Table 2 Summary the number of year of life lost, YLL rates and age-adjusted rate by Three board categories, Thailand, between in the year 1997 and in the year 2006

Disease groups/ gender	1997		2006		Age-adjusted YLL rate 1997 (per 1000)
	Number of YLL (%)	Crude YLL rate (per 1000)	Number of YLL (%)	Crude YLL rate (per 1000)	
Communicable diseases	2,994,406 (27.25)	49.52	2,412,708 (21.27)	38.53	49.15
Non-communicable diseases	4,686,862 (42.65)	77.51	6,215,142 (54.75)	99.25	90.86
External causes group	2,578,922 (23.46)	42.65	2,371,778 (20.90)	37.87	41.51

*Direct standardized YLL rates by using the population in 2006 as reference population

(Table1). When comparing years of life lost between 1997 and 2006, Thailand has seen a slightly decline premature mortality of around 7.54% in age adjusted year of life lost rates (from age-adjusted YLL rate 196.04 per 1000 in 1997 to 181.25 per 1000 in 2006). The percentage decrease in age-adjusted YLL rate of male (10.11%) was higher than that of female (1.62%). On the contrary, males have an excess premature mortality rates than females at all age groups so the proportion of year of life lost (YLL) among males was two times higher than those among females. By age groups, the proportions of year loss were the highest in the age 15-44 group (60-67% of the total loss years) and lowest in the infant group (4-5%). The findings display that percentage decrease stemmed from substantial reduction particularly the aged 1-44 years whereas mortality burden in elderly (60 and over) has continued increasing from 19.83% in 1997 to 28.96% in 2006 as a result of increasing number of people over the age 60 years.

As depicted in Figure 1, YLL rates vary considerably by age ranges examined which allow for comparison of these rates only when they derived from the same age range. On the other hand, between 1997 and 2006, age-specific YLL rates improved for the young children and young adult (1-44 years) but worsened for the ages less than one year and the age groups after 45 years. Thus, the increase in the YLL rate at 45-59 years over two periods indicates early death or risk-target group of premature mortality.

Meanwhile, the overall premature mortality among males was higher than among females. In the view of sex-age specific YLL rates, it was found that males have exceed premature mortality rates than females in every age group particularly in the age group of 15-29 years and 30-44 years, being two or three times higher than female (Figure 2).

Premature mortality by major disease groups

The premature mortality progress toward three broader categories found that proportion of disease group burden for communicable diseases: non-communicable diseases: an external cause of injuries was 27:43:24 in 1997 and comparatively 21:55:21 in 2006. These relative proportions indicated Thailand encounters to triple burden of disease. The non-communicable diseases, the majority of premature mortality cause, increased from 4,686,862 person-years to 6,215,142 person-years from 1997 to 2006 respectively (Table 2) or 42.65% in 1997 to 54.75% in 2006. By and large, nearly 90% of this cause occurred in adult aged 45 years and over. The second cause was communicable diseases which slightly declined from 2,994,406 person-years in 1997 to 2,412,708 person-years in 2006, next to external causes of injury group accountable for 2,578,922 person-years in 1997 to

Table 3 Comparison of the primary causes of premature death by number of year of life lost and rate, Thailand, between 1997 and 2006

Primary causes of premature death in 1997	Number of YLL	YLL Rate (per 1000)	Primary causes of premature death in 2006	Number of YLL	YLL Rate (per 1000)
1. HIV	2,051,255	33.92	1. HIV	1,356,101	21.65
2. Road traffic injury	1,260,151	20.84	2. Road traffic injury	1,165,905	18.62
3. Cerebrovascular disease	579,526	9.58	3. Cerebrovascular disease	726,581	11.60
4. Liver cancer	467,964	7.74	4. Ischemic heart disease	568,040	9.07
5. Self-inflicted injuries	395,537	6.54	5. Cirrhosis of the liver	488,899	7.81
6. Diabetes mellitus	376,347	6.22	6. Liver cancer	409,101	6.53
7. Drowning	334,964	5.54	7. Self-inflicted injuries	340,607	5.44
8. Ischemic heart disease	317,222	5.25	8. Nephritis and nephrosis	271,633	4.34
9. Violent / Homicide	305,834	5.06	9. Violent / Homicide	263,926	4.21
10. Cirrhosis of the liver	271,167	4.48	10. Chronic obstructive pulmonary diseases	260,410	4.16
11. Nephritis and nephrosis	218,490	3.61	11. Drowning	260,033	4.15
12. Pancreas cancer	196,030	3.24	12. Lower respiration infection Diseases	243,961	3.90
13. Tuberculosis	175,559	2.90	13. Trachea, bronchus and lung Cancer	219,025	3.50
14. Chronic obstructive pulmonary disease	168,323	2.78	14. Cervix uteri cancer (Female)	162,655	5.13
15. Trachea, bronchus and lung cancer	161,561	2.67	15. Tuberculosis	150,053	2.40
Total 10,988,606 person-years			Total 11,350,350 person-years		

2,371,778 person-years in 2006. In fact, communicable disease group was represented by HIV mainly contributing 57%, followed by perinatal problems by 12%, and respiratory infectious diseases by 10%. In contrary, non-communicable diseases were taken account for cardiovascular diseases by 29% followed by cancer diseases by 28%, digestive diseases by 11% and gentio-urinary diseases by 6%. On the other hand, external causes of injuries group approximated 50% were caused by road traffic injury, along with self-inflicted and violence constituting a further 14% and 11% respectively. Notably, about 25% were classified as other unintentional injured death such as fall, poisoning, drowning and war. Meanwhile, the mortality in the ages 1-44 contributes more to the premature death from HIV infection and all causes of injuries. These causes demonstrated a 2:1 for male to female ratio from HIV and 5:1 from injury causes.

Above all, non-communicable diseases tended to be important cause of death for advance age in both males and females.

The first fifteen primary causes of premature mortality

Table 3 shows the specific-causes of mortality ranked by the number of year of life lost contribution to premature mortality. The first fifteen primary causes accumulated for 60-66% of the total year loss. HIV, road traffic injury, cerebrovascular disease remain the common leading causes of premature mortality over the period 1997 through 2006. Trends of HIV and road traffic injury declined while cerebrovascular disease increased in the same time. The remainder composition of the first fifteen causes of premature mortality after rang three were less agreed between 1997 and 2006. However, these diseases continue to be common causes of premature death. This movement indicated that there are dynamic trends of specific disease in mortality burden.

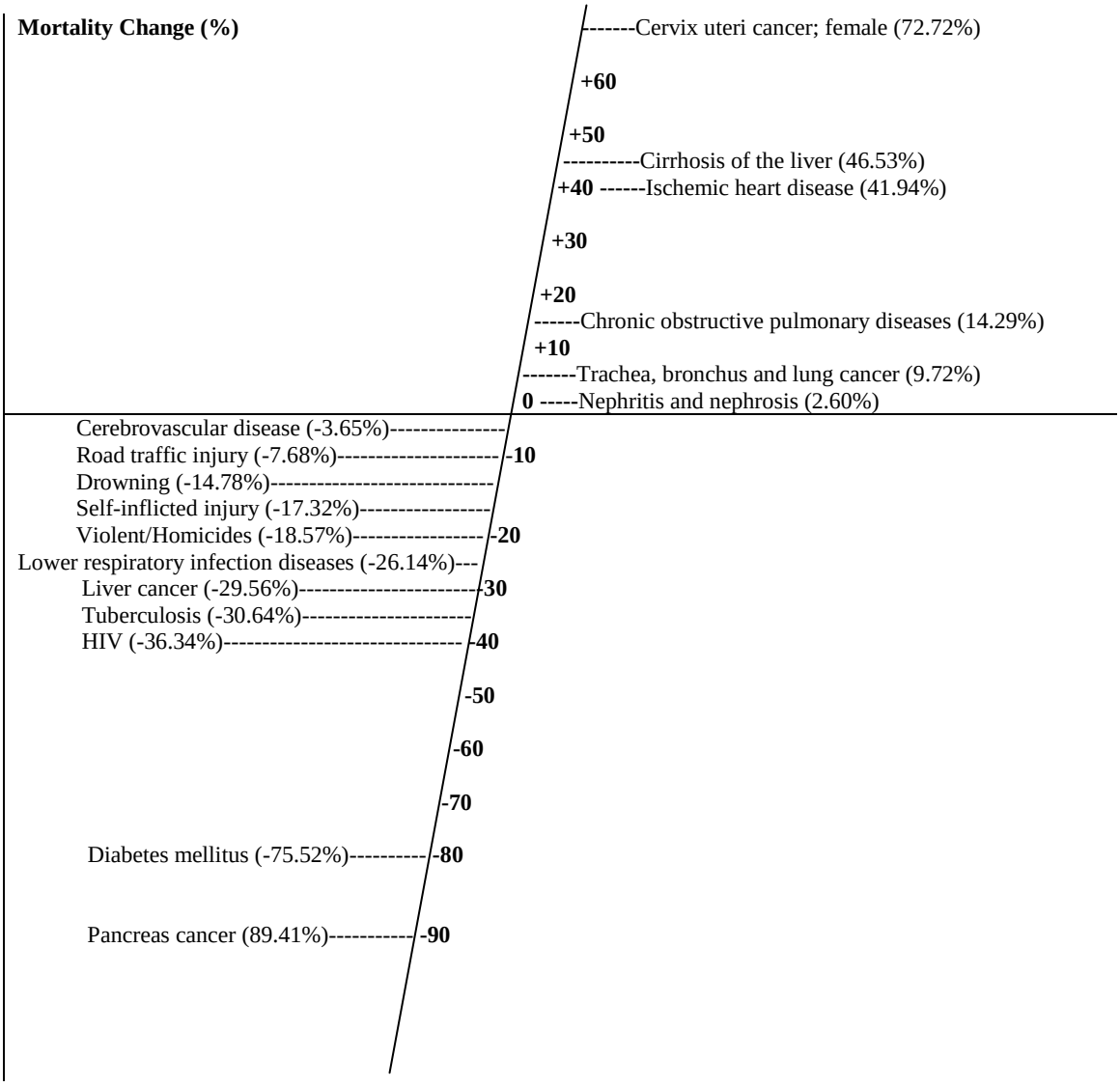
Table 4 displays the percentage differences in age-adjusted causes-specific mortality rate of YLL in 1997 and 2006. Overall premature mortality trend slightly declined by 7.54% from age-adjusted 196.04 per 1000 in 1997 to crude corresponding YLL rate 181.25 per 1000 in 2006. However, certain leading causes of premature mortality substantially declined in age-adjusted specific-cause YLL rate occurred from pancreas cancer (-89.41%), diabetes mellitus (-75.52%), HIV (-36.34%), tuberculosis (-30.69%), liver cancer (-29.56%), lower respiratory infection disease (-26.14%), violent/homicide (-18.57%), self-inflicted (-17.32%), drowning (-14.78%), road traffic injury (-7.68%), and cerebrovascular disease (-3.65%). On the other hand, some diseases contributed to percentage increase in age adjusted YLL rate such as cervix cancer (+72.72%), cirrhosis of the liver (+46.53%), ischemic heart disease (+41.94%), chronic obstructive pulmonary disease (+14.29%), trachea, bronchus and lung cancer (+9.72%), and nephritis and nephrosis (+2.60%).

As depicted in Figure 3, trends in age-adjusted YLL rate for the fifteen leading causes of premature mortality over the period of 1997 through 2006 were drawn on a line graph. Dramatic declines in premature mortality occurred for HIV (36.34%),

Table 4 The percentage difference of age-adjusted causes-specific mortality rate of YLL in 1997 and causes-specific mortality rate of YLL in 2006 by the first fifteen primary causes of premature death and gender, Thailand

Leading causes of premature death	Overall			male			Female		
	Age-adjusted of YLL rate in 1997	YLL rate in 2006	% diff.	Age-adjusted of YLL rate in 1997	YLL rate in 2006	% diff.	Age-adjusted of YLL rate in 1997	YLL rate in 2006	% diff.
All causes	**196.04**	**181.25**	**-7.54**	**260.20**	**233.89**	**-10.11**	**132.09**	**129.95**	**-1.62**
1. HIV	**34.01**	**21.65**	**-36.34**	**53.60**	**29.16**	**-45.59**	**14.50**	**14.34**	**-1.10**
2. Road traffic injury	**20.17**	**18.62**	**-7.68**	**34.10**	**31.85**	**-6.35**	**6.49**	**5.72**	**-11.86**
3. Cerebrovascular disease	**12.04**	**11.60**	**-3.65**	**13.51**	**13.57**	**+0.44**	**10.55**	**9.69**	**-8.15**
4. Ischemic heart disease	**6.39**	**9.07**	**+41.94**	**8.14**	**10.94**	**+34.39**	**4.63**	**7.25**	**+56.58**
5. Cirrhosis of the liver	**5.33**	**7.81**	**+46.53**	**8.22**	**12.33**	**+50.00**	**2.43**	**3.80**	**+56.38**
6. Liver cancer	**9.27**	**6.53**	**-29.56**	**10.51**	**9.32**	**-11.32**	**8.00**	**3.82**	**-52.25**
7. Self-inflicted injuries	**6.58**	**5.40**	**-17.32**	**10.45**	**9.09**	**-13.01**	**2.73**	**1.88**	**-31.14**
8. Nephritis and nephrosis	**4.23**	**4.34**	**+2.60**	**5.05**	**4.15**	**-17.82**	**3.41**	**4.52**	**+32.55**
9. Violent / Homicide	**5.17**	**4.21**	**-18.57**	**8.90**	**7.65**	**-14.04**	**2.87**	**0.86**	**-70.03**
10. Chronic obstructive pulmonary diseases	**3.64**	**4.16**	**+14.29**	**4.79**	**6.17**	**+28.80**	**2.46**	**2.19**	**-10.98**
11. Drowning	**4.87**	**4.15**	**-14.78**	**7.41**	**6.85**	**-7.56**	**2.37**	**1.52**	**-35.86**
12. Lower respiration infection diseases	**5.28**	**3.90**	**-26.14**	**4.18**	**5.12**	**+22.48**	**2.91**	**2.61**	**-10.31**
13. Trachea, bronchus and lung cancer	**3.19**	**3.50**	**+9.72**	**4.17**	**4.30**	**+3.11**	**2.21**	**2.71**	**+22.62**
14. Cervix uteri cancer	**2.97**	**5.13**	**+72.72**	**-**	**-**	**-**	**2.97**	**5.13**	**+72.72**
15. Tuberculosis	**3.46**	**2.40**	**-30.69**	**4.71**	**3.43**	**+27.18**	**2.20**	**1.39**	**-36.82**
16. Diabetes mellitus	**7.64**	**1.87**	**-75.52**	**6.26**	**1.90**	**-69.65**	**9.03**	**1.85**	**-79.51**
17. Pancreas cancer	**4.25**	**0.45**	**-89.41**	**7.87**	**0.51**	**-93.52**	**0.64**	**0.40**	**-37.50**

Figure 3 Percentage change in age-adjusted YLL rates of primary causes of premature mortality, Thailand, 1997-2006



followed by tuberculosis (30.64%), and liver cancer (29.56%). Concurrent substantial percentage increase in age-adjusted YLL rates occurred for cervix uteri cancer in female (72.72%), cirrhosis of the liver (46.53%), and ischemic heart disease (41.94%) respectively.

Furthermore, the specific-causes of premature mortality are dynamic. These specific-causes considerably vary with genders (Table 4). For example, HIV has percentage decreased in age-adjusted YLL rate much greater for male (-45.59%) than for female (-1.10%). Ischemic heart disease, on the contrary, has percentage increased among female (+56.58%) greater than male (+34.39%). Pursuing this further, chronic obstructive pulmonary disease has increased age-adjusted YLL in male (+28.88%), but decreased in female (-10.98%) etc.

It is evident that dynamic trends of specific diseases in premature mortality burden provide important clues to the success of ongoing health services and the need for development of interventions. For example; premature mortality of HIV or AIDS declined by 36.34% along with tuberculosis by 30% owing to results of the effective preventive and control measures such as 100% condom use campaign, antiretroviral drug program, sentinel surveillance for HIV to monitor the effectiveness of intervention programmes [8], TB programmes (DOTS), and etc. Road traffic injury has slightly declined (7.68%), while the first two leading causes among childhood; road accident and drowning are here to stand. This is because child injuries have been neglected as a public health problem issue and the information is insufficient to determine practice and well-targeted prevention measure. For chronic diseases; cerebrovascular disease has declined by 3.65%, liver cancer by 29.56%, and breast cancer by 41.94%. In contrast, premature mortality rate from ischemic heart disease has increased by 41.94%, cirrhosis of the liver by 46.53%, chronic obstructive pulmonary disease by 14.29%, and cervical cancer by 72.72%. Over a decade the numerous researches have shown

that much of the burden of chronic diseases are attributable to environment and life style factors, including rapid shift risk level upwards [9-10]. The prevention of disease and the promotion of health are the ultimate goal of public health. The prevention will remain concentrating on the major diseases such as cancer, heart diseases, injuries, and AIDS which are currently accountable for premature mortality. Achieving that goal requires assurance that public health intervention can reach those groups of people suffering from mortality that can be avoided by using current knowledge and technology.

DISCUSSION

While the burden of disease is dynamic, greater access to health information and to capacity to analyze it, is promoting better decision-making. The results from premature mortality reveal that the distribution of the premature mortality burden in Thailand during study period points out a mix pattern of disease or triple burden of disease from relative proportion of communicable diseases: communicable diseases: injuries causes from 27:43:24 in 1997 to 21:55:21 in 2006 as Thailand was facing with the attempts to flight against the infectious diseases, improving the response to an increasing of chronic diseases and preparing to meet the impact of injuries. Although proportions of premature mortality from communicable diseases and injuries causes slightly have declined, the proportions from non-communicable diseases have continuously increased.

The changes of premature mortality among age groups were seen that probability of premature mortality in adult has gradually improved similarly in both sexes, while that in elderly has continuously increased (at a rate of 379.32 to 431.38 per 1000 for the age of 60 years old and over between 1997 and 2006). World Health Organization 2003 [11] proposed an index to indicate development state using two mortality indicators with the comparatively high number of death between developing countries and developed countries that the developing countries have high adult mortality while developed countries have high elderly mortality. Whereas the adult mortality is improving from mortality reduction in HIV infection and road traffic injuries, non-communicable diseases are becoming the dominant cause of illness among adult aged over 45. The finding provides strong evidence that an increasing trend of premature mortality in the age 45-59 group in both sexes (at a rate of 219.03 to 242.47 per 1000 between 1997 and 2006) or risk-target group of premature mortality caused by 75% chronic diseases pose a new challenge for policy-maker and create a new public health alarm that it's important not only HIV infectious or road traffic injuries to be seriously aware of by the general health public as leading contributor to premature death but also increasing mortality trend in chronic diseases mortality among the age 45-59 years old group.

Continuous changes and development of specific disease in mortality burden provide the essential information of the planning process. An appropriate health-care delivery system should follow good health planning resulting from well-formulated public health policy. Decisions must be based on evidences about the pattern of diseases, their risk factors, and cost-effective of interventions. However, the study is *ad hoc* study providing epidemiology events: health problems, and trend of disease. The causal and relationship with other factors need specific designs such as randomized control trials such as match-pair case control, and etc.

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REFERENCES

1. National Statistic Office. Report the survey of population change round 1-5. Bangkok, Office of the Prime Minister Press; 1964-2005.
2. Ministry of Public Health. Annual public health statistics. Nonthaburi: The Ministry of Public Press; 1996-2006.
3. Chuprapawan C et al. The report on causes of death Thaialnd 1997-1998. Nonthaburi: The Ministry of Public Press; 2003.
4. Porapakkham Y, Rao C, Pattaraarchachai J, Polpraset W, Vos T, Adair T, Lopez AD. The burden of premature mortality in Thailand, 2005: new estimated from corrected vital registration in Setting Priorities using Information on Cost-Effectiveness (SPICE): Proceedings of the Steering Committee Meeting; 2009 May 29; Bangkok; 2009. p.1-47.
5. World Health Organization. Global burden study 2002. Geneva: World Health Organization; 2002.
6. United Nations. Estimation of adult mortality from information on the distribution of deaths by age. In: Manual X: indirect techniques for demographic estimation (United Nations publication, Sales No. E.83.XIII.2). New York: Department of International Economic and Social Affairs, Population Division; 1983.
7. World Health Organization. Global burden study 2005. Geneva: World Health Organization; 2005.
8. Phoolcharoen W, Detels R. Acquired immunodeficiency syndrome. In: Detels R, MacEwen J, Beaglehole R, and Tanaka H, editors. Oxford textbook of public health. 4th ed. New York: Oxford University Press; 2002. p.1453-77.
9. World Health Organization. The world health report 2002: reducing risks promoting healthy life. Geneva: World Health Organization; 2003.
10. Beaglehole R, Ebrahim S, Readdy S, Voute J, Leeder S. Prevention of chronic diseases: a call to action. Lancet. 2007; 370: 2152-7.
11. World Health Organization. The world health report 2004: the challenges in public health. Geneva: World Health Organization; 2004.