DIFFERENCES IN MORTALITY BY EDUCATION LEVEL AMONG PATIENTS IN DIABETIC REGISTRY FOR THAILAND

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Abstract. This study was conducted in order to determine the impact of education on mortality due cardiovascular, infectious and renal disease, and cancer among Thai diabetics using data from the Thailand diabetes registry cohort prospected and conducted between April 2003 and February 2006. The study population consisted of 9,370 registered diabetic patients attending ten diabetes clinics at tertiary medical centers in Bangkok and major provinces. The population was classified by education level: those who had not yet attained a bachelor's degree classified as having "lower education" (7,684: 82%) and those with a bachelor's degree or higher classified as having "higher education" (1,686: 18%). The overall mortality rate among those in the higher education group was lower than those in the lower education group (8.9 *vs* 20.5 per 1,000 patient-years, respectively) with a hazard ratio (HR) of 0.43 (0.31-0.61). The higher education group also had lower mortality rates due to infectious disease [HR 0.10 (0.02-0.41)], renal disease [HR 0.24 (0.06-0.99)] and cardiovascular disease [HR 0.42 (0.22-0.80)]. There was no difference in cancer mortality between the two groups [HR 1.25 (0.74-2.11)].

Keywords: diabetes, educational level, mortality rate, death rate

INTRODUCTION

Provision of good education for its population is a major socioeconomic problem for many countries, especially developing countries. In Thailand, most of people do not attain a bachelor's degree level education (Aekplakorn *et al*, 2007). Education has an impact not only on the socioeconomic wellbeing of people and their country but also on the health of people. Education and other socioeconomic factors have been shown to influence morbidity and mortality rates associated with diabetes in developed countries in Europe (Koskinen *et al*, 1996; Gnavi *et al*, 2004; Livingstone *et al*, 2012) and the United States (Miech *et al*, 2009). The burden of diabetes is unevenly distributed across society by educational levels (Brown *et al*, 2004). A better educated diabetic population has

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advantages related to health (such as how to take care of themselves), and may have easier access to quality health care (Brown *et al*, 2004).

There have been few prospective studies evaluating the effect of differences in education levels on mortality among diabetics in Thailand. Most information comes from developed countries in Europe and from the US where there is the benefit of reduction in cardiovascular mortality (Dray-Spira *et al*, 2010). Developed and developing countries have different health problems, especially in relation to infectious diseases. The quality and availability of health care systems may be limited in developing countries. This may effect diabetic mortality.

We studied the impact of education level on mortality among 9,370 Thai diabetic patients.

MATERIALS AND METHODS

Study design

Thailand maintains a Diabetic Registry database, which has been described previously (Pratipanawatr *et al*, 2010). Diabetic patients attending diabetes clinics at ten tertiary care hospitals throughout Thailand are included in the registry. Education levels are also included in the registry. We obtained data regarding 9,370 diabetic patients attending the diabetic clinics described above from April to December 2003.Data recorded included demographic data, relevant findings on physical examination, laboratory results during the 12 month period prior to recruitment, medications used (including insulin, oral hypoglycemic agents, anti-hypertensive agents, lipid lowering agents and aspirin) and complications of diabetes. Patients gave informed consent prior to being included in the registry. The study was approved by the Ethics Committees at each hospital and by the Khon Kaen University Ethics Committee for Human Research (HE 490625).

Two educational level categories were used: those who had not attained a bachelor's degree (7,684; 82%) were placed in the "lower education" group and those with a bachelor's degree or higher (1,686; 18%) were placed in the "higher education" group. Subjects were divided into six categories by employment: unemployed, home maker, student, unskilled laborer, skilled laborer and professional such as engineer, teacher, nurse or physician.

Patient health care plans, if any, were noted. The plans were: National Health Security, Social Security, Civil Service health plan, private health insurance and self pay. The Civil Service health plan is a health plan for government officers and their families. It covers all health care costs and is considered to be the best health care plan in Thailand. Social Security is the health care plan for workers, financed by contributions from their employers. National Health Security is provided by the government for all Thai people who have no other coverage. It covers almost all essential health care but does not cover expensive procedures, such as renal transplants.

The vital status of each of the 9,370 diabetic patients in the database was determined and for those who had died the cause of death was determined by two independent physicians by review of the medical records, with disagreements settled by consensus. The causes of death were categorized into four groups: cardiovascular, infectious, renal, and cancer. Death from cardiovascular disease included cardiac disease, stroke and sudden death of undetermined cause.

Table 1
Patient demographic data by education level.

	Lower education 7,684	Higher education 1,686	*p*-value
Age	60.3 ± 13.5	55.6 ± 12.8	<0.01
Female (%)	5,389 (70.1)	785 (46.6)	<0.01
Duration of DM (years)	9.2 (0.1-46.5)[a]	8.0 (0.1-46.4)[a]	
Type 2 DM	7,302 (95.0)	1,565 (92.8)	<0.01
Smoking status (%)			
Non-smoker	6,232 (81.1)	1,255 (74.4)	<0.01
Ex-smoking	994 (12.9)	321 (19.0)	
Current smoker	458 (6.0)	110 (6.5)	
Health care plan (%)			
Civil service	4,034 (52.5)	1,222 (72.5)	<0.01
Self pay and insurance	2,295 (29.9)	332 (19.7)	
Social security	445 (5.8)	95 (5.6)	
National health security	910 (11.8)	37 (2.2)	
Occupation (%)			<0.01
Unemployed	2,765 (36.0)	539 (32.0)	
Home maker	2,317 (18.6)	127 (7.5)	
Unskilled labor	1,432 (18.6)	105 (6.2)	
Skilled labor	422 (5.5)	100 (5.9)	
Professional	596 (7.8)	786 (46.6)	
Student	152 (2.0)	29 (1.7)	
Education level (%)			
No schooling	841 (10.9)	0 (0)	
Elementary education	4,227 (55.0)	0 (0)	
Secondary education	1,843 (24.0)	0 (0)	
Vocational or high vocational certificate	773 (10.1)	0 (0)	
Bachelor's degree	0 (0)	1,355 (80.4)	
Higher than bachelor's degree	0 (0)	301 (19.6)	

[a]Median (minimun-maximun).

Statistical analysis

Descriptive statistics were used. Proportions of studied variables were compared using the χ^2 and Fisher's exact tests. Differences in mean values for the studied variables were compared using the Student's *t*-test and the Mann-Whitney *U* test.

Cox proportional hazard models were used to calculate hazard ratios (HRs) for the four mortality categories by education level. The models were adjusted for age and sex. The proportional hazard assumption and goodness-of-fit were tested.

Statistical analyses were performed using STATA, version 10.0 (Stata Corp, College Station, TX).

RESULTS

Patient baseline characteristics

The baseline characteristics and diabetic complications for each education level group are shown in Tables 1, 2 and 3. Differences in treatments between the

Table 2
Diabetic complications among study subjects by education level.

	Lower education	Higher education	*p*-value
Hypertension (%)	5,834 (75.9)	1,151 (68.3)	<0.01
Serum creatinine (mg/dl) (%)			<0.01
<1.5	6,264 (81.5)	1,450 (86.0)	
1.5 to 3.0	1,051 (13.7)	149 (8.8)	
>3.0	369 (4.8)	87 (5.2)	
Previous history of coronary artery disease (%)	621 (8.1)	137 (8.2)	NS
Previous history of cerebrovascular disease (%)	352 (4.6)	58 (3.4)	0.04

Table 3
Patient laboratory data among study subjects by education level.

	Lower education	Higher education	*p*-value
Height (cm)	156.6±8.7	161.6±8.5	<0.01
Weight (kg)	62.8±12.6	66.5±12.9	<0.01
BMI ($kg.m^{-2}$)	25.6±4.4	25.4±4.1	NS
SBP (mmHg)	143.1±23.3	138.5±20.9	<0.01
DBP (mmHg)	78.6±11.4	79.6±11.0	<0.01
FBS (mg/dl)	153.9±57.9	152.0±51.2	NS
HbA1c (%)	8.2±1.9	8.1±1.8	0.03
Cholesterol (mg/dl)	197.9±43.4	193.5±37.8	<0.01
Triglyceride (mg/dl)	152.7±109.4	141.8±85.2	<0.01
HDL cholesterol (mg/dl)	52.8±21.4	51.8±21.7	NS
LDL cholesterol (mg/dl)	114.7±35.9	113.6±35.0	NS

BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; FBS, fasting blood sugar; HDL, high density lipoprotein; LDL, low density lipoprotein.

groups are shown in Table 4. The higher education group was predominantly male, and the lower education group was predominantly female. The people in higher education group tended to be younger, have a shorter duration of diabetes, a lower prevalence of hypertension, renal insufficiency and of previous cerebrovascular diseases. The members of the higher education group tended to have better health care plans and more likely to receive expensive medications, such as thiazolidinedione, angiotensin II receptor blockers (ARB) and statins. A large proportion of those in the higher education group were professionals, while those in the lower education group tended to be home makers or unskilled labor. Both groups had a similar proportion of unemployed members. The higher education group had slightly better glycemic, blood pressure and lipid control.

The two groups had different patterns of diabetes, anti-hypertensive and lipid-lowering medications, except insulin and alpha-adrenergic blocking agents. Patients in the higher education group were more likely to be taking statins and metformin.

Table 4
Treatment of study subjects by education levels.

	Lower education	Higher education	*p*-value
Insulin (%)	2,251 (29.3)	462 (27.4)	NS
Sulfonamide (%)	5,952 (65.8)	1,065 (63.2)	0.044
Metformin (%)	5,184 (67.5)	1,189 (70.5)	0.015
Thiazolidinedione (%)	348 (4.5)	157 (9.3)	<0.01
ACE inhibitor (%)	2,800 (36.4)	496 (29.4)	<0.01
Angiotensin II receptor blocker (%)	577 (7.5)	184 (10.9)	<0.01
β-blocker (%)	1,558 (20.3)	258 (15.3)	<0.01
Alpha-blocker (%)	243 (3.2)	64 (3.8)	NS
Calcium channel blocker (%)	1,735 (22.6)	310 (18.4)	<0.01
Diuretic (%)	2,262 (29.4)	347 (20.6)	<0.01
Statin (%)	3,293 (42.9)	845 (50.1)	<0.01
Fibrate (%)	1,001 (13.0)	225 (13.4)	<0.01
ASA (%)	2,735 (35.6)	556 (33.0)	0.042

Table 5
Numbers of deaths, mortality rates, unadjusted hazard ratios (HRs), adjusted hazard ratios and their 95% CIs for overall mortality, and for cardiovascular disease, infectious disease, cancer and renal disease.

Mortality causes	Lower education		Higher education		HR	
	Deaths *n*	Mortality per 1,000 patient-years	Deaths *n*	Mortality per 1,000 patient-years	Unadjusted	Adjusted for age and sex
All causes	388	20.5	37	8.9	0.43 (0.31-0.61)	0.47 (0.33-0.66)
Cardiovascular	109	5.8	10	2.4	0.42 (0.22-0.80)	0.48 (0.25-0.93)
Infectious	89	4.7	2	0.5	0.1 (0.02-0.41)	0.11 (0.03-0.46)
Cancer	65	3.4	18	4.5	1.25 (0.74-2.11)	1.53 (0.89-2.64)
Renal	38	2	2	0.5	0.24 (0.06-0.99)	0.22 (0.05-0.90)
Others causes	85	4.5	5	1.2	0.26 (0.11-0.64)	0.26 (0.10-0.64)

Mortality rates, hazard ratios and survival estimation curves

The crude overall mortality rate for the lower education group (20.5 per 1,000 patient-years) was higher than for the higher education group (8.9 per 1,000 patient-years) (Table 5). The higher education group has significantly lower HR for all mortality causes than the lower education group by 53%, [HR 0.47(0.33-0.66)]. The Kaplan-Meier survival estimate curves are shown in Fig 1.

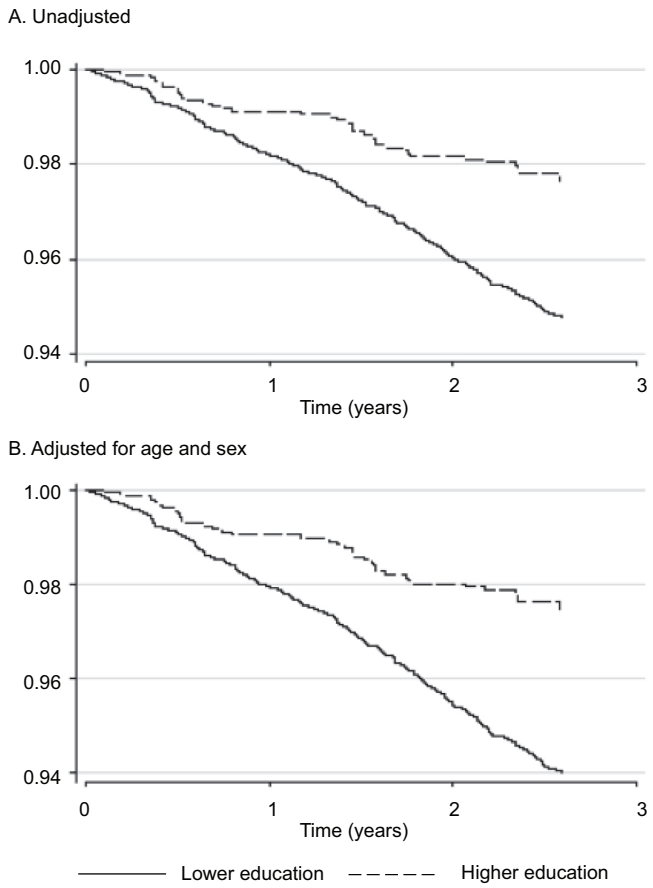

Fig 1–Kaplan-Meier all-cause survival estimate curves by education level. A, Unadjusted. B, Adjusted for age and sex.

The relationship between education level and all major specific causes of mortality rate is shown in Table 5. A lower mortality rate was seen among those with higher education level for infectious disease [adjusted HR 0.11 (0.03-0.46)), renal disease [adjusted HR 0.22 (0.05-0.90)] and cardiovascular disease [adjusted HR 0.48 (0.25-0.93)]. Cancer was the only mortality cause that showed no different rates among the groups of higher and lower education level [HR 1.53 (0.89-2.64)]. The Kaplan-Meier survival estimate curves for these different mortality causes are shown in Fig 2.

DISCUSSION

We found an association between education level and mortality rates in Thai diabetic patients. The majority of diabetics (82%) did not have a bachelor's degree, which is expected in a developing country. The higher education group had a 53% lower mortality rate. The greatest difference in mortality by education level was in infectious diseases, followed by renal and cardiovascular diseases.

These findings agree with previous studies in the US (Miech *et al*, 2009; Dray-Spira *et al*, 2010; Saydah and Lochner, 2010). Thai diabetics in the lower education study group had a mortality rate twice that of the higher education study group, similar to a study from the US (Saydah and Lochner 2010). The difference in mortality among Thai diabetics was due to infectious disease [HR 0.11 (0.03-0.46)]. In the US, lower cardiovascular disease mortality is the main death reduction among diabetics with difference education levels (Dray-Spira *et al*, 2010). Our study also found a lower cardiovascular disease mortality in the higher education group, [HR 0.48 (0.25-0.93)]. Mortality from renal disease, mainly due to inability to afford renal transplantation, was nearly 80% lower in the higher education group. This could be explained by differences in health care plans and access to health services between the two groups. Mortality due to cancer was the only factor studied not associated with education level. One study

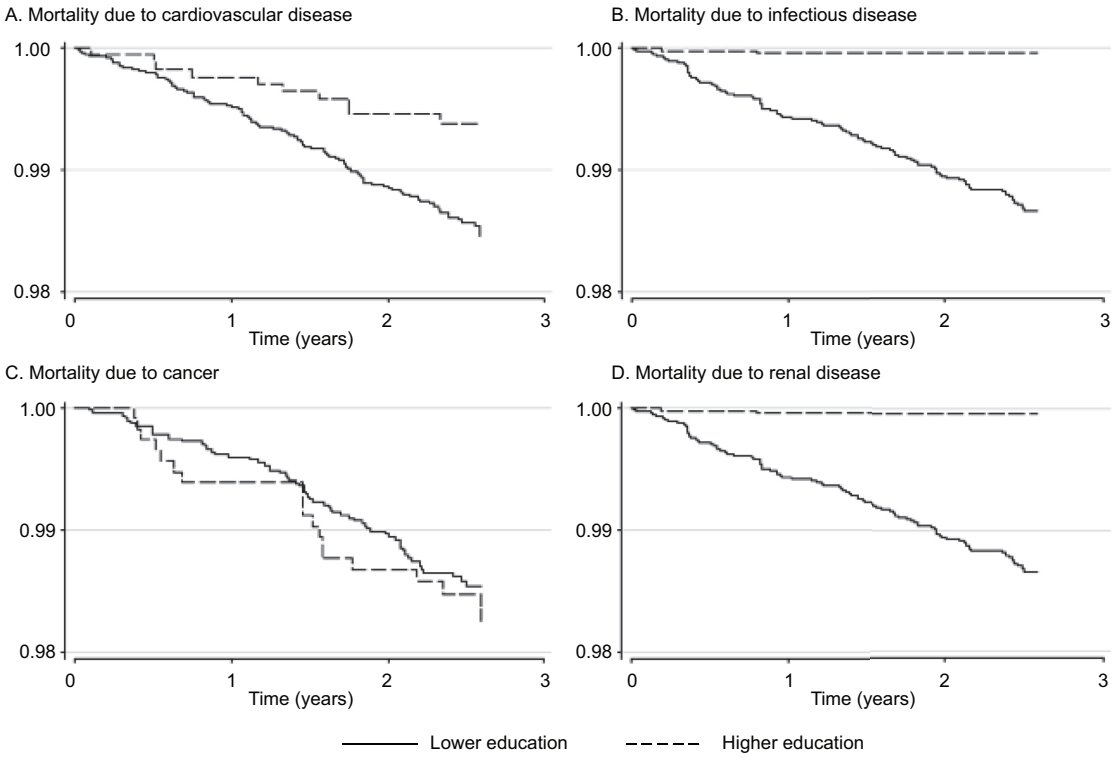

Fig 2–Kaplan-Meier survival estimate curves by education level (adjusted for age and sex). A, Mortality due to cardiovascular disease. B, Mortality due to infectious disease. C, Mortality due to cancer. D, Mortality due to renal disease.

found a positive association between education and cancer mortality (Devesa and Diamond, 1980) and another study found a negative association (Albano *et al*, 2007). Results might also vary by the period of study and type of cancer.

The relationship between education and health outcomes has been extensively studied and three main mechanisms have been proposed: 1) access to care, 2) quality of care and 3) health behaviors of patients (Brown *et al*, 2004).

Education brings economic opportunity and improved health outcomes, as seen in our study. Improving education is important for improving diabetes outcomes in Thailand.

In conclusion, Thai diabetics with at least a bachelor's degree had a 53% lower mortality rate in our study than those with lower education levels. Higher education was associated with lower mortality for all major causes studied except cancer. Lower mortality due to infectious disease was especially associated with higher education.

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REFERENCES

Aekplakorn W, Hogan M, Chongsuvivatwong V, *et al*. Trends in obesity and associations with education and urban or rural residence in Thailand. *Obesity* 2007; 15: 3113-21.

Albano JD, Ward E, Jemal A, *et al*. Cancer mortality in the United States by education level and race. *J Natl Cancer Inst* 2007; 99: 1384-94.

Brown AF, Ettner SL, Piette J, *et al*. Socioeconomic position and health among persons with diabetes mellitus: a conceptual framework and review of the literature. *Epidemiol Rev* 2004; 26: 63-77.

Devesa SS, Diamond EL. Association of breast cancer and cervical cancer incidence with income and education among whites and blacks. *J Natl Cancer Inst* 1980; 65: 515-28.

Dray-Spira R, Gary-Webb TL, Brancati FL. Educational disparities in mortality among adults with diabetes in the U.S. *Diabetes Care* 2010; 33: 1200-5.

Gnavi R, Petrelli A, Demaria M, *et al*. Mortality and educational level among diabetic and non-diabetic population in the Turin Longitudinal Study: a 9-year follow-up. *Int J Epidemiol* 2004; 33: 864-71.

Koskinen SV, Martelin TP, Valkonen T. Socioeconomic differences in mortality among diabetic people in Finland: five year follow up. *Br Med J* 1996; 313: 975-8.

Livingstone SJ, Looker HC, Hothersall EJ, *et al*. Risk of cardiovascular disease and total mortality in adults with type 1 diabetes: Scottish registry linkage study. *PLoS Med* 2012; 9: e1001321.

Miech RA, Kim J, McConnell C, Hamman RF. A growing disparity in diabetes-related mortality U.S. trends, 1989-2005. *Am J Prev Med* 2009; 36: 126-32.

Pratipanawatr T, Rawdaree P, Chetthakul T, *et al*. Thailand Diabetic Registry cohort: predicting death in Thai diabetic patients and causes of death. *J Med Assoc Thai* 2010; 93 (suppl 3): S12-20.

Saydah S, Lochner K. Socioeconomic status and risk of diabetes-related mortality in the U.S. *Public Health Rep* 2010; 125: 377-88.