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Prevalence of insufficient fruit and vegetable intake and associated factors in older adults in Thailand

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Abstract

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This cross-sectional study aimed to describe the prevalence of insufficient fruit and vegetable intake (FVI), and examined factors associated with insufficient FVI in adults aged 50 years and older in the communities of Thailand. The data collection was conducted from September 2015 to March 2016. Multi-stage cluster sampling was used to draw a sample of 3,875 in 16 districts from 14 provinces across different regions of Thailand. The variables were collected included socio-demographic factors, lifestyles, anthropometric factors, health status and FVI. An Electronic form was developed for data entering from all study sites. Face to face interview by trained research assistants was used to fill up the electronic form of questionnaire. Chi-square test and multiple logistic regression were performed to examine associations between the independent variables and insufficient FVI.

From the total number of participants, 97.73% completed questionnaires. The majority (72.9%) were 50 to 69 years old. Overall prevalence of insufficient FVI were 77.4 %, 78.3 % among men and 76.9% among women. In multiple logistic regression, marital status, household monthly income, regions, and tobacco used (Adj OR = 1.36, 95% CI= 1.04-1.78) were significantly associated with insufficient FVI. After adjusting for other factors, older adults who used tobacco were 1.36 times more likely to have insufficient FVI than those who did not.

The amount of fruit and vegetable intake by older adults in communities of Thailand were considerably lower than current recommendations (daily intake of at least five servings; 400 g). The results suggested that public education and campaigns on adequate consumption of fruit and vegetable should be promoted to target low household monthly income, north eastern region, and tobacco use. This findings could help health promotion policy implementation to increase FVI among this target group in Thailand.

Keywords: Fruits, vegetables, insufficient intake, risk factors, older adults

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ความชุกและปัจจัยที่มีความสัมพันธ์กับการบริโภคผักและผลไม้ไม่เพียงพอในผู้ใหญ่สูงอายุในประเทศไทย

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บทคัดย่อ

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ความชุกและปัจจัยที่มีความสัมพันธ์กับการบริโภคผักและผลไม้ไม่เพียงพอในผู้ใหญ่สูงอายุในประเทศไทย
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การศึกษาแบบภาพตัดขวางนี้มีวัตถุประสงค์เพื่ออธิบายสถานการณ์ความชุกและปัจจัยที่มีความพันธ์กับการบริโภคผักและผลไม้ไม่เพียงพอในประชากรไทยที่มีอายุตั้งแต่ 50 ปี ขึ้นไป เก็บข้อมูลในช่วงเดือนกันยายน 2558 ถึงมีนาคม 2559 ทำการสุ่มตัวอย่างประชากรจำนวน 3,875 คน จาก 16 อำเภอ 14 จังหวัด ครอบคลุมทุกภูมิภาคของประเทศไทย ด้วยวิธีการสุ่มแบบแบ่งกลุ่มหลายขั้นตอน ตัวแปรที่นำมาศึกษาได้แก่ ปัจจัยด้านลักษณะประชากรและสังคม ปัจจัยด้านพฤติกรรมสุขภาพ ปัจจัยด้านการตรวจสมรรถภาพร่างกาย ปัจจัยด้านสภาวะโรคเรื้อรัง และการบริโภคผักและผลไม้ เก็บข้อมูลโดยใช้วิธีการสัมภาษณ์โดยผู้สัมภาษณ์ที่ผ่านการอบรม และบันทึกรวบรวมผลผ่านระบบสารสนเทศอิเล็กทรอนิกส์ วิเคราะห์ด้วยการทดสอบไคสแควร์และการถดถอยลอจิสติกพหุคูณเพื่อศึกษาความสัมพันธ์ระหว่างการบริโภคผักและผลไม้ไม่เพียงพอกับปัจจัยเสี่ยงที่ศึกษา

การศึกษานี้มีผู้ตอบแบบสอบถามครบถ้วนคิดเป็นร้อยละ 97.73 พบว่าส่วนใหญ่ (72.9 %) มีอายุอยู่ในช่วง 50-59 ปี ความชุกของการบริโภคผักและผลไม้ไม่เพียงพอเท่ากับ 77.4% โดยพบ 78.3%ในผู้ชาย และ 76.9% ในผู้หญิง ผลการวิเคราะห์หลายตัวแปรพบว่า สถานภาพสมรส รายได้ของครอบครัวต่อเดือน ภาค และการสูบบุหรี่ (Adj OR 1.36, 95% CI =1.04-1.78) เป็นปัจจัยที่มีความสัมพันธ์ต่อการบริโภคผักและผลไม้ไม่เพียงพอในผู้ใหญ่สูงอายุที่สูบบุหรี่พบว่าโอกาสที่จะบริโภคผักและผลไม้ไม่เพียงพอมากว่าผู้ใหญ่สูงอายุที่ไม่สูบถึง 1.37 เท่า

ปริมาณการบริโภคผักและผลไม้ในผู้สุงอายุในประเทศไทยพบว่าต่ำกว่าคำแนะนำมาก (เท่ากับอย่างน้อย 5 ส่วนบริโภค หรือ 400 กรัมต่อวัน) ผลการศึกษานี้ได้ แนะนำว่าควรให้สุขศึกษาและรณรงค์ให้มีการบริโภคผักและผลไม้ให้เพียงพอในกลุ่มเป้าหมาย คือ กลุ่มที่มีรายได้ของครอบครัวต่อเดือนต่ำ กลุ่มที่อาศัยอยู่ภาคอีสาน และกลุ่มผู้สูบหรี่ การค้นพบนี้สามารถช่วยส่งเสริมนโยบายสุขภาพเพื่อนำสู่การปฏิบัติเพื่อเพิ่มการบริโภคผักและผลไม้ในกลุ่มเป้าหมายในประเทศไทย

คำสำคัญ: ผลไม้ ผัก การบริโภคที่ไม่เพียงพอ ปัจจัยเสี่ยง ผู้สูงอายุ

Introduction

Nowadays older adults are the fastest growing segment of the world population. Older adults are increased of chronic condition and specific geriatric condition[1]. Common health problems in the elderly are diabetes, hypertension, chronic obstructive pulmonary disease, coronary heart disease, high cholesterol, stroke, arm weakness, joint pain, long-term pain, falls and fractures respectively[2]. Many studies reveal that fruit and vegetable consumption can be help to reduce those disease. Fruit and vegetables are essential components of a healthy diet because of low energy density and containing sources of micronutrients and fiber[3].

Insufficient FVI is a problem that burdens many countries, however the factors related to low FVI may differ by geographic regions and sub populations. The World Health Survey in 2002-2003 has shown that prevalence of inadequate fruit and vegetable consumption from 52 low- and middle-income countries are 77.6% men and 78.4% women[4]. The prevalence in Thailand is 84% in men, 79% in women[4]. The results of Thailand National Health Examination Survey IV reported the level of insufficient FVI by age which were 84.1, 90.1 and 91.9 in age groups of 60-69, 70-79 and over 80 years old respectively[5].

The World Health Organization recommends an intake as of 400 grams or 5 servings of fruit and vegetable daily for the prevention of chronic diseases, such as heart diseases, cancer, diabetes, and obesity[6].

Numerous studies reveal that adequate FVI can prevention chronic diseases and delay cell deterioration process. However, both developed and developing countries presented the evidence of inadequate FVI among general population especially in older adult. Whereas there is the globally growing percentage of the older adult number. The more age of elderly the more prevalence of chronic disease and geriatric problem, which these related with inadequate FVI. There were a very few study, therefore this study was conducted to describe the prevalence of insufficient fruit and vegetable intake, and examine factors associated with insufficient FVI among adults aged 50 years and older in the communities of Thailand. This findings will be useful for public education, promoting adequate intake of fruit and vegetable and also for planning and policies.

Methods

Sampling technique

A cross-sectional study was conducted from September 2015 to March 2016 in 3,875 subjects who randomly selected from 16 districts in 14 provinces across different regions of Thailand. Established questionnaire from the study on Global ageing (SAGE) was modified according to variables in the study. The questionnaire consisted of five sections: socio-demographic factors, lifestyles, anthropometric factors, health status factors and FVI. The data was collected by trained research assistants through a face to face interview using a structured questionnaire. Electronic form was developed for data entering from all study sites via on-line application (http://ageingbackend.damasac.com). Data were collected independently from the households of the selected community following the inclusion and exclusion criteria.

Measures

Section 1: Socio-demographic factors included age, gender, current marital status, religious denomination, education level, household monthly income, area of residence, health insurance and region.

Section 2: Lifestyles factors were consisted of 18 questions included alcohol consumption, tobacco use and physical activity . Alcohol use was assessed with the question 'Have you ever consumed a drink that contains alcohol in the past 3 month only?' Response options were 'Yes' or 'No'. Tobacco used was assessed with the question 'Have you used smokeless tobacco?' any tobacco products such as cigarettes, cigars, pipes, chewing tobacco, or snuff?' The response options were 'Yes' or 'No' in the past 3 month only. Physical activity was measured by using the General Physical Activity Questionnaire (GPAQ) which gathers information on physical activity in three domains (activity at work, travel to and from places, and recreational activities), as well as time spent sitting[7]. For physical activity, in addition to the total minutes of activity, the activity volume was also computed by weighing each type of activity by its energy requirement in metabolic equivalents (METs). The number of days and total physical activity MET minutes per week were used to classify respondents into three categories of low, moderate, and high level of physical activities.

Section 3: Anthropometric factors involves the measurement of height and weight. Weight (without foot wear and any accessories) were measured by research assistants who were trained. Similarly, height was measured (without foot wear) by positioning the stadiometer on a firm surface against the wall. Body mass index (BMI) was calculated as weight in kg divided by height in metres squared. Overweight and/or obesity was defined as BMI ≥ 25 kg/m², normal as between ≥ 18.5 ,<25 kg/m², and underweight as < 18.5 kg/m^2.

Section 4: Health status factors were assess about chronic conditions of the respondents with the questions; "Have you ever been diagnosed with chronic condition ?" (Chronic condition include; hypertension, diabetes, stroke, angina, lost all of natural teeth and depression). Response items are: "Yes" or "No".

Section 5: Fruit and vegetable intake were assessed using 2 questions "How many serving of fruit do you eat on a typical day ? and "How many serving of vegetables do you eat on a typical day ? with in the 24 – hour dietary recall data. In this study, insufficient fruit and vegetable consumption was defined as less than 400 grams or five servings of fruit and vegetable a day. Adequate fruit and vegetable consumption was defined minimum of 400 grams or five servings of fruit and vegetable per day.

Data analysis

The data were analyzed using SPSS version 16.0 for Windows. Data entry staff checked the missing and consistency and range checks. Firstly, descriptive statistics was used to calculate median, quartile deviation (QD), minimum and maximum, numbers and percentage. Descriptive statistics was used to determine the prevalence of insufficient FVI and describe each independent variable. Secondly, Chi-square tests were used to identify an association between of insufficient FVI and each independent variable. Crude OR was used to measure the strength of the association between of insufficient FVI and each independent variable. The computed odds ratios

were reported with 95% confidence intervals and a two-tailed significance level of 0.05 was used as the cut-off point for statistical significance. Finally, multiple logistic regression analysis was used to determine the significant predictors of insufficient FVI among adults aged 50 year and older in the communities of Thailand. All significant independent variables with a p-value < 0.05 in the Chi-square test were included in the multiple logistic regression.

Ethical consideration

The proposal was approved by the ethical committee of Mahidol University. No individual level identifiers were included in any public data set and no individual identifiers were sent to the authors. The approval number was COA. No. 2014/266.3009.

Results

The frequency distribution of socio-demographic factors are shown in Table 1. The age of respondents ranged from 50-97 years, with median age was 62 years. Nearly two-thirds (62.9%) of respondents were female. Of those were married (70.5%), followed by 23.5% were divorced, separated and widowed groups, only a few were single (6.0%). Buddhism was the great majority of respondents (92.6%). Regarding to their education, elementary education level was the highest (63.9%). Over half (53.1%) of them had household monthly income less than 10,000 baht, meanwhile 5.8% received their family monthly income greater than 30,000 baht. The majority had been living in rural area (69.4%). Concerning to health insurance, the universal coverage was the largest percentage (84.4%). On the other hand, most of the respondents had been living in north eastern region (32.3%).

Table 1 Distribution of respondents by socio-demographic factors

Variables	Number	Percent
Age group (years)	**3787**	
50-59	1404	37.1
60-69	1354	35.8
70-79	745	19.7
80 and over	287	7.4
Median = 62 QD = 6.5, Min = 50, Max = 97		
Gender	3787	
Male	1404	37.1
Female	2383	62.9
Current marital status	3787	
Single	228	6.0
Married/Cohabiting	2669	70.5
Divorced, Separated and widowed	890	23.5
Religions denomination	**3787**	
Buddhism	3507	92.6
Non-Buddhism	280	7.4
Educational levels	**3787**	
No formal education	144	3.8
Lower Elementary school	613	16.2
Elementary school	2421	63.9
Junior high school	223	5.9
Secondary school	192	5.1
Vocational school/ University	194	5.1
Household monthly income (Baht/month)	**3787**	
<10000	2011	53.2
10001-20000	1225	32.3
20001-30000	330	8.7
>30000	221	5.8
Areas of residence	**3787**	
Urban	1159	30.6
Rural	2628	69.4
Health insurance		
Universal coverage	3195	84.4
Non - universal coverage	592	15.6
Region	**3787**	
Northern	319	8.4
Central	674	17.8
North eastern	1123	32.3
Eastern	310	8.2
Western	645	17.0
Southern	616	16.3

Table 2 shows 11.6% had alcohol consumption, while tobacco using was only 10.9 %. According to physical activity, 74.6% had low physical activity, followed by 17.1% had moderate physical activity, only 8.3% had high physical activity. Furthermore, most of respondents had normal (57.0%) in Body Mass Index, while overweight and underweight were 34.0 and 9.0% respectively.

Table 2 Distribution of respondents by lifestyle factors and anthropometric factors

Variables	Number	Percent
Alcohol consumption	**3787**	
Yes	440	11.6
No	3345	88.4
Tobacco use	**3787**	
Yes	413	10.9
No	3374	89.1
Physical activity	**3787**	
Low Physical activity	2824	74.6
Moderate Physical activity	649	17.1
High Physical activity	314	8.3
Body mass index	**3787**	
Underweight	339	9.0
Normal	2160	57.0
Overweight	1288	34.0

Table 3 shows nearly one-thirds (31.9%) had hypertension, while group diagnosed with diabetes was 17.8%. Regarding to another health status, only 3.3% had stroke, followed by angina 2.1%. Slightly two-thirds (68.0%) had lost all of permanent teeth. The depression was only 2.6%

Table 3 Distribution of respondents by health status

Health status	Number	Percent
Hypertension	**3787**	
Yes	1208	31.9
No	2579	68.1
Diabetes	**3787**	
Yes	673	17.8
No	3114	82.2
Stroke	**3787**	
Yes	125	3.3
No	3662	96.7
Angina	**3787**	
Yes	79	2.1
No	3708	97.9
Lost all of permanent teeth	**3787**	
Yes	2577	68.0
No	1210	32.0
Depression	**3787**	
Yes	99	2.6
No	3688	97.4

Table 4 shows most of respondents (77.4%) had insufficient in FVI, while sufficient in FVI was only 22.6 percent. The highest insufficient FVI was detected in the northeast of Thailand (82.6%), males (78.3%) and older adults aged between 70-79 years (78.5%).

Table 4 Prevalence of insufficient fruit and vegetable intake among older adults in Thailand

Variables	Total sample n	Insufficient fruit and vegetable intake	
		Yes (%)	No (%)
Total	3787	77.4	22.6
Age group (years)			
50-59	1404	77.8	22.2
60-69	1354	76.7	23.3
70-79	745	78.5	21.5
80 and over	284	76.4	23.6
Gender			
Male	1404	78.3	21.7
Female	2383	76.9	23.1
Region			
Northern	319	71.8	28.2
Central	674	73.9	26.1
North eastern	1123	82.6	17.4
Eastern	310	80.6	19.4
Western	645	74.0	26.0
Southern	616	76.1	23.9

Table 5 shows current marital status, household monthly income, health insurance, region and tobacco use were significantly associated with insufficient FVI. The variables with no significant association with insufficient FVI were not shown in Table.

Table 5 Association between independent variables with insufficient fruit and vegetable intake

Socio-demographic factors	Insufficient fruit and vegetable intake				
	n	Yes (%)	No (%)	Crude OR (95% CI)	p-value
Current marital status	3787				
Single	228	69.7	30.3	0.63(0.46-0.87)	.005
Married/Cohabiting	2669	77.7	22.3	0.96(0.79-1.15)	.620
Divorced, Separated and Widowed	890	78.5	21.5	1	
Household monthly income (Baht/month)	3787				
<10000	2010	79.0	21.0	1.50(1.10-2.05)	.011
10001-20000	1226	76.2	23.8	1.26(0.93-1.76)	.137
20001-30000	330	76.7	23.3	1.31(0.89-1.93)	.172
>30000	221	71.5	28.5	1	
Health Insurance	3787				
Universal coverage	3195	78.1	21.9	1.25(1.02-1.53)	.028
Non-Universal coverage	592	74.0	26.0	1	
Region	3787				
Northern	319	71.8	28.2	0.80(0.59-1.08)	.148
Central	674	73.9	26.1	0.89(0.69-1.14)	.352
North eastern	1123	82.6	17.4	1.49(1.17-1.88)	.001
Eastern	310	80.6	19.4	1.31(0.93-1.83)	.121
Western	645	74.0	26.0	0.89(0.69-1.15)	.371
Southern	616	76.1	23.9	1	
Tobacco use	3787				
Yes	413	82.3	17.7	1.40(1.08-1.83)	.012
No	3374	76.9	23.1	1	

Table 6 shows current marital status, household monthly income, regions and tobacco use were significantly associated with insufficient FVI. After adjusting for other factors, older adults who used tobacco were 1.36 times more likely to have insufficient FVI than those who did not.

Table 6 Multiple logistic regression for predictors of insufficient fruit and vegetable intake

Variables	Adj. OR	95% CI for OR		P-value
		Lower	Upper	
Current marital status				
Single	0.65	0.47	0.91	0.011
Married/Cohabiting	0.93	0.78	1.12	0.464
Divorced, Separated and Widowed	1			
Household monthly income (Baht/month)				
<10000	1.38	1.01	1.89	0.046
10001-20000	1.21	.87	1.67	0.256
20001-30000	1.31	.89	1.94	0.173
>30000	1			
Health Insurance				
Universal coverage	1.14	.93	1.40	0.211
Non-Universal coverage	1			
Region				
Northern	.79	.58	1.08	.139
Central	.91	.71	1.17	.465
North eastern	1.43	1.12	1.81	.004
Eastern	1.34	.95	1.89	.092
Western	.92	.71	1.19	.539
Southern	1			
Tobacco use				
Yes	1.36	1.04	1.78	.023
No	1			

Discussion

This study was conducted in adults aged 50 years and older in the communities of Thailand. The overall prevalence of insufficient FVI were 77.4 %, which 78.3% in men and 76.9 % in women . These were compatible with the World Health Survey in 2002-2003 which showed that prevalence of inadequate fruit and vegetable (FV) consumption from 52 low-and middle-income countries are 77.6% in men and 78.4% in women[4]. However, the prevalence of insufficient FVI in this study was less than that in several Asian Health and Demographic Surveillance System sites where insufficient FVI was found to be more than 89% in men and 96% in women in Bangladesh, 96% in men and 92% in women in Indonesia, and more than 84% in men and more than 79% in women in Thailand[8]. Thailand National Health Examination Survey III (aged over 15) revealed that the consumption of insufficient fruit and vegetable only 73.4%. Moreover, 77.4% of Thais adult aged 50 years and older in this study consumed insufficient fruit and vegetable which was slightly better. Even though previously we had campaign for fruit and vegetable consuming for Thais but the traditional Thai eating pattern was changed to fast food from Western culture. In addition, the problem of insufficient fruit and vegetable consuming could lead to health problems especially non-communicable diseases, cancer and cardiovascular disease risk. Therefore, one perform this study to access prevalence and factors which correlated with insufficient fruit and vegetable consuming using results to set better policy for promoting Thais health consume more fruit and vegetable.

Multivariate analysis determined that three socio-demographic factors were significant associated with insufficient FVI: current marital status, household monthly income and regions. This study indicated that the level of insufficient FVI increased by age which were 77.8, 76.7, 78.5 and 76.4 in the age groups of 50 – 59, 60 – 69, 70 – 79 and over 80 years old respectively. This is correlated with Thailand National Health Examination Survey III, IV[5,9]. Considering from the age, the older of age showed the higher of insufficient fruit and vegetable consuming due to they are facing the difficulty of preparation. These obstacles depend on personal, health and lowering of appetite contrasts with the research[10] that indicated fruit and vegetable sufficient consuming when older. However the factor of age in this research was not significantly associated with insufficient FVI when getting older. The factor of age in this research was not significantly related with insufficient FVI, which is related to study in South Africa[11]. These might due to sample size of population has low distribution of age which is different from other studies[4,12-15] indicated that age is the factor showed relation with insufficient fruit and vegetable intake.

Even though gender is the factor that showed no significantly to insufficient FVI but in this study found that among female consume sufficient fruit and vegetable per day according to standard recommend (400 gram or 5 serving per person daily) which is higher that among male. This study supports other studies' result that older women eat more fruits and vegetables than older men, even though older men eat more food overall[10, 15-16]. These differences affected from disparity of knowledge, confidence and good nutrition of food preparation. In addition we found that male realized in health consumption less than female[16-17]. Male who is able to cook and access

information about nutrition will consume more fruit and vegetable[15, 17]. In the context of Thai social, female is the person who responsible for food in the family.

From data analysis by Chi-square test and multiple logistic regression, current marital status showed significantly associated with insufficient FVI. This study found that elderly who is widow, divorce status or separate status has higher chance to have insufficient FVI than those who were single or marital status. These were related to other studies that marriage is positively associated with fruit and vegetable intake among older men and older women. Single men are at particularly high risk of low intake[15]. Marriage is particularly beneficial for older man's FVI and the presence of a woman in the household is associated with higher FVI of male household members[18]. However, the benefits of marriage for FVI are difficult to separate from the benefits related to companionship and eating meals together[19].The experience of widowhood heightens risk of inadequate diet for both men and women because they often lack skills in the process of choosing and preparing nutrient-rich foods. Following the death of a spouse, women are particularly socioeconomically vulnerable and at risk of social isolation. Older women, who might be more accustomed to cooking for others, are often less inclined to prepare food and cook complete meals for themselves that might be reserved for shared special occasions[18]. From previous study found that married participants consume fruit and vegetable more than widow or divorced participants. Moreover married men have more fruit and vegetable than single men but it was not different in women. This is suggestion to study more in this topic about relations among status, supporting from families and fruit and vegetable consumption in different culture[20]. In addition, the study should be added currently marital status and interaction in social or family members because previous studies showed separation causes lower fruit and vegetable consumption. Social interactions causes increasing of fruit and vegetable consumption except elderly people who is limited area with nutrition risk[21].

Many studies showed that low educated population is the significant factor that causes inadequate fruit and vegetable consumption[8, 14, 22]. In USA found that high education level related to adequate consumption of fruit and vegetable. Some studies found that knowledge is the factor related to amount of fruit and vegetable consumption[20]. Therefore the study in the future should be cover relationship between level of education in elderly and their knowledge about amount of fruit and vegetable consumption to confirm that knowledge is major factor to state adequate fruit and vegetable consumption. However in this study was not show that level of education related to inadequate fruit and vegetable consumption. These could explain from most of population of this study are in elementary education level (63.9%) causes no differences.

Household monthly income was the significant factor that associated with inadequate fruit and vegetable consumption which is similar to many studies[4, 12-15]. From this study found that family that has low household income, lower than 10,000 baht, has a chance to face inadequate fruit and vegetable consumption which has higher chance to have 1.38 times of inadequate fruit and vegetable consumption of family that has household income over 30,000 baht. Even though Thailand is agricultural country, be able to produce high amount, verities and export fruit and

vegetable[23], but we found that Thai population consume fruit and vegetable lower than standard recommend due to fruit and vegetable is more expensive. These reasons leading to low income family could access to fruit and vegetable lower than high income family. Therefore high income indicated ability to access to quality food, varieties and sufficient amount [24]. Consequent of these is setting policy and develop program for low income population to consume seasonal fruit and vegetable. However there should be further study that include relationship between income, price, demand of consumers and healthy food.

This study found that population who live in urban area consume adequate fruit and vegetable higher than population who live in rural area which is correlated with Thailand National Health Examination Survey III and IV[5,9] due to it is convenient to purchase food. There are many fresh markets and convenient stores available all the time which is different from population who live in rural area which most of vegetable and fruit were naturally planted. These plants depend on natural water sources therefore the drought has direct effects to inadequate fruit and vegetable consumptions[23]. These results agreed with studies from other countries showed that the differences of food in each area found obviously differences in city area due to easy to access fruit and vegetable[1]. Restaurants in countryside carry less fruit and vegetable. Moreover the price of fruit and vegetable in countryside is more expensive than others[1]. Elderly who lives in countryside has difficulty to access fruit and vegetable due to they could not in driving[21]. In rural area, elderly were consume lower fruit and vegetable[25] and program that government stated could not be access due to low tax collection[1]. In addition fruit and vegetable consumption in rural area and urban area was different even though this study found that it is not significantly associated between areas of residence. Moreover it is not related to factor of inadequate fruit and vegetable.

In this study, the population were classified into 6 regions as follows Northern, Central, North-eastern, Eastern, Western, and Southern region. Region is the significant factor that related to inadequate fruit and vegetable consumption. The study found that fruit and vegetable consumption is different among regions and mostly is insufficient. Especially in North-eastern region, has the highest prevalence of insufficiently fruit and vegetable consumption followed by Eastern, Southern, Western, Central and Northern region respectively. On the other hand the people in Northern region is the most prevalence of sufficient fruit and vegetable consumption. In this result is different to Thailand National Health Examination Survey III and IV[5,9]. The surveys found that people in Southern region is the highest prevalence of sufficient fruit and vegetable consumption, similar to eating culture in this region that has been gotten influence from Indian Chinese and Java, because mostly foods is spicy, they is often eat with vegetable. Sticky rice and chili sauces (Naampik aung, Naampik num) are the main menu of Northern people, these are always eaten with vegetable. As for people in North-eastern region has highest prevalence of insufficient fruit and vegetable consumption may conform to eating culture due to some region is arid, the mostly raw material for cooking come from Natural source. There for fruit and vegetable consumption of this region is depend on topography and seasonal status. However for more understand about differentiation of quantity

of fruit and vegetable consumption among regions, the author suggest that should further study other factors that may be effect.

Tobacco used was significant factor of insufficient FVI from this study. Smoking group had higher chance to have insufficient FVI 1.36 times as numerous as non smoking group (Adj OR = 1.36, 95% CI = 1.04-1.78). These might due to non smoking group have better health behavior. They keep healthy positive way which is agreed with other studies[11, 26-27] presented that heavy smoker is significant factor that effect insufficient FVI. However in this study included current tobacco use in 3 month part. Since smoking is related to insufficient FVI, therefore study about regular and occasionally smoking should be conducted in further study.

In this study, health related factors including hypertension, diabetes, stroke, angina, lost all of permanent teeth and depression were not related to insufficiently fruit and vegetable consumption significantly similar to studies in South Africa[11]. But different result in other studies[27-28], which showed that health related factors to consumption.

Nutrition is linked to the function and quality of life for older adults with chronic disease[29-31]. Sufficiently fruit and vegetable consumption in all ages help reducing incidence of chronic disease[32], delay developing of dementia and related conditions[33], delay physical declination due to high serum carotenoids level, promote muscle and bone strength[34], reduce incidence of cataract in women[35]. Even if sufficiently fruit and vegetable consumption help to prevent these previous conditions but geriatrics is high risk for sufficiently fruit and vegetable consumption due to limitation of physical function, disability and chronic illness, accessibility, preparation, loss of appetite and dental problem, all factors are relates to less fruit and vegetable consumption.

Loss of appetite result from changing of hungry reception[36], taste and smelling[37] worry about digestion, contentment of eating, mood condition each day, dental problems. Mostly vegetable is eaten in fresh condition[30], it was difficult in chewing, bitten or swallowed, common problems in geriatrics are molar tooth or false tooth[38].

However, four factors as current marital status, household monthly income region in Thailand, and tobacco use significantly related to insufficiently fruit and vegetable consumption but when it is determined by adj OR found that size of relation is not high, even if 95% CI is narrow, it may have other factors besides aforementioned variables such as knowledge, perception of benefit of vegetal consumption, believe, and attitude.

The strength of this study is a large sample size of older adults across different regions of the communities of Thailand. It is modified from international standard questionnaire which reflects a significant advantage over other national dataset sources. Moreover, On-line electronic form of questionnaire was developed for data entering from all study sites.

This study had several limitations. First, the process of data collecting with face to face interview of health variables such as FVI, physical activity, tobacco or alcohol use should be interpreted with caution because of time limiting with many questions; it is possible that measurement errors occurred. The two fruit and vegetable questions depended on memory, therefore, there was the possibility of recall bias. However, this bias is minimized since the questions

refer to a very short time period. One main limitation is that this method may not provide reliable estimates of the usual intake of participants. The face to face interview assessment of physical activity remains the most feasible and affordable instrument for global surveillance. However, objective population measures of physical activity, such as pedometers or accelerometers may be beneficial to determine if differences between groups revealed in the present study represent true differences in physical activity behavior. The study did not validate the measurement of dietary intake of fruit and vegetable and physical activity, which are highly susceptible to respondent bias in the form of under or over reporting. Many studies in the area of nutritional epidemiology have established the need to integrate validation of measurements of dietary intake and physical activity into the study design. Without such an inbuilt component, the internal validity of the measurements are compromised. Second, information on knowledge, psychosocial determinants (habit, motivation, goals, beliefs about capabilities, skills, taste, attitudes, and self-efficacy) and environmental factors such as local availability were not collected and should be included in future studies. Further, seasonal differences in availability of fruit and vegetable may have influenced the consumption patterns and should be assessed in future studies. Finally, this study was based on data collected in a cross-sectional survey. We cannot, therefore, ascribe causality to any of the associated factors in the study.

Recommendation

Recommendations for policy makers

1. promoting in planting of local vegetables according to seasons. Water should be managed sufficiently to supply for agriculture all year round. In addition adequate physical activity and smoking cessation should be promoted in older adults populations to increase FVI.

2. Activities on FV consumption campaigns should be promoted and announced as national agenda and all organizations integrate, worked together to increase FV intake including children, juvenile until geriatrics.

3. Policy about food security of Thailand should be comprehensively reviewed in terms of accessibility of fruit and vegetable of people. Although Thailand had policy that cover Food and Agriculture Organization of the United Nation (FAO) and similar to policy of other country but most of them still focus on economic development which was not connect to food security and nutrition of people especially fruit and vegetable.

4. Promotion of fruit and vegetable consumption should be changed because previously Thailand and other countries focus on knowledge but USA provided free fruits and vegetables for students which could increase fruit and vegetable consumption in this group of populations. Other countries still have no method to manage system and mechanism such as price and tax, control of market mechanisms and products distribution.

5. FVI promotion should be focus among older people who are widowed/ divorced/separate marital status, and live in north eastern region.

Recommendation for health care providers

Insufficient FVI data in elderly has to be used to apply for planning and management in public health for older adult population. Activities and projects could be set easily and practical. These could be used to adjust in order to correct health behavior. For long last success, these have to be returned to community and everyone brain storm, take action and process by themselves supported by government and societies.

Recommendations for future studies

For future studies, other factors that related to fruit and vegetable consumption behavior should be included such as knowledge of fruit and vegetable consumption, perceived benefit, family members, social interaction, believe and attitude. The study should also investigate association between fruit and vegetable consumption with income, price, demand of consumers and healthy food.

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