การป่วยและการป่วยด้วยโรคร่วมในกลุ่มผู้สูงอายุภาคใต้ส่วนล่าง: การวิเคราะห์เวลาที่อยู่รอดก่อนที่จะมีการป่วย

Morbidity and Multi-morbidity among the Elderly Population in Southernmost Thailand: Cox Proportional Hazards Regression Model of Survival Approach

พนม สุขจันทร์[1*], แวนูรมา เจ๊ะเมาะ[1], ค่อลิฟ ปะหยังหลี[1]

Phnom Sukchan[1*], Waenurama Chemoh[1], Kolip Payanglee[1]

(Received: Sep2, 2019; Revised: Nov 22, 2019; Accepted: Dec 17, 2019)

บทคัดย่อ

การศึกษานี้มีวัตถุประสงค์เพื่อศึกษาการกระจายของการป่วย การป่วยด้วยโรคร่วมและวิเคราะห์เวลาที่อยู่รอดก่อนที่จะมีการเจ็บป่วยรวมทั้งปัจจัยเสี่ยงต่อการป่วยด้วยโรคเป็นการศึกษาเชิงสำรวจภาคตัดขวางในชุมชนเขตเมืองกึ่งเมืองและชนบทของจังหวัดนราธิวาสในเขตภาคใต้ของประเทศไทยตั้งแต่เดือนมกราคมถึงกันยายน 2560 กลุ่มตัวอย่างศึกษาเป็นผู้สูงอายุ อายุ 60 ปีขึ้นไปจำนวน 517 คน ใช้แบบสอบถามและการตรวจร่างกายเบื้องต้นเพื่อรวบรวมข้อมูล ข้อมูลความเจ็บป่วยได้จากการประเมินตามผลการทดสอบสุขภาพและใบสั่งยาของแพทย์โดยพยาบาลที่เป็นผู้ช่วยนักวิจัย โรคถูกจำแนกตามรหัสการวินิจฉัยทางการแพทย์ (รหัส ICD-10-CM) ใช้เทคนิควิเคราะห์ nonparametric วิธี Kaplan-Meier และ Cox proportional hazards model เพื่อประเมินฟังก์ชันการอยู่รอดและวิเคราะห์ปัจจัยเสี่ยง ผลการศึกษาพบว่าผู้สูงอายุร้อยละ 68.7 มีโรคประจำตัว ร้อยละ 51.8 ป่วยด้วยโรคใดโรคหนึ่ง ร้อยละ 0.8 มีการป่วยร่วมอย่างน้อยสี่โรคที่แตกต่างกัน โดยที่ร้อยละ 16.8 ถูกจัดเป็นประเภทป่วยหลายโรคร่วม ร้อยละ 58.7 ของผู้สูงอายุหญิงป่วยด้วยโรคความดันโลหิตสูงความดันโลหิตสูงพบมากที่สุดในโรคระบบไหลเวียนเลือดในขณะที่เบาหวานเป็นโรคที่พบมากที่สุดในโรคระบบต่อมไร้ท่อ เส้นโค้งการอยู่รอดสำหรับการเจ็บป่วยผู้สูงอายุลดลงถึง ร้อยละ 50 ที่อายุประมาณ 77 ปีหรือ 17 ปีหลังจากเข้าสู่วัยสูงอายุ เพศศาสนาระดับการศึกษาการตรวจสุขภาพการดื่มแอลกอฮอล์และออกกำลังกายเป็นปัจจัยเสี่ยงที่สำคัญสำหรับการเจ็บป่วยของผู้สูงอายุ ผู้สูงอายุในภาคใต้ของประเทศไทยมีอัตราความชุกของการป่วยและการป่วยด้วยโรคร่วมในระดับที่สูง

คำสำคัญ: ผู้สูงอายุ การเจ็บป่วย การอยู่รอด ภาคใต้ของประเทศไทย

Abstract

This study aims to investigate the distribution of morbidity, multi-morbidity and survival time to present morbidity including determining morbidity risk factors. A community-based cross-sectional survey was conducted in urban, semi-urban and rural areas of Narathiwat Province in southernmost Thailand from January to September 2017. The study participants were 517 elderly 60 years of age and older. A questionnaire and basic physical examinations were used to gather data. Morbidity data were assessed based on

[1] คณะแพทยศาสตร์ มหาวิทยาลัยนราธิวาสราชนครินทร์

[1] Faculty of Medicine, Princess of Naradhiwas University

[*] Corresponding Author: phnom.s@pnu.ac.th

health testing results and doctor prescriptions by researcher nurses. Diseases were classified by medical diagnosis codes (ICD-10-CM Code). Nonparametric techniques such the Kaplan-Meier method and the Cox proportional hazards model were used to estimate the survival function and identify risk factors. Of the elderly sample, 68.7% were suffering from diseases; 51.8% were suffering from one disease, 0.8% had four different diseases, and 16.8% were categorised as multi-morbidity. The percentage of morbidity among female elderly was 58.7%. Hypertension was the most common disease of the circulatory system, while diabetes was the most common disease in the endocrine category. The survival curve for elderly morbidity declined to 50% at an age of approximately 77 years or 17 years after becoming elderly. Gender, religion, education level, health check-up, alcohol consumption and exercise were significant risk factors for elderly morbidity. The elderly in southernmost Thailand have a high prevalence of morbidity and suffer from multi-morbidity.
Keywords: Elderly, Morbidity, Survival, Southernmost Thailand

Introduction

The elderly population, which includes those persons aged 60 years or older, has increased substantially in most countries and worldwide. According to the World Population Report of the United Nations, the global elderly population is projected to grow by 56% from 901 million to 1.4 billion between 2015 and 2030(United Nations, 2012). Additionally, the global elderly population is expected to more than double between 2015 and 2050 to nearly 2.1 billion. Two thirds of the world's elderly live in developing regions such as Asia, Africa, Latin America and the Caribbean, and their numbers are growing faster there than in developed regions (WHO, 2014). This phenomenon is the result of declining world fertility and mortality rates due to social development and advancements in medical technology. Global life expectancy at birth is projected to increase by 10 years to reach 76 years in 2045–2050 (National Guideline, 2016).

Ageing is a specific mechanism of change in the human body that is linked to health status and many complex factors. The ageing process is associated with the accumulation of cell damage over time. In the elderly, all body systems are typically weakened, and the body's capacity for recovery is diminished. Consequently, the elderly are at increased risk of developing a host of different diseases (Martin-Ruiz & von Zglinicki, 2014; Steves, Spector, & Jackson, 2012). The health status of the global elderly population has revealed a trend of a rising proportion of chronic disorders. According to a recent report, chronic diseases accounted for 60% of all deaths worldwide, and approximately 80% of patients with chronic diseases were in less-developed and developing countries.

Changes in physical condition, lifestyle and urbanization patterns have induced a shift in elderly morbidity patterns (Chatterji, Byles, Cutler, Seeman, & Verdes, 2015). These changes have resulted in a higher prevalence of non-communicable diseases, such as coronary heart disease, hypertension, stroke, cancer, chronic obstructive pulmonary disease (COPD) and diabetes (Woo et al., 2007). Unhealthy behaviours such as tobacco use and physical inactivity also affect health status (Strong, Mathers, Leeder, & Beaglehole, 2005).

In particular, hypertension and diabetes are major factors in elderly morbidity. A previous study reported that the average prevalence of hypertension in the elderly population was 18.3%, including 19.1% in males and 17.5% in females (Yuvaraj, Gowda, & Umakantha, 2010). These chronic diseases in the elderly persons usually lead to multi-morbidity, which is clinically significant and reduces quality of life.

Multi-morbidity is defined as the occurrence of several illness or medical conditions in the same person. The prevalence of multi-morbidity among the elderly has been studied in both less-developed and developed countries worldwide such as Asia, Europe and North America (Banjare & Pradhan, 2014; Uijen & van de Lisdonk, 2008). Among studies in Asia, in Bangladesh, the overall prevalence of multi-morbidity in the study population was 53.8% (Khanam et al., 2011). In the United States, Wolff et al. reported in 2002 that 82% of the elderly people had 1 or more chronic conditions, and 65% had multiple chronic conditions (Wolff, Starfield, & Anderson, 2002). A study in rural China found that 21.7% of elderly have at least two morbidities, and 15.9% have three or more morbidities (Zhou et al., 2010).

The increase in the elderly population in southernmost Thailand is consistent with global patterns. The fertility rate is declining, and advances in medical services are promoting increased life expectancy. However, maintaining the health of the elderly population remains a challenge for medicine, and a large proportion of the elderly are illiterate and live in poor environmental conditions. While the distributions of morbidity and multi-morbidity among the elderly in developed countries have been established (Fortin, Lapointe, Hudon, & Vanasse, 2005; Uijen & van de Lisdonk, 2008; Wolff, Starfield, & Anderson, 2002), the available literature on morbidity and multi-morbidity among the elderly in southernmost Thailand is limited. The aim of this study was to investigate the distribution of morbidity, multi-morbidity and survival time to presenting any morbidity after the age of 60 years. In addition, the important factors affecting morbidity among the elderly were determined. The results will be significant for local healthcare practitioners in southernmost Thailand. In addition, the evaluation of the morbidity profile will have implications for providing healthcare for the benefit of the elderly population in developing areas and internationally.

Materials and Methods

Study Design

A community-based cross-sectional survey was conducted to assess morbidity and multi-morbidity among elderly dwelling in Narathiwat Province in southernmost Thailand. Multi-stage random cluster sampling with the non-replacement procedure was used to select study areas. Participants were sampled from urban, semi-urban and rural areas. The study was conducted from January to September 2017 and was approved by the Ethics Committee of Princess of Naradhiwas University (PNU 2017-002). Permission for data collection was received from the community administration committee. All eligible participants received an explanation of the process and project from the investigators and provided written informed consent.

Study Setting

The sampling procedure for selecting the study participants involved three stages. A block of provinces in southernmost Thailand was selected as the sampling frame in the first stage. Among the three provinces of Narathiwat, Yala, and Pattani, Narathiwat was selected. Then, the characteristic area was selected at the second stage, followed by the selection of the target village at the third stage. For urban cluster sampling, 4 of 22 communities located within 5 kilometres of city hall with a population density over 112 persons per square kilometre (km2) were selected: Galaepayae, Samaianajus, Nanakon and Yaguk. For semi-urban cluster sampling, 3 of 24 villages located within 10 kilometres of city hall with a population density of 85-112 persons per km2 were selected: Hutaetuwor, Baerape and Khopaka. Rural clusters were defined as areas located more than 30 kilometres from city hall with a population density of less than 85 persons per km2. The sampling procedure successively selected 1 of 10 districts and 2 of 58 sub-districts. Khongu, Khochumboe, Saikow, and Torlang in the Bangkunthong and Praiwan sub-districts were selected as the 4 villages in rural areas. In total, 11 villages were included in the study area. The proportion of the elderly population in the chosen areas was 12-17% during the last 5 years.

Study Sample and Sampling Methods

The study participants were elderly persons aged 60 years and older. The participants had been living in the study area for at least 20 years and agreed to provide personal data. The exclusion criteria were elderly persons who were in a critical stage of illness and/or unable to communicate, including those who were unwilling to participate in the study. Based on the prevalence of metabolic syndrome in the Asian community, we calculated the sample size as follows: previous data indicated that the prevalence of hypertension in the elderly population was 19.3%. Using an alpha error of 1% and a design effect magnitude of 2, assuming an absolute precision of 6% (Banjare & Pradhan, 2014), and estimating an adjustment of 5% for incomplete questionnaires, the total sample size was calculated as approximately 604 elderly persons.

Data Collection Procedure

The proposal was prepared in response to the organisation's strategic research agenda and to address health issues in the area and was supported by data obtained by the authors and research team. After obtaining approval from the Ethics Committee of Princess of Naradhiwas University, the head of the village administration committee was contacted to coordinate the research. Community practice nurses of the sub-district health promotion hospital and community health volunteers were invited to participate in local researcher team and were assigned to support and gather health data from the elderly in this study. The team in each study area comprised nurses and 3-5 community health volunteers. They received short-course training from the project's authority on the purposes of the study, methods and procedures, their responsibilities and tasks, and compensation.

Elderly in each household of the study setting were surveyed by community health volunteers. Then, a complete listing of the participants was prepared, and study participants were selected using probability proportion to sample size (PPS) and computer-generated random numbers without replacement.

Qualified elderly were approached by the local researcher team and invited to participate and sign the consent form. The eligibility of the elderly was investigated based on demographic characteristics and personal health behaviours by using a questionnaire in combination with basic physical examinations. Morbidity data were assessed by researcher nurses, and diseases were classified by medical diagnosis codes (ICD-10-CM Code). The diseases were identified based on documented evidence of clinical registration at the hospital including health test results, doctor prescriptions, supporting documents after annual health check-ups or number of physician visits at the hospital. The personal illness data were repeatedly cross-checked and confirmed with the hospital by the researcher nurses.

Main Outcome Measures

The main outcome of the study was morbidity among elderly persons. Morbidity was categorised following medical diagnosis codes in the ICD-10-CM Code Set, which was used to classify diseases and a wide variety of signs, symptoms, abnormal findings, and complaints. To simply describe morbidity among the elderly, the result was arranged according to organ systems. Study participants who presented more than one disease were categorised as having multi-morbidity.

Independent Variable

Demographic characteristics and personal data including age, gender, religion, married status and educational level were categorised by dwelling area, and personal health behaviours including smoking, alcohol consumption and exercise behaviour were analysed as long-term health risk factors. A positive result for smoking was recorded if the participant was a current or previous smoker of cigarettes, and a positive result for alcohol behaviour was recorded if the participant was currently consuming alcohol or had in the past. The positive exercise behaviour category included participants who exercised regularly such as jogging, walking, yoga or any activities involving body movement for at least 15 minutes 3 days per week.

Statistical Analysis

Epidata version 3.1 software was used for data processing analysis, data input, data correction and data completion. R software version 3.2.3 (2015-12-10, "Wooden Christmas-Tree") (The R Foundation for Statistical Computing 2008, Austria) and R studio version 1.0.153 (2009-2017 RStudio, Inc.) were used to analyse the study data. Demographic characteristics and personal health behaviours were used as independent variables and were described as frequency and percent, while the distribution difference between dwelling areas was tested by a chi-square test or Fisher's test. Nonparametric techniques such the Kaplan-Meier method and the Cox proportional hazards model were used to estimate the survival function and identify risk factors. Results of the hazards model were presented as crude and adjusted risk ratios. Final mathematical models were applied by using the best model to identify risk factors for morbidity in the elderly.

Results

Demographic characteristics and personal health behaviours of the participants

Table 1 presents a comparison of the demographic characteristics and personal health behaviours of the participants by dwelling area. Of the 526 elderly who met the eligibility criteria, 517 (98.3%) completed the questionnaire and became study participants. Approximately half of the participants were aged between 60 and 69 years (47.0%). Approximately two-thirds were female (59.2%), Muslim (58.8%), married (56.9%) or educated at the primary school level (61.7%). Gender, religion, marital status and education level were found to differ significantly between dwelling areas. In terms of personal health behaviours with a positive health impact, most of the participants responded favourably in terms of health check-ups and exercise (62.9%, 75.4%).

Elderly morbidity patterns

Table 2 presents the elderly morbidity patterns by age. The participants were divided into 5 groups by age (60–65, 66–70, 71–75, 76–80 and 80+ years). The study results showed that 355 (68.7%) elderly suffered from disease. The percentage of unhealthy elderly was highest among those aged between 71 and 75 years (77.9%). Approximately half of the participants, 268 (51.8%), suffered from one disease, and only 4 (0.8%) were ill with four different diseases. Of the 87 (16.8%) elderly classified as multi-morbidity, the prevalence was highest among those aged between 71 and 75 years (21.2%).

Table 1 Demographic characteristics and personal health behaviours of the participants by dwelling area

Factors	Total (N=517)	Dwelling area n (%)			p-value
		Urban n=206	Semi-urban n=98	Rural n=213	
Age (Years)					0.1345
60-69	243 (47.0)	111 (53.9)	44 (44.9)	88 (41.3)	
70-79	181 (35.0)	64 (31.1)	36 (36.7)	81 (38.0)	
≥80	93 (18.0)	31 (15.0)	18 (18.4)	44 (20.7)	
Gender					0.0210*
Male	211 (40.8)	81 (39.3)	30 (30.6)	100 (46.9)	
Female	306 (59.2)	125 (60.7)	68 (69.4)	113 (53.1)	
Religion					0.0001***
Islam	304 (58.8)	154 (74.8)	59 (60.2)	0 (0)	Fisher's Exact
Buddhism	213 (41.2)	52 (25.2)	39 (39.8)	213 (100)	Test
Marital status					0.0001***
Single	9 (1.7)	5 (2.4)	2 (2.0)	2 (0.9)	Fisher's Exact
Married	294 (56.9)	103 (50.0)	45 (45.9)	146 (68.5)	Test
Others	214 (41.4)	98 (47.6)	51 (52.0)	65 (30.5)	

Table 1 (continue) Demographic characteristics and personal health behaviours of the participants by dwelling area

Factors	Total (N=517)	Dwelling area n (%)			p-value
		Urban n=206	Semi-urban n=98	Rural n=213	
Education					≤0.0001***
None	135 (26.1)	74 (35.9)	36 (36.7)	25 (11.7)	Fisher's Exact
Primary school	319 (61.7)	79 (38.3)	55 (56.1)	185 (86.9)	Test
Secondary school / Higher	63 (12.2)	53 (25.7)	7 (7.1)	3 (1.4)	
Health check-up					0.0152*
No	192 (37.1)	76 (36.9)	48 (49.0)	68 (31.9)	
Yes	325 (62.9)	130 (63.1)	50 (51.0)	145 (68.1)	
Smoking					0.0105*
No	461 (89.2)	179 (86.9)	82 (83.7)	200 (93.9)	
Yes	56 (10.8)	27 (13.1)	16 (16.3)	13 (6.1)	
Alcohol					≤0.0001***
No	474 (91.7)	199 (96.6)	93 (94.9)	182 (85.4)	
Yes	43 (8.3)	7 (3.4)	5 (5.1)	31 (14.6)	
Exercise					≤0.0001***
No	127 (24.6)	81 (39.3)	28 (28.6)	18 (8.5)	
Yes	390 (75.4)	125 (60.7)	70 (71.4)	195 (91.5)	

Table 2 Description of elderly morbidity patterns by age group (N=517)

Morbidity	60–65 Years (n=145)	66–70 Years (n=111)	71–75 Years (n=104)	76-80 Years (n=72)	80+ Years (n=85)	Total (n=517)
No	59 (40.7)	38 (34.2)	23 (22.1)	19 (26.4)	23 (27.1)	162 (31.3)
Yes	86 (59.3)	73 (65.8)	81 (77.9)	53 (73.6)	62 (72.9)	355 (68.7)
Morbidity patterns						
One morbidity	60 (41.4)	61 (55.0)	59 (56.7)	41 (56.9)	47 (55.3)	268 (51.8)
Two morbidities	23 (15.9)	11 (9.9)	17 (16.3)	9 (12.5)	13 (15.3)	73 (14.1)
Three morbidities	2 (1.4)	1 (0.9)	4 (3.8)	2 (2.8)	1 (1.2)	10 (1.9)
Four morbidities	1 (0.7)	0 (0.0)	1 (1.0)	1 (1.4)	1 (1.2)	4 (0.8)
Multi-morbidity (At least two morbidities)	26 (17.9)	12 (10.8)	22 (21.2)	12 (16.7)	15 (17.6)	87 (16.8)

Morbidities in the elderly

Table 3 presents the frequency and percentage of selected morbidities in the participants by gender. There were a total of 460 morbidities in 10 categories of disease in the 2018 ICD-10-CM Codes among the elderly in this study. The proportion of morbidity was higher among the female elderly, 270 (58.7%), than among males. The category of diseases of the circulatory system (I00-I99) had the highest morbidity prevalence, followed by the category of endocrine, nutritional and metabolic diseases (E00-E89). Hypertension (I10) was the most common disease in the I00-I99 category, and diabetes (E11) was the most common disease in the E00-E89 category. Hypertension had the highest prevalence among female elderly, 67.4%, and diabetes had the highest prevalence among male elderly (13.3%).

Table 3 Frequency and percentage of morbidities in elderly by gender

Disease groups (2018 ICD-10-CM Codes)	**Frequency and percentage of morbidity**	
	Male n (%)	**Female n (%)**
C00-D49 Neoplasms		
- Neoplasms of unspecified behavior (D49)	3 (1.6)	1 (0.4)
E00-E89 Endocrine, nutritional and metabolic diseases		
- Diabetes (E11)	23 (12.1)	36 (13.3)
- Dyslipidemia (E78.5)	3 (1.6)	8 (3.0)
F01-F99 Mental, Behavioural and Neurodevelopmental disorders		
- Neurosis (F48.9)	0 (0.0)	1 (0.4)
- Major depressive disorder (F33)	0 (0.0)	1 (0.4)
G00-G99 Diseases of the nervous system		
- Paralytic syndromes (G83)	2 (1.1)	1 (0.4)
I00-I99 Diseases of the circulatory system		
- Hypertension (I10)	128 (67.4)	171 (63.3)
- Heart disease (I25)	12 (6.3)	12 (4.4)
J00-J99 Diseases of the respiratory system		
- Asthma (J45)	1 (0.5)	7 (2.6)
- Vasomotor and allergic rhinitis (J30)	3 (1.6)	1 (0.4)
K00-K95 Diseases of the digestive system		
- Gastric ulcer (K25)	2 (1.1)	9 (3.3)
- Irritable bowel syndrome (K58)	1 (0.5)	2 (0.7)
M00-M99 Diseases of the musculoskeletal system and connective tissue		
- Osteoarthritis (M15)	5 (2.6)	1 (0.4)
- Gout (M10)	5 (2.6)	7 (2.6)
- Thoracic, thoracolumbar, and lumbosacral intervertebral disc disorders (M51)	0 (0.0)	2 (0.8)

Table 3 (continue) Frequency and percentage of morbidities in elderly by gender

Disease groups (2018 ICD-10-CM Codes)	**Frequency and percentage of morbidity**	
	Male n (%)	**Female n (%)**
N00-N99 Diseases of the genitourinary system		
- Disorders of kidney (N28)	0 (0.0)	4 (1.5)
R00-R99 Symptoms, signs and abnormal clinical and laboratory findings		
- General symptoms and signs (R50-R69)	1 (0.5)	5 (1.9)
Total	**190 (100.0)**	**270 (100.0)**

Kaplan-Meier Survival Curves

The Kaplan-Meier survival curve for elderly morbidity declined to 50% when the elderly reached approximately 77 years of age, or 17 years after classification as elderly. The survival curves for female and rural elderly morbidity were longer than those for the male group and other dwelling areas, but these differences were not significant (p>0.05). The data are presented in Figures 1, 2, and 3 and Tables 4 and 5.

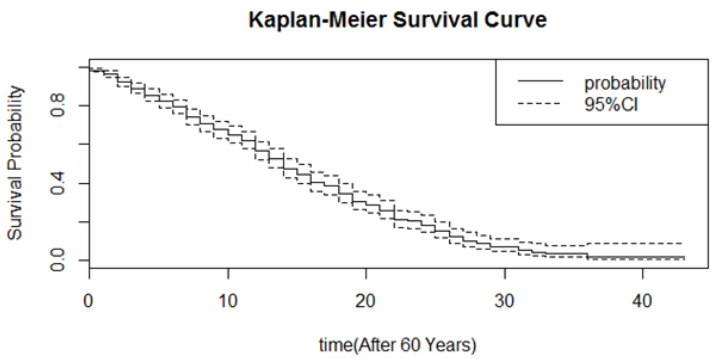

Figure 1 Kaplan-Meier Survival Curves and 95% CI of the elderly population in southernmost Thailand

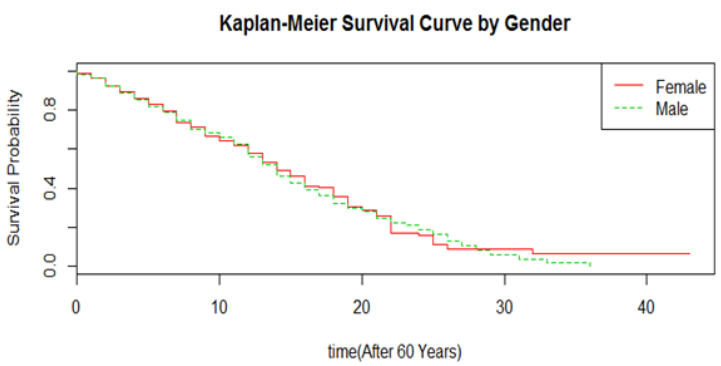

Figure 2 Comparison of Kaplan-Meier survival curves by gender in the elderly population

Table 4 Comparison of survival curves by gender in the elderly population

Gender	N	Observed	Expected	(O-E)^2/E	(O-E)^2/V
Male	211	133	135	0.0373	0.0653
Female	306	222	220	0.0229	0.0653
Chisq= 0.1 with 1 degree of freedom, p= 0.798					

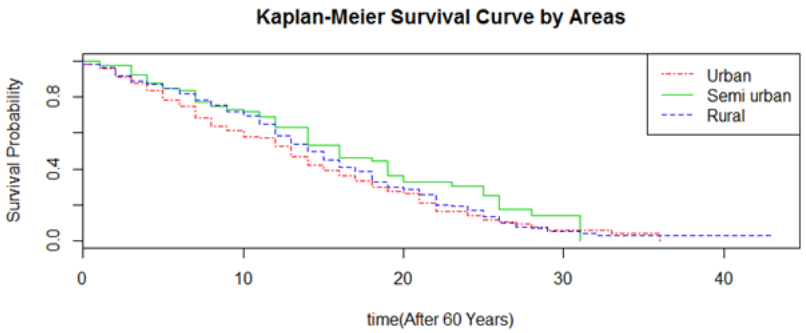

Figure 3 Comparison of Kaplan-Meier survival curves by dwelling areas in the elderly population

Table 4 Comparison of survival curves by gender in the elderly population

Area	N	Observed	Expected	(O-E)^2/E	(O-E)^2/V
Urban	206	142	127	1.79907	3.028
Semi urban	98	56	70	2.80266	3.784
Rural	213	157	158	0.00768	0.015
Chisq= 5 with 2 degrees of freedom, p= 0.0823					

Table 6 Initial model design for Cox proportional hazards regression

Models	Model 1	Model 2	Model 3
Variables	Only demographic variables	Only health behaviour variables	All independent covariates
	• Gender • Religion • Education levels • Marital status • Dwelling area	• Health check-up • Alcohol • Smoking • Exercise	• Gender • Religion • Education levels • Marital status • Dwelling area • Health check-up • Alcohol • Smoking • Exercise

Cox proportional hazards regression of elderly morbidity

Table 6 presents the 3 initial model designs for Cox proportional hazards regression of elderly morbidity. Gender, religion, education level, health check-up, alcohol consumption and exercise were 5 important variables in the final model result that showed significant differences in risk among the groups. Female elderly had an approximately 1.5-fold higher risk of morbidity than males ($p<0.001$); similarly, Muslim elderly had an approximately 1.5-fold higher risk of morbidity than the other groups ($p<0.01$). The elderly with a primary school education level had an approximately 1.5-fold increased risk of morbidity compared with illiterate elderly ($p<0.01$). The elderly with a secondary school education level or higher had an approximately 2-fold higher morbidity risk than illiterate elderly ($p<0.001$). Health check-up, alcohol consumption and exercise were associated with an approximately 1.5-fold greater risk of morbidity compared with elderly without those experiences ($p<0.05$). The results are presented in table 7.

Table 7 Results of Cox proportional hazards regression of elderly morbidity

Covariance	Hazard Risk of morbidity					
	Model 1		Model 2		Model 3	Final Model
	Crude HR (95% CI)	Adj. HR (95% CI)	Crude HR (95% CI)	Adj. HR (95% CI)	Adj. HR (95% CI)	Adj. HR (95% CI)
Demographic variables						
Gender						
Male (Ref)	-	-	-	-	-	-
Female	1.03	1.49**	-	-	1.71***	1.66***
	(0.83, 1.27)	(1.16, 1.90)			(1.31, 2.23)	(1.27, 2.15)
Religion						
Buddhist (Ref)	-	-	-	-	-	-
Muslim	1.05	1.18	-	-	1.42*	1.49**
	(0.85, 1.3)	(0.86, 1.62)			(1.01, 2.00)	(1.15, 1.92)
Education levels						
None (Ref)	-	-	-	-	-	-
Primary school	1.47**	1.53**	-	-	1.47**	1.48**
	(1.15, 1.89)	(1.16, 2.01)			(1.11, 1.93)	(1.13, 1.96)
Secondary school and higher	2.24***	1.99***	-	-	1.89**	1.98***
	(1.54, 3.27)	(1.34, 2.98)			(1.26, 2.82)	(1.35, 2.92)
Marital status						
Single (Ref)	-	-	-	-	-	-
Married	1.62	1.61	-	-	1.67	1.64
	(0.52, 5.08)	(0.51, 5.11)			(0.52, 5.32)	(0.51, 5.20)
Others	1.02	0.89	-	-	0.95	0.93
	(0.32, 3.22)	(0.28, 2.84)			(0.29, 3.03)	(0.29, 2.97)

Table 7 (continue) Results of Cox proportional hazards regression of elderly morbidity

Covariance	Hazard Risk of morbidity					
	Model 1		Model 2		Model 3	Final Model
	Crude HR (95% CI)	Adj. HR (95% CI)	Crude HR (95% CI)	Adj. HR (95% CI)	Adj. HR (95% CI)	Adj. HR (95% CI)
Dwelling area						
Urban (Ref)	-	-	-	-	-	-
Semi-urban	0.71*	0.76	-	-	0.79	-
	(0.52, 0.97)	(0.55, 1.06)			(0.56, 1.11)	
Rural	0.88	0.90	-	-	0.93	-
	(0.71, 1.11)	(0.63, 1.26)			(0.65, 1.33)	
Health behaviour variables						
Health check-up						
No (Ref)	-	-	-	-	-	-
Yes	-	-	1.50***	1.46***	1.36*	1.41**
			(1.20,1.89)	(1.16, 1.84)	(1.07, 1.74)	(1.11, 1.79)
Alcohol						
No (Ref)	-	-	-	-	-	-
Yes	-	-	1.63*	1.40	1.66*	1.72**
			(1.12, 2.38)	(0.94, 2.08)	(1.09, 2.53)	(1.14, 2.58)
Smoking						
No (Ref)	-	-	-	-	-	-
Yes	-	-	1.28(0.91, 1.81)	1.21(0.84, 1.74)	1.19(0.81, 1.75)	-
Exercise	-	-	-	-	-	-
No (Ref)	-	-	1.26	1.21	1.32*	1.30*
Yes			(0.99, 1.61)	(0.94, 1.56)	(1.02, 1.72)	(1.00, 1.69)
Likelihood ratio test	**-**	**45.84*** **	**-**	**20.55*** **	**64.66*** **	**62.18*** **

p-value; *<0.05, **<0.01, ***<0.001

Discussion

Two thirds (68.7%) of the elderly participants in this study were suffered from diseases. The percentage of morbidity was highest among elderly aged 71 to 75 years (77.9%). Approximately half of the participants (51.8%) were suffering from one disease, and 0.8% was ill with four different diseases. One-fifth (16.8%) of the elderly were categorised as multi-morbidity. The proportion of morbidity was higher among female elderly (58.7%) than male elderly. Morbidities associated with the circulatory system and the category of endocrine, nutritional and metabolic diseases had the highest prevalence. Hypertension was

the most common disease of the circulatory system, while diabetes was the most common disease in the endocrine category. Hypertension had the highest prevalence among female elderly, 67.4%, and diabetes had the highest prevalence among male elderly (13.3%).

The Kaplan-Meier survival curve for elderly morbidity declined to 50% at an age of approximately 77 years, or 17 years after classification as elderly. The survival curves for female and rural elderly morbidity were longer than those for male elderly and elderly in other dwelling areas, but these differences were not significant ($p>0.05$). Gender, religion, education level, health check-up, alcohol consumption and exercise were associated with significant differences in risk among the groups.

This study showed that 68.7% of the elderly were suffering from disease. The percentage of elderly with morbidity was highest at ages between 71 and 75 years. This finding is consistent with studies in Bangladesh (Khanam et al., 2011) India, and the United States (Shankar, Tondon, Gambhir, & Tripathi, 2007; Wolff, Starfield, & Anderson, 2002), for which prevalences of 1 or more chronic conditions of 84%, 88.8 % and 82%, respectively, were reported. The higher morbidity of females compared with males was also consistent with previous results. However, 16.8% of the present sample had multi-morbidity, whereas a prevalence of 53.8% was found in Bangladesh. This difference might be due to the definition of morbidity used in this study, which was identified based on documented evidence of clinical registration at the hospital including health test results and doctor prescriptions.

Hypertension and diabetes had the highest prevalences among the elderly, with rates of 67.4% and 13.3%. This result is consistent with previous studies in Nigeria and India (Abegunde & Owoaje, 2013; Banjare & Pradhan, 2014) that observed that non-communicable diseases were dominant in the elderly. In another study in southern India, 43% of the participants were diabetic, and 47.7% had hypertension (Bharati et al., 2011). However, other studies have observed different relative prevalence, with a higher prevalence of diabetes in the elderly than hypertension. This phenomenon might be explained by differences in local food, consumption habits and the health behaviours of the population groups in each region (Baweja, Agarwal, Mathur, Haldiya, & Mathur, 2008; Correa et al., 2017). Although non-communicable diseases had the highest morbidity in this study and in previous studies, the types of illness that manifested differed among the study sites and included chronic obstructive airway disease, cataracts, osteoarthritis, stroke, obesity, signs of thyroid hypofunction, obstructive pulmonary symptoms and symptoms of heart failure (Joshi, Kumar, & Avasthi, 2003; Khanam et al., 2011).

Gender was identified as a factor promoting morbidity in the elderly. Morbidity was 1.5-fold higher among females than males, in accordance with studies in Africa, Asia and America (Abegunde & Owoaje, 2013; Chinnakali et al., 2012; Wolff, Starfield, & Anderson, 2002). The life expectancy of females is longer than that of males, and thus the target population for reducing morbidity might be females. However, studies in Bangladesh and India reported a higher prevalence of morbidity among males (Khanam et al., 2011; Yuvaraj, Gowda & Umakantha, 2010). This difference may be due to differences in the definitions and methods of measuring illness; in addition, the study in India focused on the general population above 18 years of age.

Religion was identified as a significant factor for morbidity. This study found that Muslim elderly were at 1.5-fold higher risk of morbidity than other groups. This finding has not been clearly observed in any previous studies, with the exception of a study conducted in northern India in which the results did not reach the level of significance (Kaur, Bansal, Anand, Kumar, & Singh, 2017). This finding of our study might be explained by the poor socioeconomic conditions of Muslim elderly, who primarily live in less-developed areas. These factors might increase the risk of morbidity.

Education level was a significant influencing factor for morbidity, consistent with previous reports (Banjare & Pradhan, 2014; Khanam et al., 2011; Medhi, Hazarika, Borah, & Mahanta, 2006; Morrone et al., 2011), Elderly with a primary school education level and a secondary school plus higher education level had 1.5- and 2.0-fold higher risks of morbidity than illiterate elderly, respectively. These findings diverge from other findings that a high education level promotes health (Bharati et al., 2011; Wong, Mercer, Woo, & Leung, 2008). The present findings may be explained by the fact that highly literate elderly are in the highest social classes, with high salaries but also high levels of responsibility; the resulting heavy workloads caused them to ignore their health due a lack of time. However, we were surprised to find that elderly who received health check-ups had a 1.5-fold higher risk of morbidity compared to the other group. This finding is consistent with previous studies in China, which have shown that health check-ups increase opportunities to discuss personal health problems (Dishion et al., 2015; Xu, Chen, Cao, Wang, & Yang, 2015). Similarly, exercise was classified as a factor promoting morbidity. This result may suggest that health-conscious elderly are more diligent about receiving health check-ups and exercising, which may increase their apparent risk of morbidity.

In addition, alcohol consumption was associated with morbidity. This result is in agreement with previous studies that have shown that alcohol consumption is associated with morbidity and disability among the elderly (Khokhar & Mehra, 2001; Medhi, Hazarika, Borah & Mahanta, 2006). Alcohol clearly has various adverse effects on health such as effects on the brain (Anstey et al., 2006; Pilling, Yesufu-Udechuku, Taylor, Drummond, & Group, 2011). However, in this study, alcohol was consumed only by Thai Buddhist elderly and not by Muslim elderly.

The study had several limitations. Elderly morbidity was based on documented evidence. The study was community-based in the southernmost province, which is a remote area that has unique social and cultural characteristics. The populations in this area have limited and basic infrastructure, and some of the residents do not have access to health services. In addition, the study did not collect diagnoses of some diseases specifically important in the elderly such as mental disorders, skin diseases and infectious diseases.

Conclusions

The elderly in southernmost Thailand have a high prevalence of morbidity and suffer from multi-morbidity. Morbidity was higher among female elderly than male elderly. Hypertension and diabetes were the most common diseases of the circulatory system and endocrine, nutritional and metabolic system.

Half of these elderly suffered morbidity by approximately 77 years or age, or 17 years after classification as elderly. Gender, religion, education level, health check-up, alcohol consumption and exercise were associated with significant differences in risk among the groups.Our findings suggest a need for medical and public health service providers to develop health-promoting programmes to improve and maintain elderly health. However, this study was a preliminary study describing and investigating basic factors influencing elderly morbidity. Multi-morbidity among the elderly warrants further investigation in subsequent studies.

Acknowledgements

The study was financially supported by the National Research Council of Thailand (NRCT). We would like to thank the directors and all nurses in sub-district health promotion hospitals in Narathiwat Province and the community health volunteers who facilitated data collection. We acknowledge all of the elderly participants and their relatives for their kind cooperation.

Authors' Contributions

PS1 is the first and corresponding author and designed the study, coordinated the data collection, analysed and interpreted the data, and prepared the manuscript (90%). WC2 and KP3 edited the manuscript (10%). All authors read and approved the final manuscript.

Competing Interests

The authors declare that they have no competing interest.

Significance for public health

In this research, the elderly in southernmost Thailand have a high prevalence of morbidity and suffer from multi-morbidity, especially hypertension and diabetes. We suggest for medical and public health service providers to develop early health-promoting programs to improve and maintain elderly health. Health education program for a caregiver is another important concerning which the public health should build in monitoring and improve the potential health care coverage.

References

Abegunde, K. A., & Owoaje, E. T. (2013). Health problems and associated risk factors in selected urban and rural elderly population groups of South-West Nigeria. *Annals of African Medicine, 12*(2), 90-97.

Anstey, K. J., Jorm, A. F., Reglade-Meslin, C., Maller, J., Kumar, R., von Sanden, C., Sachdev, P. (2006). Weekly alcohol consumption, brain atrophy, and white matter hyperintensities in a community-based sample aged 60 to 64 years. *Psychosomatic Medicine, 68*(5), 778-785.

Banjare, P., & Pradhan, J. (2014). Socio-economic inequalities in the prevalence of multi-morbidity among the rural elderly in Bargarh District of Odisha (India). *PLoS One, 9*(6), e97832.

Baweja, S., Agarwal, H., Mathur, A., Haldiya, K., & Mathur, A. (2008). Assessment of nutritional status and related risk factors in community dwelling elderly in western Rajasthan. *Journal of the Indian Academy of Geriatrics, 4*(1), 5-13.

Bharati, D. R., Pal, R., Rekha, R., Yamuna, T. V., Kar, S., & Radjou, A. N. (2011). Ageing in Puducherry, South India: An overview of morbidity profile. *Journal of Pharmacy and Bioallied Sciences, 3*(4), 537-542.

Chatterji, S., Byles, J., Cutler, D., Seeman, T., & Verdes, E. (2015). Health, functioning, and disability in older adults—present status and future implications. *The Lancet, 385*(9967), 563-575.

Chinnakali, P., Mohan, B., Upadhyay, R. P., Singh, A. K., Srivastava, R., & Yadav, K. (2012). Hypertension in the Elderly: Prevalence and Health Seeking Behavior. *The North American Journal of Medical Sciences, 4*(11), 558-562.

Correa, N., Rajaraman, D., Swaminathan, S., Vaz, M., Jayachitra, K. G., Lear, S. A., et al., (2017). Perceptions of healthy eating amongst Indian adolescents in India and Canada. *Appetite, 116*, 471-479.

Dishion, T. J., Mun, C. J., Drake, E. C., Tein, J. Y., Shaw, D. S., & Wilson, M. (2015). A transactional approach to preventing early childhood neglect: The Family Check-Up as a public health strategy. *Development and Psychopathology, 27*(4 Pt 2), 1647-1660.

Fortin, M., Lapointe, L., Hudon, C., & Vanasse, A. (2005). Multimorbidity is common to family practice: is it commonly researched?. *Canadian Family Physician, 51*, 244-245.

Joshi, K., Kumar, R., & Avasthi, A. (2003). Morbidity profile and its relationship with disability and psychological distress among elderly people in Northern India. *International Journal of Epidemiology, 32*(6), 978-987.

Kaur, G., Bansal, R., Anand, T., Kumar, A., & Singh, J. (2017). *Morbidity profile of noncommunicable diseases among elderly in a city in North India.* Clin Epidemiol Glob Health.

Khanam, M. A., Streatfield, P. K., Kabir, Z. N., Qiu, C., Cornelius, C., & Wahlin, **Å**. (2011). Prevalence and Patterns of Multimorbidity among Elderly People in Rural Bangladesh: A Cross-sectional Study. *Journal of Health, Population and Nutrition, 29*(4), 406-414.

Khokhar, A., & Mehra, M. (2001). Life style and morbidity profile of geriatric population in an urbans community of Delhi. *Indian Journal of Medical Sciences, 55*(11), 609-615.

Martin-Ruiz, C., & von Zglinicki, T. (2014). Biomarkers of healthy ageing: expectations and validation. *Proceedings of the Nutrition Society, 73*(3), 422-429. doi:10.1017/s0029665114000147

Medhi, G. K., Hazarika, N. C., Borah, P. K., & Mahanta, J. (2006). Health problems and disability of elderly individuals in two population groups from same geographical location. *Journal of the Association of Physicians of India, 54*, 539-544.

Morrone, A., Donini, L. M., Scardella, P., Piombo, L., Pinto, A., Giusti, A. M., et al., (2011). [Malnutrition in the elderly: clinical features, psychological and social determinants. Preliminary results]. *Ann Ig, 23*(2), 161-172.

National Guideline, C. (2016). *National Institute for Health and Care Excellence: Clinical Guidelines Multimorbidity: Assessment, Prioritisation and Management of Care for People with Commonly Occurring Multimorbidity*. London: National Institute for Health and Care Excellence (UK). Copyright (c) National Institute for Health and Care Excellence, 2016.

Pilling, S., Yesufu-Udechuku, A., Taylor, C., Drummond, C., & Group, G. D. (2011). Diagnosis, assessment, and management of harmful drinking and alcohol dependence: summary of NICE guidance. B*ritish Medical Journal, 342*, d700.

Shankar, R., Tondon, J., Gambhir, I. S., & Tripathi, C. B. (2007). Health status of elderly population in rural area of Varanasi district. *Indian Journal of Public Health, 51*(1), 56-58.

Steves, C. J., Spector, T. D., & Jackson, S. H. (2012). Ageing, genes, environment and epigenetics: what twin studies tell us now, and in the future. *Age Ageing, 41*(5), 581-586.

Strong, K., Mathers, C., Leeder, S., & Beaglehole, R. (2005). Preventing chronic diseases: how many lives can we save?. *Lancet, 366*(9496), 1578-1582.

Uijen, A. A., & van de Lisdonk, E. H. (2008). Multimorbidity in primary care: prevalence and trend over the last 20 years. *European Journal of General Practice, 14 Suppl 1*, 28-32.

United Nations Population Fund and HelpAge International (2012). *Ageing in the twentyfirst century: A challenge and a celebration*. ISBN 978-0-89714-091-5, http://www.unfpa.org/publications/ageing-twenty-first-century

WHO. (2014). *World Health Statistics-Large Gains in Life Expectancy*. Retrieved from http://www.who.int/mediacentre/news/releases/2014/worldhealth-statistics-2014/en/.

Wolff, J. L., Starfield, B., & Anderson, G. (2002). Prevalence, expenditures, and complications of multiple chronic conditions in the elderly. *Archives of Internal Medicine, 162*(20), 2269-2276.

Wong, S. Y., Mercer, S. W., Woo, J., & Leung, J. (2008). The influence of multi-morbidity and self-reported socio-economic standing on the prevalence of depression in an elderly Hong Kong population. *BMC Public Health, 8*(1), 119.

Woo, E. K., Han, C., Jo, S. A., Park, M. K., Kim, S., Kim, E., et al., (2007). Morbidity and related factors among elderly people in South Korea: results from the Ansan Geriatric (AGE) cohort study. *BMC Public Health, 7*, 10.

Xu, G., Chen, Z., Cao, X., Wang, Y., & Yang, P. (2015). Analysis of pulmonary function test results in a health check-up population. *Journal of Thoracic Disease, 7*(9), 1624-1629.

Yuvaraj, B., Gowda, M. N., & Umakantha, A. (2010). Prevalence, awareness, treatment, and control of hypertension in rural areas of davanagere. *Indian Journal of Community Medicine, 35*(1), 138-141.

Zhou, B., Chen, K., Wang, J., Wang, H., Zhang, S., & Zheng, W. (2010). Quality of Life and Related Factors in the Older Rural and Urban Chinese Populations in Zhejiang Province. *Journal of Applied Gerontology, 30*(2), 199-225.