

การกินหมากกับโอกาสการตายของประชากรชาวชนบทไทย

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บทคัดย่อ

การวิจัยครั้งนี้มีวัตถุประสงค์เพื่อศึกษาผลของการกินหมากกับโอกาสการตายของประชากรชาวชนบทไทย ด้วยวิธีการศึกษาย้อนหลังระยะยาวกลุ่มตัวอย่างกลุ่มเดียว กำหนดกรอบตัวอย่างจากรายงานการตายของกระทรวงสาธารณสุข สุ่มตัวอย่างแบบชั้นภูมิ 2 ขั้นตอน กลุ่มตัวอย่างเป็นคนที่ยายจำนวน 207 คน คนที่มีชีวิตจำนวน 674 คน เครื่องมือที่ใช้ คือ แบบสัมภาษณ์และแบบสอบถามสาเหตุการตายโดยการสัมภาษณ์ ทดสอบผลของปัจจัยที่ศึกษาต่อโอกาสของการตายด้วย *Cox's Proportion Hazard Model*

ผลการศึกษาพบว่า อายุมีผลเชิงบวกกับการตาย เพศชายมีโอกาสตายมากกว่าเพศหญิง 1.9 เท่า คนที่ไม่ออกกำลังกายมีโอกาสตายมากกว่าคนที่ออกกำลังกาย 1.7 เท่า และคนที่กินหมากมีโอกาสตายมากกว่าคนที่ไม่กิน 1.4 เท่า

Areca Nut Consumption: A Hazard of Death for the Thai Rural Population

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ABSTRACT

The purpose of this study is to study areca nut chewing that would affect the probability of death. This is a longitudinal retrospective panel study using the sampling frame from the death report of the Ministry of Public Health, based on a two-stage stratified sampling of 207 "death" and 674 "survive". Tools used were interviews and verbal autopsies, with the Cox's Proportion Hazard Model being used to analyze factors that would affect the probability of death.

It was found that age has a positive affect on death. Males are 1.9 times more at risk of death than females. Married, divorced and widowed are 1.8 times more at risk of death than single. Non exercise are 1.7 times more at risk of death than exercise. Areca nut chewers are 1.4 times more at risk of death than non chewers.

Rationale and Significance of the Problem

Areca Nut Consumption is a culture of Asian countries that has been handed down from generation to generation over a very long period of time. Thai history indicated that in the past areca nut chewing was a past time of prominent figures as well as ordinary people, up till the time of Field Marshal Pibulsongkram when a law was passed prohibiting consumption of areca nuts as well as forbidding the planting of areca nut trees, presumably a period when consumption of areca nuts declined (Kanchanapisek Homepage, 2007). However, at present it is found that consumption of areca nuts is still in practice in several countries, such as India, Taiwan, or even America where a number of people still chew areca nuts following migration, using different consumption methods (Parsell, 2005). The intention of areca nut consumption is to mash the mixture of lime, piper betel leaf, clove, cardamom, etc. and mixing them together and then suck on the juice of the mixture -- sometimes consuming in combination with strong or mild tobacco (Reid, 1985). Anyhow, in order to know whether such a practice has any effect on health and whether it is a hazard of death or not, and if so how so, it is necessary to be aware of the characteristics and main ingredients that could affect the body as well as the characteristics of the ingredients consumed with areca nuts, details as shown as follows:

Areca nuts have a common name of Areca Nut or Betel Nut or Pan Masala, with a botanical name of *Areca Catechu*, Linne'; it is a palm-type vegetation. Residues left from chewing areca nuts and ingredients are sometimes called "betel quid". Areca nut trees probably originated from the Malayan islands; a great number is also found in the Ceylonese islands, India, Indochina and the Philippines. An areca nut is 20–30 mm. in diameter; its skin is fiber-like with an orangey-yellow seed on the inside that is quite hard, with an astringent and sub-acrid taste. Areca nut is a type of fragrant plant of Asia, that is said to help sweeten one's breath and strengthen one's gums as well as help in food digestion. The Chinese and Indians use them as vermifuge. The main components of an areca nut comprise tennin gallic acid, gum, lignin, volatile and fix oils, iron peroxide, magnesium phosphate, and other salts, tennin, which is similar to catechu-tennic acid which upon dry distillation, gives out pyrocaechin, not found in the nut itself and upon extraction gives arecoline whose effects are similar to nicotine, which could be used as

taenifuge (Henriette's Herbal Homepage, 2007). An areca nut comprises tannis (11–26%) which is a stimulant, alkaloid (0.15–0.67%) and arecoline.

Areca nuts could be eaten either, raw, sun-dried, grilled or boiled by slicing the nuts into thin slices, or grinding or grounding them; they are usually taken with lime (which acts as a catalyst) and piper betel leaves, used to wrap up all the ingredients, giving a mint or menthol taste that acts as a breath freshener. Lime taken with areca nuts contains calcium hydroxide, which would cause oxidative damage in the DNA of the buccal mucosa cells of chewers (Nair, Bartsch, & Nair, 2004). While research has not yet found any effects on the body from eating piper betel leaves. A revision of the result of the study is presented herein below:

The study divides the sample of areca nut consumers into 4 groups: Group 1 comprises of those who consume areca nuts with tobacco, Group 2 comprises of those who consume areca nuts and smoke, Group 3 comprises of those who consume only areca nuts, and Group 4 comprises of those who neither consume areca nuts nor tobacco and who do not smoke. A high level of nitrosamine acid is found in the urine of those who consume areca nuts with tobacco, while a great quantity of arecaline is found in the saliva of those who consume areca nuts either with tobacco or without tobacco. Nicotine and cotinine are found both in the saliva and urine of those who consume tobacco and those who consume areca nut and tobacco. During consumption, the N-nitrosamine compound would form *invivo* in the oral cavities, or in the stomach after swallowing the dregs, and it has been discussed that this N-nitroso compound formed *invivo* could be the cause of malignancy in the upper alimentary tract of areca nut consumers (Nair, Ohshima, Friesen, Croisy, Bhide, & Bartsch, 1985).

A study made on an Asian community living in the United Kingdom (about 3% of total population) indicated that 79–96% of areca nut consumers are of Bangladesh origin while the remaining 27–47% is of other Asian races. It was also found that 22–77% of adult Asians, depending on the race, became addicted to consumption of areca nuts and showed symptoms of withdrawal when not chewing. Arecoline and Arecaidine cause catecholamines; thus those who consume areca nuts will have a certain level of norepinephrine and epinephrine which causes a sympathetic activation of the nervous

system. Areca nut consumption increases the hazard of having oral cavity cancer; continuous consumption causes abuse and addiction until it would become difficult to quit due to withdrawal (Angeles, Seidel, Farre, Algar, Pichini, & Mur, 2006). Prolonged and habitual chewing causes oral submucosa fibrosis and cheek muscles become hardened and the chewer would be unable to open his mouth wide and would have oral cavity problems thereby increasing the overall risk of cancer. However, areca nut chewing in combination with tobacco and lime has been proven to be a cause of cancer, with tobacco being the accelerator.

In Thailand a study conducted by Chatrchaiwiwatana, S. (2006) found that areca nut chewing causes periodontitis and increases the possibility of teeth-loss. However, the study which shows that areca nut chewing causes oral cavity cancer was mostly conducted on patients who had come in for treatment, or had health problems or had fallen ill from cancer before it was discovered that the cause of the cancer could have come from chewing areca nuts. That was a reality situation depicting the circumstances at the time of study, but it was not known which variable was the cause and which was the result, nor was it known about exposure or outcome as to which had occurred first and which came afterwards (Public Health Faculty, Mahidol University, 2005). This type of study indicates a sampling bias as it is a study made on those who had already fallen ill from that particular disease, and probably volunteered, meaning the participants were willing to take part in the study, which would have different characteristics from non participants, who were still healthy. The study also indicates a late look bias, being a study of people who have already shown symptoms before coming in for treatment while those who were seriously ill had no chance of coming in for treatment, having died beforehand.

Northeastern Region and Wang Namkheo District

The Northeastern Region has the largest area in Thailand with a population of approximately 21 million, the highest density in Thailand (National Statistics Office, 2007b). It is well-known for its drought, thereby unsuitable for cultivation. At times it also floods, with the result that there is no flow of steady income, leaving the bulk of the

population in poverty with the highest out-migration rate. In the past, around the year 1930, migration was made to the central and southern regions. For the present, drought and flooding are still concerns in this region. With regard to the matter of mortality, in the year 1930 the mortality rate was very high, and even as far as the years 2005 – 2006 it still has the second highest mortality rate compared to other regions (6.95/per 1,000 population), second only to the northern region (10.28/1,000 population) (Ministry of Public Health, 2007; National Statistics Office, 2007a). Besides, it was found that most of the adult population died as a result of non-communicable disease, with cardiovascular disease and accidents ranking second and third respectively. (National Statistics Office, 2007a). Nowadays, there has been development in the cultivation process where technology is utilized. However, it was found that the northeastern people employed chemicals, chemical fertilizers and pesticides to help increase productivity for rice crops, tapioca and assortment of vegetables (Sirindhorn Anthropology Center, 2001). Moreover, northeastern people still have certain improper behaviors with regard to food preparation and consumption, such as consuming uncooked food. It was found that the number of northeastern people who died of cancer, neoplasm of the liver as well as diabetes ranked the highest in Thailand (National Statistics Office, 2007a). Moreover, from surveys it was found that one out of three northeastern people consume liquor and alcoholic drinks, ranking them the second highest, second only to northern people (Ministry of Public Health, 2001). The overall mortality picture found northeastern people having the second lowest life expectancy at birth, second to northern people, with males at 69.58 years and females at 76.43 years.

In speaking of the Northeast, a major province in this region from past to present and sometimes known as “The gateway to the Northeast”, is Nakhon Ratchasima Province. In the year 2007 it has a population of approximately 2.5 million, and it was found that the mortality rate of the adult population was high, crude death rate about 5.54% in the year 2002, being the third highest, ranking below the north and central regions respectively (Ministry of Public Health, 2001). Tobacco consumption rate for population aged 11 years and over was 23.4% (national survey = 17.4%); alcohol consumption rate was 32.3% (Ministry of Public Health, 2003). This high mortality rate was the result of several

interesting factors. For example, the reason for the high mortality rate through accidents was due to the fact that the province is situated on the main highway, linking the central region to the northeastern region. Besides, there was also a high mortality rate from infectious disease through migration as well as non-infectious disease through improper behavior.

The terrain of Wang Namkheo District comprises hilly plateaus alternating with plains in wavy grounds throughout the entire area (Ministry of Interior, 2007). It possesses the characteristics of a semi-isolate hill village which is rather difficult to access (Kunstadter, 1969). Thus any geographical area which differs from other areas will have differentiations in illness and death patterns (Murray, 1967). The natives are those who have resided there for over 50 years, comprising an ethnic group called by the Thai-Korat as “Chao Bon” (high land people), while the Chao Bon call themselves “Niakun” or “Yiakun”. These people would build villages in temporary cluster homes, ready for migration at any time; for instance, whenever somebody dies, a Chao Bon will have to dismantle his home and rebuild a new one nearby because of superstitious belief. In the past they cultivated mobile plantations, hunted animals and gathered food from the forests. Generally, in an indigenous society around the year 1968 when the overall mortality level of the whole country was still high, at the rate of 708.2 person/100,000 population and the cause of death from major infectious diseases of the time was cholera and tuberculosis, respectively. The Chao Bon people during that period has the same level and causes of death as appeared in the statistics of Thailand (Plainoi & Plainoi, 1986). Nowadays, although the Chao Bon people have become Buddhists, their belief in spirits still exists. Occult or traditional healing through misinformation, for example, healing with holy water, or not using health care services of the public health centers when ill, all affected health and finally resulted in death.

Formerly, Wang Namkheo District used to be a forestry preservation area, but in the year 1965 Strategic Highway No.304 was constructed, with the result that more migrants moved into the area. During the same period of time, the Government allowed a forestry concession, causing a huge loss in fertile forestry area and turning it into a cultivation area for the migrants. Merchants and capitalists from other areas streamed

into Wang Namkheo District to set up business, and around the year 1973 Sal Chao Po (Joss House) Market or Market 79, which became the rural trading and distribution center for merchandise and capital as means of production at the time, came into existence. Finally, in the year 1978 the Agricultural Land Reform Office (ALRO) pronounced it a land reform area and distributed deeds right to farmers in the year 1975. In talking about Wang Namkheo District, in the beginning it was part of Pak Thongchai District, then on April 1, 1992 it became a sub-district and was finally elevated to a district on December 5, 1996. During the years 2002 – 2006 the crude death rate was between 4.5–5.8 persons/1,000 population. The major causes of death in the year 2006 were Infectious Disease, Non-Infectious Disease and Death from External Causes, respectively (Nakhon Ratchasima Public Health Office, 2007). Due to the fact that the natives were upper land dwellers, migrants entering the area led to variations in lifestyle, culture and geographical characteristics all of which affected health and hence the said causes of death. Data from the 1997 health survey on Thais living on high land showed that they were more addicted to tobacco and alcohol consumption than those living in plains, with the rate of alcohol addicts rather high. Moreover, the belief in the old ways of health care meant traditional cure. Beliefs in spirits, areca nut chewing, smoking and drinking all affected health and longevity as stated above (National Statistics Office, 2007a).

From the above reasons, the authors designed a retrospective panel longitudinal study, interviewing inhabitants in the same household as the deceased between January 1, 2002 –July 31, 2006, a period of 54 months, so that there would be no inconsistencies from data slippages. Anyhow, areca nut chewing is a behavior that is observable, no matter how long the subject had died; thus household informants should be able to recall the cause of death and consumption behavior of the deceased. Verbal autopsy was the tool used to determine the cause of death as reported by relatives. Moreover, data matching for accuracy was made with the Death Report of the Ministry of Public Health. The research question was whether or not areca nut consumption is a hazard of death for the population, and if so, how so? This study should help inform the rural population who still likes to consume areca nuts to become aware of its long-term harmful effects as well as being a hazard of death.

Behavioral Concept

Behavioral, epidemiological and medical factors are all highly related to death, but it is also found that the economical factor of poorer countries also affects the said health. Besides, it was also found that education, which is a sociological factor, also affects health behavior and affects death. Therefore, it could be said that no single factor is responsible for death, but the factors are so interwoven so as to become indistinguishable (Mechanic, 2007). From the sociological point of view, behavioral patterns usually stemmed from socialization where man's lifestyle has to conform to the rules of society, which is the outcome of projected thoughts, beliefs and trends through personal relationships until the individual develops similar concepts. For example, a person who eats half-cooked food got his behavior from his family with similar tastes in food since childhood, which conforms to the behavior in that particular community (Sukhothai Thammathirat University, 2004). This study focused on behavior arising from using well-known abusive and addictive substances that resulted in illness and death, namely, cigarette smoking, alcoholic drinks consumption, focusing on areca nut consumption, still mostly found in the north-eastern rural communities of Thailand. Areca nuts contain arecoline and arecaidine, which stimulate the body to release catecholamines. Areca nut chewers have a certain level of norepinephrine and epinephrine hormones that would induce a sympathetic activation of the nervous system (Angeles, Seidel, Farre, Algar, Pichini, & Mur, 2006), causing the chewer to become alert and refreshed. However, the study found that areca nut chewers are hazardous to oral cavity cancer. Moreover, habitual consumption would cause abuse and addiction, and due to lack of knowledge of its harm, the areca nut chewing population would have no thought of quitting this habit. Besides, the general public does not place this habit on the same rank of importance as smoking and drinking, and it is therefore essential that a study be made of its effect on mortality by providing knowledge and understanding on areca nut consumption in order to affect the proper behavioral change.

Research Objective

This research aimed at studying areca nut consumption as a cause of death under a research hypothesis that gender, age and areca nut consumption behavior affect death.

Method and Material

This research was a 10-year retrospective longitudinal panel study up to the present time, during January 1, 1996 to data collection time, where the significant data, besides general characteristics, were socio-economics characteristics, history of illness and disability, ability to perform daily living activities. As for data on the deceased, the Death Report of the Ministry of Public Health during the years 2002–2006 was used as a sampling frame, where a two-stage stratified sampling was made, dividing into sub-district and village levels. Interviewers would make a retrospective questionnaire of the deceased from relatives, caretakers and those in close contact with the deceased, whereby additional questions would be asked on the symptoms and outward display of the illness that resulted in death. Diagnosis of death would be made by comparing with the verbal autopsy. Public health volunteers stationed at the village acted as guides and gave additional information on the deceased in the area under their responsibilities. The said information would be rechecked in detail with the death report in order to control the quality of the death data. The tools used consist of questionnaires for household members, divided into two main sets, for “survive” and “death” members within a household. Moreover, the questionnaires were categorized under three age-groups, namely youths, adults and old age. For members under “death” a verbal autopsy would be conducted as well.

Moreover, the authors placed emphasis on important behavioral issues of health, food consumption, regular areca nut consumption, period of time for such behavior that would result in mortality differences between populations. Anyhow, in order that the said factors could affect population mortality, a time factor would have to be involved. With regard to health when the time dimension is taken into consideration, whether a person has good or bad health at the present time affects that person’s future health, finally ending in death. The period of time elapsed would be considered as a developmental process throughout his entire life. It is said that birth, youth, adulthood all interconnect. Therefore, at each period of time, both good and improper behavior would affect said

future health. Research on health showed that a man's lifespan or longevity depends on his health care behavior (Institute of Medicine, 2001). Due to this reason the authors chose to conduct an analysis through a longitudinal study.

The populations under study were those over 15 years of age, living in households with a member who died during January 1, 2002 –July 1, 2006, using the death report as a sample frame for the first stage. Thereafter, a strata-type random sampling was made at sub-district and village levels whereby data was collected from every household whose member died during said period in order to control socio-economical, environmental and behavioral factors since members of the same household would display similar behaviors which might have affected the death of a member of that household, while simultaneously showing differentiations between households due to said factors as well. Design of the research questionnaire therefore began with the name of the deceased, thereafter using the member of that household as a sample group to study the behaviors of “survive” and “death” members of the household. In addition, a verbal autopsy was also conducted on the “cause of death” section.

Data Analysis

Factors affecting the hazard of death were analyzed by using Cox's Proportional Hazard Model as statistics. Since a study on population behavior always involve a time span, most studies was therefore conducted on a point measurement or an interval measurement. The outcome would be an occurrence of event at that particular point. For behavior, however, focus was mostly on frequency and time span, i.e. for how long a period has the event under study occurred, which differs from the point measurement and interval measurement stated above, which would be for a short span of time while the temporal orders concept was that behavior at the time of study has occurred and taken place during a very long span of time and has continued to the present. For example, moral belief measured during the interview was something that was present prior to the interview and has continued to that present time, which was a period of 10 months; or that the use of abusive and addictive substance had occurred 8 months prior to the interview. Therefore, the authors selected the statistics for analyzing the factors affecting the hazard of death which could measure the time span of that particular event, using the Cox Proportional Hazard Model.

Result

To understand the variables and statistics used in the analysis, the authors would like to present the details of the variables which would be useful in the analysis and in translating the study of the Cox Regression analysis as appeared in Table 1, which comprises of Variables under study, Operational Definition and Scale of Measurement.

Table 1 Variables under study, Operational Definition and Scale of Measurement.

Variables	Operational Definition	Scale of Measurement
Age	Age	Ratio scale
Gender	Gender (0 = female, 1 = male,)	Dichotomous
Active	Ability in Activity of Daily Living (0=no, 1= yes)	Dichotomous
Marital Status	Marital Status of Population (0=single, 1=married/widowed/ divorced)	Dichotomous
Residence	Place of residence (0= rural, 1= urban)	Dichotomous
Alcohol Drinking	Alcohol consumption behavior (0=none, 1= regular)	Dichotomous
Cigarette Smoking	Smoking behavior (0=none, 1= regular)	Dichotomous
Areca nut chewing	Areca nut chewing (0=none, 1= regular)	Dichotomous
Time	Time of study in months	Ratio scale
Death	Death status (0=death, 1=survive)	Dichotomous

The primary data indicated the distribution of death of the unit under study, classified into age group, gender, socio-economic characteristics and behavior. Table 2 shows distribution of the above data. The following Table 2 has once again been prepared to accommodate the scale of measurement of each variable, to be proved by the Cox Proportional Hazard Model.

The Primary Data shows a distribution of death as a unit of the analysis, categorized according to age, gender, socio-economical and behavioral characteristics. Table 2 shows distribution of data derived from the research before utilization as proof of the analysis on the hazard of death.

Table 2 General Characteristics of the Population of Wang Namkheo District, Nakorn Ratchasima Province, categorized according to Biological, Socio-Economical and Behavioral Factors of “Death” and “Survive” population.

Variables	Death		Survive	
	Number (n=207)	Percent	Number (n=674)	Percent
Biological Factor				
1) Age Group				
15-19	3	4.2	69	95.8
20-24	7	10.6	59	89.4
25-29	6	6.5	86	93.5
30-39	16	19.8	65	80.2
35-39	12	13.6	76	86.4
40-44	12	15.6	65	84.4
45-49	14	19.4	58	80.6
50-54	13	25.0	39	75.0
55-59	16	31.4	35	68.6
60-69	9	27.3	24	72.7
60-64	19	37.3	32	62.7
60-64	17	40.5	25	59.5
70-79	19	54.3	16	45.7
>80	44	63.8	25	36.2
2) Age Group				
Female	83	19.5	343	80.5
Male	124	27.5	327	72.5
Socio-ecpnomnic status				
3) Marital Status				
Single	15	8.4	163	91.6
Married/Divorced Wondowed	189	33.3	378	66.7
Don't Know/no answer	3	2.1	143	97.9

Table 2 (continued)

Variables	Death		Survive	
	Number (n=207)	Percent	Number (n=674)	Percent
Behavior Factors				
4) Exercise	133	38.6	212	61.4
No	71	19.7	289	80.3
Yes	3	1.7	173	98.3
Don't Know/no answer				
5) Regular Cigarette Smoking				
No	141	20.8	538	79.2
Yes	66	32.7	136	67.3
6) Regular Areca Nut chewing				
No	168	21.1	630	78.9
Yes	39	47.0	44	53.0

From interviews on behavioral factors which could lead to the probability of death or longevity of the population, there were more females than males in the “survive” , and only in the marital status variable that “death” was more than “survive”. With regard to the behavioral factor, it was found that for the population that exercised regularly “death” was less than “survive”. Similarly, in consumption of abusive and addictive substances, namely smoking cigarettes and areca nut chewing, results obtained were the same, namely that the population under “death” would consume almost twice as much. Non smokers had 4 times more probability of being in the “survive” than in the “death”. Before an analysis was made on the factor affecting death which focused on the result of areca nut chewing, the authors would like to show the distribution and standard deviation of the independent variables used as prediction variables in this study, using the variable scale of measurement as stated in Table 1, shown in Table 3 below:

Table 3 Mean and Standard Deviation of Variables under study for “death” and survive” populations

Variables	Death (n=207)		Survive (n=614)	
	Mean	S.D.	Mean	S.D.
Age	59.31	20.47	40.34	17.31
Gender	0.60	0.49	0.49	0.50
Marital Status	0.93	0.26	0.76	0.43
Exercise	0.41	0.61	0.72	0.76
Cigarette Smoking	0.32	0.47	0.20	0.40
Areca nut chewing	0.19	0.30	0.07	0.25

Table 3 found that “death” had a mean age of 59.31 years with a standard deviation of 20.47 years, while “survive” had a mean age of 40.34 years with a standard deviation of 17.31 years. This table showed the mean and standard deviation in order to attain the midpoint value. For example, the mean value of the areca nut chewing variable equals 0.19 when 0 represented non areca nut chewers and 1 represented areca nut chewers. The mean value showed that the majority did not partake in areca nut chewing and these values would be used in the analyzing process. The authors therefore selected a related variable as an independent variable in analyzing Cox regression as is shown in Table 4.

Table 4 Analysis of Cox regression, with variables of age, gender and behavioral factor on abusive and addicted substances

Risk Factor	O.R.(S.E.)
Age	1.031*** (.004)
Gender ¹	1.877*** (.179)
Marital Status ²	1.797** (.288)
Exercise ³	1.703*** (.155)
Cigarette Smoking ⁴	1.140 (.174)
Areca Nut chewing ⁵	1.439* (.220)

* p<0.05 ** p<0.01 ***p<0.001

Reference: (1) female , (2) single , (3) exercise ,(4) no smoking, (5) no areca nut chewing

Table 4 illustrated that age had a positive effect on mortality, that was when age increases the hazard of death also increases. Males were 1.9 times more at risk of death than females. This study also found that the populations aged below 25-29 years were proportionately more single than married, and this proportion was on the increase (70-78%). The 50-54 age group upwards were mostly found in the widowed group (30-54%). It was also found that there were more married males than married females (49.3% and 46.1%, respectively).

Cox's Proportional Hazard Model

The proportional hazard model is the most general of the regression models because it is not based on any assumptions concerning the nature or shape of the underlying survival distribution. The model assumes that the underlying hazard rate is a function of the independent variables. Thus, Cox's regression model may be considered to be a nonparametric method. The model may be written as:

$$h\{(t), (z_1, z_2, \dots, z_m)\} = h_0(t) \cdot \exp(b_1 \cdot z_1 + \dots + b_m \cdot z_m)$$

where $h(t, \dots)$ denotes the resultant hazard, given the values of the m covariates for the respective case (z_1, z_2, \dots, z_m) and the respective survival time (t) . The term $h_0(t)$ is called the baseline hazard; it is the hazard for the respective individual when all independent variable values are equal to zero. The authors can linearize this model by dividing both sides of the equation by $h_0(t)$ and then taking the natural logarithm of both sides:

$$\log[h\{(t), (z_{\dots})\} / h_0(t)] = b_1 \cdot z_1 + \dots + b_m \cdot z_m$$

Consequently, a proportional hazard model was:

$$\begin{aligned} \log[h\{(t), (z_{\dots})\} / h_0(t)] = & 1.031 \cdot \text{Age} + 1.877 \cdot \text{Gender} + 1.797 \cdot \text{Marital Status} \\ & + 1.703 \cdot \text{Exercise} + 1.140 \cdot \text{Cigarette} + 1.439 \cdot \text{Areca Nut} \end{aligned}$$

An interesting discovery was that those who did not exercise were 1.7 times more at risk of death than those who exercise regularly. With regard to habitual consumption of abusive and addictive substances it was found that regular areca nut chewers were 1.4 times more at risk of death than those who did not. In order to show the differentiation in the hazard of death between areca nut chewers and non chewers, it could be clearly

seen from the Hazard function graph that after 30 months of consumption the hazard of death increases continuously and starts to widen from the graph of those who do not chew, as shown in Figure 1

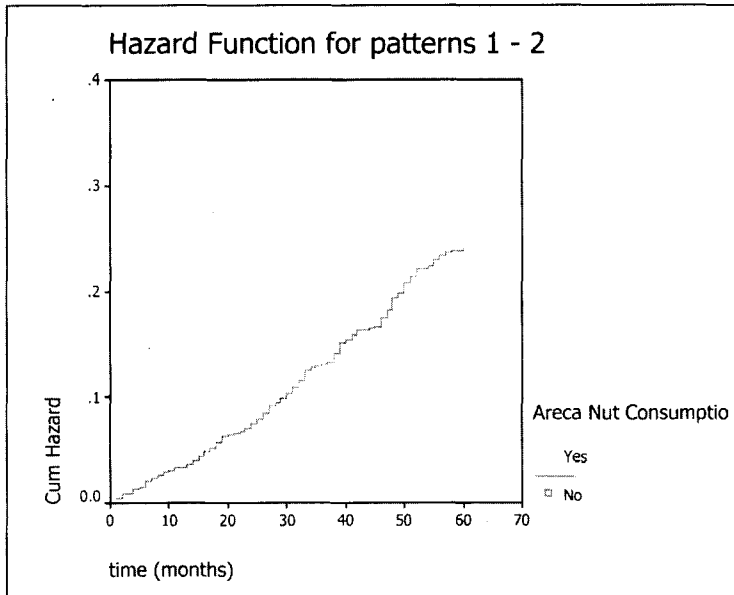


Figure 1 Hazard function of areca nut consumption

Upon consideration of the effects of cigarette smoking as a cause of death as shown in Figure 2, it was also evident that the hazard of death for smokers were greater than non smokers. Therefore, in considering the effects of various toxins entering the human body from areca nut chewing and smoking, it could be seen that the hazard of death for areca nut chewers were greater than for non chewers, e.g., in comparing the slope of the graphs between areca nut chewers and smokers, it could be seen that the slope of the graph for smokers was less than that of the chewers, thereby indicating that the toxin in areca nuts was greater than in cigarettes. Moreover, in considering the differentiation between the hazard of death of smokers as compared to non smokers it was found that the differentiation was less than the differentiation between areca nut chewers and non chewers. This was evident from the graphs of the hazard of death for areca nut chewers which had a greater slope at a 45 degrees slant, indicating that areca nut chewers were more at risk of death within the same period of time under comparison.

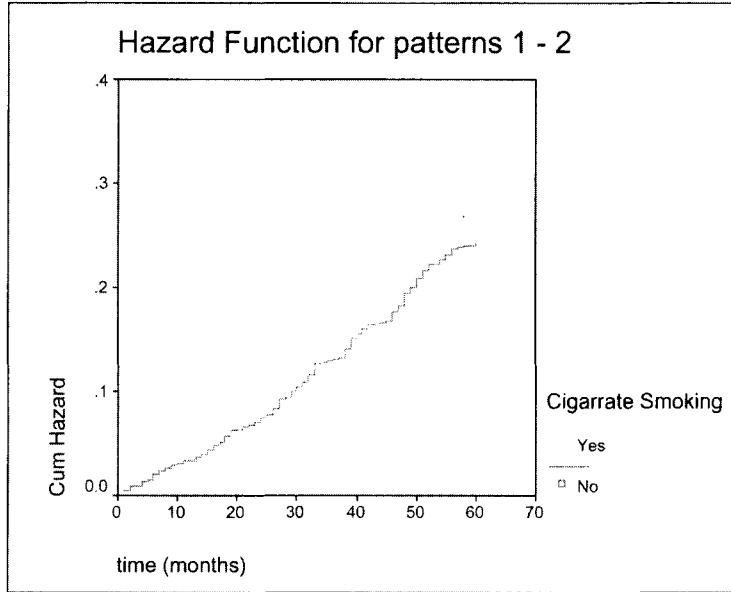


Figure 2 Hazard function of cigarette smoking

Discussion

With regard to the behavioral factor, it was found that for the population that exercised regularly “death” was less than “survive”, with the National Statistics Office survey in the year 2004 stating that 29.1% Thais exercise regularly. Similarly, in consumption of abusive and addictive substances, namely smoking cigarettes and areca nut chewing, results obtained were the same, namely that the population under “death” would consume almost twice as much. Non smokers had 4 times more probability of being in the “survive” than in the “death”, while the national data level for the year 2003 was 20.3%, respectively (Ministry of Public Health, 2007). It could be seen that the behavior of the sample differed from that of the national level because these were special characteristics of each area depending on their lifestyle, culture and traditional beliefs – for example, areca nut chewing is still found in rural areas; or perhaps it was due to the inequality in health care service -- for example, various campaigning, limitations in gathering information, distance from health facilities, etc., for which further research is required.

According to the Cox Proportional Hazard Model presented the effect of age on probability of dying. It was in compliance with the study made by Gompertz (1825) in England, namely that when age increases the hazard of death also increases. Age is a significant variable representing the biological factor. Time is closely related to age since all living beings has the same end point, namely death. Therefore the age variable is a significant factor that has an effect on mortality. For longitudinal studies, age indicates development during the passage of time, whether it be development in accordance with age, development of disease, development in health status. Age is therefore a representative of bodily changes and the recipient of sociological influences (Hobcraft, Menken & Preston, 1982). Even Makeham's theory on epidemiology follows the same line of thought, namely that when age increases the hazard of death for the elderly is greater than for the youth.

The males were more at risk of death than females. It complied with studies in several countries, e.g. Kruger and Nesse's research in the U.S.A (2004) found that males were 1.5 times more at risk of death than females; those who were married, widowed or divorced were 1.8 times more at risk of death than those who were single--which may differ from other general studies where it was found that singles are more at risk of death than those who were married since married people tend to select healthy people to marry. Moreover, singles tend to live in different environments from married people (Dublin, Lotka, & Spiegelman, 1949). Anyhow, marital status alone might not account for all the differentials, and one could say the same of education, since it could be seen that married, divorced and widowed persons tend to fall under the elderly age group. Therefore, the outcome of the study could be influenced by said gender and age. From an analysis of the Thai population census for the year 2000 of the Institute for Population and Social Research, it was found that Thai males have a first married age of 27.3 years and Thai females of 24.0 years, an increase of 2.3 years for males and 2 years for females from the 1960 census.

This outcome of exercise variable gave the same result as the Kokkinos, Narayan, John, Colleran, Pittaras, Notargiacomo, Reda, and Papademetriou, (1995) study on 15,650 Caucasian and African-American male war veterans in the U.S.A. where it was found

that those who exercised regularly are 70% less at risk of death than those who had little exercise.

With regard to habitual consumption of abusive and addictive substances, for this finding there is still no data on studies showing a direct affect of areca nut consumption to death, but there is data confirming that it has an effect on the risk of oral cavity cancer. For example, Radio Taiwan International, 2008 found that regular areca nut chewers were 28 times more at risk of having oral cavity cancer than non chewers. In Thailand, Aroonprapan S., Supawan, K., Rit-Oue and Ratanarangsima, K., (2005) selected cases of oral cavity cancer in the Samut Prakarn Province and found that the statistically significant factors which were related to oral cavity cancer were cigarette smoking, alcohol consumption, areca nut chewing and working outdoors. It was also evident that the hazard of death for smokers were greater than non smokers, which complies with the study made by Salynn (2008) on 12,483 females aged between 30–55 years in the U.S.A. between 1980–2004, where it was found that out of the 36% under “death”, 29% had never smoked, 35% was still smoking, while the remaining 36% used to smoke; and the distance between the graphs of “death” and “survive” became more evident after 40 months of smoking.

Conclusion

Age and gender are major biological factors affecting mortality, with age having a positive result on the hazard of death, while males are more at risk of death than females. Anyhow, socio-economic and behavioral factors such as marital status, exercise, etc. all affecting mortality. This study focused on the inappropriate behaviors, with emphasis on cigarette smoking and areca nut chewing where it was found that the areca nut chewing populations are 1.4 times more at risk of death than non chewers. Therefore, since both factors are avoidable, the authors made this research in order that the result would confirm the research question and thereby answer the question asked in this research. Anyhow, there are a great number of studies that confirm a greater risk of death through cigarette smoking while there is still little study on the subject of areca nut chewing, which could be part of the reason why the Thai rural population has an average lifespan that is lower than that of the urban population. That is why it is essential that accurate information be broadcasted, and it is up to all concerned to make suitable proposals.

Research Recommendation

The behavior of consuming abusive and addictive substances by the Thai people is still of major concern, but there has been continuous campaigning as well as stimulation on the subconscious level. Continuous knowledge and information have been given and laws and regulations passed to control drinking and smoking with a good level of success. However, areca nut chewing does not seem to be of concern to the Thai society. Areca nut chewing is regarded as a culture carried on through generations. It is a cheap addictive substance which could easily be planted within the household. Ingredients used whether they are piper betel leaves or lime is easily and cheaply bought and consumed. However, consumption is addictive and that is why people are still consuming it to the present time, especially in rural areas.

Anyhow, the above study showed that areca nuts and ingredients used for consumption, namely lime and tobacco are substances that accelerate the growth of cancer; at the same time research has shown that areca nut chewing causes poor health condition in the oral cavity which could develop into cancer. In some countries such as Taiwan, it was found that areca nut consumption is gaining more popularity, which probably meant that there has been some negligence in imparting information on the harmful effects of areca nut consumption. Although the risk of death from areca nut chewing is less than from smoking and drinking, it is still something that should not be overlooked; even though it is a habit practiced by the minority, has no economical effects, is not imported or does not cause the same irritation as smoking, the fumes of which might cause harm to people in close contact, but areca nut chewing might affect the longevity of the Thai population. In the past, the lifespan of the population was low, which may well have been the result of areca nut chewing by the Thai population. Thereafter, following progress, socio-economical developments as well as prohibition by the country's leader, the Thai population has a longer lifespan, an issue that should have been taken up, but had not, probably due to lack of past information on areca nut chewing of the Thai population. Therefore, the government as well as departments concerned should support research studies made on the affect of areca nut consumption on health, as well as giving information on the hazard of death for consumers, which is greater than for non consumers.

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