ORIGINAL ARTICLE

Occurrence of complications of diabetic patients during the worst flood in 2011 in Phra Nakhon Si Ayutthaya province

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Abstract

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The cross-sectional study was conducted to identify factors associated with the occurrence of complications, and to predict risk factors of complication of diabetic patients during the worst flood in 2011 in Phra Nakhon Si Ayutthaya Province. Population in the study was 19,442 diabetic patients who were registered for treatment at hospitals in Phra Nakhon Si Ayutthaya Province, from October - December 2011. Data were collected using a standardized questionnaire from 278 diabetic patients by stratified random sampling method. Data were analyzed using descriptive statistics, Chi-square test and multiple logistic regression analysis.

Most participants were females, Buddhists, aged between 41 to 60 years old. They were primarily educated, employed, and diagnosed with diabetes for less than ten years. Generally, most participants had moderated stress level, moderate awareness of the great flood, fair knowledge, and good attitude towards diabetes. Majority of them practiced self-management behavior in a good level. The study revealed that average fasting blood sugar (FBS) of diabetic patients was 153.9 mg/dL with standard deviation of 48.7 mg/dL. During the period of severe and lengthy flooding, 51 patients (18.3%) had developed complications such as hyperglycemia (9.4%), and hypoglycemia (9.0 %). Using multiple logistic regression, there are 3 predictive factors that associated with occurrence of complications. All of them were statistically significant 1) Level of stress due to flooding, 2) Fasting Blood Sugar (FBS) level, and 3) Low-Density Lipoprotein Cholesterol (LDL-C) level.

The result of this study could be used as complication prevention data by controlling stress level, FBS level, and LDL level. Moreover, public health policy should support all classes of health care system and launch out disaster preparation policy. Health care database improvement, drug reservation, and health care support for chronic disease were suggested to help improve self-care in the community.

Keywords: Occurrence of Complications, Diabetic patients, Worst flood

การเกิดภาวะแทรกซ้อนในผู้ป่วยเบาหวาน ช่วงวิกฤติมหาอุทกภัยปี พ.ศ.2554 จังหวัดพระนครศรีอยุธยา

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บทคัดย่อ

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การวิจัยแบบตัดขวางนี้มีวัตถุประสงค์ เพื่อศึกษาปัจจัยที่มีความสัมพันธ์ต่อการเกิดภาวะแทรกซ้อน และศึกษาปัจจัยทำนายโอกาสเกิดภาวะแทรกซ้อนในผู้ป่วยเบาหวานในช่วงวิกฤติมหาอุทกภัย ปี 2554 ของจังหวัดพระนครศรีอยุธยา ประชากรที่ใช้ในการวิจัย ได้แก่ ผู้ป่วยเบาหวานที่ขึ้นทะเบียนในโรงพยาบาลของจังหวัดพระนครศรีอยุธยา ตั้งแต่ ตุลาคม - ธันวาคม 2554 จำนวน 19,442 คน กลุ่มตัวอย่างที่ถูกสุ่มมีจำนวน 278 คน โดยวิธีสุ่มแบบชั้นภูมิ การรวบรวมข้อมูลทำโดยแบบสอบถามที่ผู้วิจัยพัฒนาขึ้น สำหรับการวิเคราะห์ข้อมูล นำเสนอโดยใช้ค่าร้อยละ ค่ามัธยฐาน การทดสอบไคสแควร์และการวิเคราะห์การถดถอยโลจิสติกแบบพหุเพื่อทดสอบระดับความสัมพันธ์ของปัจจัยทำนายกับการเกิดภาวะแทรกซ้อน

ผลการศึกษาพบว่า กลุ่มตัวอย่างส่วนใหญ่เป็นเพศหญิง อายุระหว่าง 51-60 ปี นับถือศาสนาพุทธ การศึกษาระดับประถมศึกษา อาชีพรับจ้างทั่วไป ระยะเวลาป่วยด้วยโรคเบาหวานน้อยกว่า 10 ปี มีภาวะความเครียดปานกลาง ความตระหนักเรื่องน้ำท่วมปานกลาง ความรู้เกี่ยวกับโรคเบาหวานปานกลาง ทัศนคติต่อโรคเบาหวานดี และผู้ป่วยส่วนใหญ่มีพฤติกรรมการดูแลตนเองในระดับดี กลุ่มตัวอย่างมีค่าระดับน้ำตาลหลังอดอาหารเฉลี่ยเท่ากับ 153.9 ไมโครกรัมต่อเดซิลิตร และส่วนเบี่ยงเบนมาตรฐานเท่ากับ 48.7 ทั้งนี้การเกิดภาวะแทรกซ้อนระหว่างการเกิดมหาอุทกภัย พบทั้งสิ้น 51 ราย คิดเป็นร้อยละ 18.3 ได้แก่ภาวะน้ำตาลในเลือดสูง 26 ราย (ร้อยละ 9.4) และภาวะน้ำตาลในเลือดต่ำ 25 ราย (ร้อยละ 9) ในการวิเคราะห์ไคสแควร์ พบว่าปัจจัยที่มีความสัมพันธ์กับการเกิดภาวะแทรกซ้อนอย่างมีนัยสำคัญทางสถิติ ได้แก่ อายุ ระดับความดันโลหิต ความเครียดต่อการเกิดมหาอุทกภัย การออกกำลังกายและระดับน้ำตาลในเลือด (p<0.01) สำหรับการวิเคราะห์ตัวแปรพหุแบบโลจิสติก พบว่าปัจจัยที่สามารถทำนายการเกิดภาวะแทรกซ้อนอย่างมีนัยสำคัญทางสถิติ คือ ระดับความเครียดในช่วงมหาอุทกภัย ระดับน้ำตาลในเลือดหลังอดอาหาร และระดับโคเรสเตอรอลไขมันความหนาแน่นต่ำในเลือด (LDL-C)

ผลการศึกษาสามารถนำมาใช้เป็นข้อมูล ในการป้องกันการเกิดภาวะแทรกซ้อนในผู้ป่วยเบาหวาน ระหว่างมหาอุทกภัย โดยควบคุมระดับความเครียดต่อการเกิดอุทกภัย ควบคุมระดับน้ำตาลในเลือดหลังอดอาหารและระดับไขมันความหนาแน่นต่ำในเลือด นอกจากนี้ในระดับนโยบายสาธารณสุขระดับเขต ควรส่งเสริมให้สถานบริการสาธารณสุขทุกระดับ ได้มีการเตรียมความพร้อมของสถานบริการในด้านต่าง ๆ เพื่อรองรับการเกิดภัยพิบัติ อาทิเช่น การพัฒนาฐานข้อมูลด้านสุขภาพ ความพร้อมของบุคลากรสุขภาพทุกระดับ การเตรียมยารักษาโรคเรื้อรัง ตลอดจนการส่งเสริมสุขภาพของผู้ป่วยโรคเรื้อรัง เพื่อป้องกันการเกิดภาวะแทรกซ้อนในช่วงเกิดภัยพิบัติ และก่อให้เกิดการพัฒนาการดูแลตนเองในชุมชนต่อไป

คำสำคัญ: การเกิดภาวะแทรกซ้อน ผู้ป่วยเบาหวาน มหาอุทกภัย

Introduction

Inadequately-controlled chronic diseases might lead to threat in life of citizens in emergency response phase during disasters. After a disaster, such as hurricane and flood, the majority of medical visits were made for endocrine, cardiovascular, or psychiatric disorders[1]. One of the endocrine diseases that were highly affected by any disaster was diabetes mellitus (DM). Normally, the complications of diabetes mellitus were far less common and less severe in people who had well-controlled blood glucose levels. The complications in diabetes mellitus could be divided into two categories, 1) acute complications such as diabetic ketoacidosis (DKA), Hyperosmolar Hyperglycemic Non-ketotic Syndrome (HHNS), hypoglycemia, and diabetic coma; and 2) chronic complications such as neuropathy, nephropathy and retinopathy. However, the occurrence of complications substantially increased during a disaster where diabetic patients often experienced poor glycemic control after a long stay in an unfavorable environment. In such setting, diabetic patients had to cope with the stresses of medications, supplies, food, and shelter. Consequently, poor glycemic control caused a greater risk for concurrent illnesses such as diabetic ketoacidosis, hypoglycemia and soft tissue infections[2].

Phra Nakhon Si Ayutthaya was one of the provinces that were damaged by the great flood in 2011, which vastly affected 16 districts, 194 sub-districts, and 1,378 communities. Phra Nakhon Si Ayutthaya Hospital is one of two hospitals that had to stall its health care service. As Phra Nakhon Si Ayutthaya Hospital was surrounded by three main rivers, namely Chaophraya River, Pasak River, and Lopburi River, the flood water could rapidly inundate the city and hospital. At that time, the patients had to be promptly evacuated; and the hospital had to be close and totally unable to provide health services. It greatly discontinued the care of chronic diabetic patients. This group of patients was facing with several challenges such as logistics, transportation, lack of security and stress from health problems and damaged properties. Hence, these factors led to increased stress. Another problem faced by the patients is the cost of medical service where they are forced, during the disaster, to change their health care center to the nearest one leading up to extra medical fees[3,4]. Moving to evacuation centers may also cause difficulty in monitoring treatment, and the charging of medical treatment fees[5]. These factors greatly affected the medical care of chronic disease. Another problem for patients apart from non-continuous drug administration or loss of medical appointments is taking care of themselves during the great flood. Whether it is eating, resting, or exercising, these routines may have been changed. Moreover, nutrition is very important for patients with chronic diseases. Poorly controlled eating habit such as the consumption of canned food can negatively affect the health of diabetes patients6. In addition, difficulties to do regular exercise and residing in an unfamiliar places can cause patient's health conditions to worsen. As a result, diabetic patients can experience dangerous complications if they cannot control their blood glucose level. Therefore, this study will explore the risk factors that associated with complication in diabetes and predict their level of incidence. This is to help establish a guideline to reduce the occurrence of diabetes complications during natural disaster such the future.

In previous research, many factors are found to be associated with occurrence of diabetic complications. They can be furthers divided into two categories, namely 1) internal factors and 2) external factors. 1) Internal factors refer to patient's health conditions such as co – morbidity, duration of diabetes, stress level, health awareness level, knowledge of diabetes, attitude towards diabetes, health behaviors, exercise routine, drug consumption, self – management, and diet control. The poor control of these internal factors can lead to higher blood glucose level, and increase the risk of complications. 2) External factors refer to social support from patient's family and health care workers team. This study shows that support from family positively correlates with drug adherence in diabetic patients. Also, regular and continuous follow-up at efficient health service and standard medical center positively affects the patient's control blood sugar level[4].

Methods

Systemic randomized sampling from a list of diabetic patients from random districts. There were 19,443 registered diabetic patients in Phra Nakhon Si Ayutthaya hospital in 2011. Seven out of 16 districts were selected using stratified random sampling namely Ayutthaya, U-Thai, Na-khonluang, Pa–chee, Sae–Na, Bang Ban and Bang Pa-in Districts. Sample size was estimated to be 380 samples[7]. Data collection was obtained between October – December, 2011 by using a structured questionnaire which was composed of 5 parts: Part I General information: there were 14 questions such as sex, age, religion, marital status, occupation, education, and income. Health information is the amount and duration anti-diabetic drugs use, duration being diagnosis as diabetes, blood pressure, lipid levels, body mass index. The severity of floods, in which affected patients' health and stress is also assessed by standard measurement[8,9]. Physical data includes the level of flood, distance to hospital, location of house[10];

Part II: Diabetic data. 10 questions pertaining to complications in diabetic patients during the great flood are developed from the literature and research proposed by Vanirat Srichana[11]. The answer could be chosen only yes / no and not sure.

Part III: Knowledge and attitude towards diabetes and Part IV: Self-management behavior in diabetes. They were classified into 7 questions regarding pertaining to diabetic control, 2 questions pertaining to drug use, and 3 questions pertaining to attitudes toward social and self adaptor behavior which were adopted from Srichana's study[11].

Part V: Social support data. There are 25 questions in this part; social support from family (12 questions), social support from community (6 questions), social support from health personnel (7 questions), which were developed by Punnarach[12]. Each question was self-assessed using 5-point rating scale.

Pre-testing of the questionnaire was done in Bang Pahan district. The KR20 result for the knowledge part was 0.7. Internal consistency reliability of attitude and social support were 0.51 and respectively. Some questions were revised to improve its reliability. The dependent variable is defined as complications (yes/no).

Participants were face-to-face interviewed by trained interviewers which were the 3rd students from faculty of Public Health, Rajabhat Phra Nakhon Si Ayutthaya at the diabetes clinic. The purpose of this

procedure was explained to all participants; also, their right was informed to refuse or withdraw anytime. Cooperation of participants was on voluntary basis and their answers would remain anonymous. As a result, the response rate was about 73.2 percent.

Data analysis

Quantitative data: frequency, percentage, mean, standard variation, and mode for analyze of general information such as age, income, number of patients with chronic diseases, blood glucose level, blood pressure level by using descriptive statistics. The researcher also identified predictive factors that influencing occurrence of complications in diabetic patients during the worst flood, including age, flood level, living in flood situation by multiple logistic regression. By using multiple logistic regression, the adjusted odds ratio with 95% confidence interval of independent variables were presented their strength of associations by controlling other factors.

Results

Table 1 shows percentage of patients by occurrence of complications. In total 51 patients (18.3%) had complications such as hypoglycemia (25 patients) and hyperglycemia (26 patients). General characteristics were described in Table 2. Most diabetic patients are female (68.3%), aged between 41-60 years (50.4%), Buddhists (94.2%) and most of them married (71.8%). Regarding to their economic status, the result found that 80 patients earned no income (29.5%).

Table 1 Percentage of patients who had occurrence of complications

	Frequency	Percentage (%)
Complication	51	18.3
No Complication	227	81.7

Table 2   Frequency and Percentage of diabetes patients by socio-demographic characteristics

Socio-demographic factors	Frequency	Percentage (%)
Sex		
Male	88	31.7
Female	190	68.3
Age (years)	Mean = 58.8	SD = 12.5
≤ 40	19	6.8
41 - 60	140	50.4
> 60	119	42.8
Religion		
Buddhism	259	94.2
Muslim	15	5.4
Others	1	0.4
Marital status		
Married	188	71.8
Single	25	9.5
Divorced	11	4.2
Widowed	38	14.5
Occupation		
Unemployment	88	32.1
Government officer	33	12.0
Agriculture	32	11.6
Employed	66	24.0
Trading	29	10.5
Others	27	9.8
Education		
No education	10	3.6
Primary education	178	65.0
Secondary education	44	16.1
College or higher degree	42	15.3
Income (baht/month)		
None	80	29.5
1 - 5,000	65	24.0
5,001-10,000	65	24.0
10,001-15,000	27	9.9
15,001-20,000	10	3.7
> 20,000	24	8.9

From table 3, most of patients have other underlying diseases such as hypertension (67.7%) and dyslipidemia (13.3%). Majority of them were diagnosed less than 10 years (74.6%). These diabetic patients are treated with medication before and after meal (43.6%).

Regarding biological factors, about 62% of patients have BMI greater than of 25 kg/m2 with average BMI of 25.4 kg/m^2 (SD = 5.4), blood pressure at high level (56.1%), FBS level higher than 125 mg%

was 75.9% (Mean = 153.9, SD = 48.7), and most has normal cholesterol level (46.0%). Cholesterol level higher than normal level of 240 mg (21.6%) (Mean = 205.2, SD = 47.0). For the most part, LDL level is in the standard range (Mean = 121.8, SD = 47.8) and only about 12 patients with 190 mg% or higher (7.0%). As for triglyceride level, about 93 patients are in standard range below 150 mg% (53.1%) with average level of 162.2 mg% (SD = 113.7).

Table 3 Percentage of diabetes patients by health status and biological factors

Health status and Biological factors	Frequency	%
Co-morbidity (n=248)		
Hypertension	168	67.7
Dyslipidemia	33	13.3
Coronary artery disease (CAD)	22	8.9
Chronic kidney disease (CKD)	22	8.9
Others	3	1.2
Duration of diabetes (years)		
≤ 10	194	74.6
11-20	55	21.2
21-30	10	3.8
31-40	1	0.4
Type of treatment (n=266)		
Oral type	240	90.2
1 drug before meal	60	22.5
1 drug after meal	64	24.1
2 drugs before and after meal	116	43.6
Injection type	26	9.8
BMI (kg/m^2)	Mean = 25.4	SD = 5.4
Underweight (<18.5)	7	2.5
Normal weight (18.5-24.9)	99	35.6
Overweight (25.0 and over)	172	61.9

Table 3 Percentage of diabetes patients by health status and biological factors (Cont.)

Health status and Biological factors	Frequency	%
Blood Pressure (mmHg)		
Optimal (< 120/< 80)	9	3.2
Normal (≥ 120/≥ 80 - 130/85)	113	40.7
High (>130/>85)	156	56.1
Biological factor		
FBS (mg%)	Mean = 153.9	SD = 48.7
Low (<100)	18	6.5
Normal (100-125)	49	17.6
High (≥ 125)	211	75.9
Cholesterol (mg%)	Mean = 205.2	SD = 47.0
Desirable (< 200)	81	46.0
Borderline high (200-239)	57	32.4
High (≥ 240)	38	21.6
Triglyceride (mg%)	Mean = 162.2	SD = 113.7
Desirable (<150)	93	53.1
Borderline high (150-199)	33	18.9
High (200-499)	45	25.7
Very High (≥ 500)	4	2.3
Low Density Lipid Cholesterol (mg%)	Mean = 121.8	SD = 47.8
Optimal (< 100)	43	25.1
Near optimal (100-129)	54	31.6
Borderline high (130-159)	26	15.2
Near high (160-189)	36	21.1
High (≥190)	12	7.0

Table 4 Percentage of diabetic patients by internal and external factors

Factors	Frequency	%
Internal factors		
Level of stress	Mean = 5.4	SD = 2.8
Low (0-4)	57	22.1
Moderate (5-6)	138	53.5
High (7-10)	63	24.4
Level of awareness	Mean = 5.4	
Low (0-4)	71	27.9
Moderate (5-6)	146	57.5
High (7-10)	37	14.6
Level of knowledge		
Poor (< 60%)	101	37.2
Fair (60-80%)	141	51.8
Good (> 80%)	30	11.0
Level of attitude		
Poor (12 – 3)	0	0.0
Fair (31 – 47)	115	42.1
Good (48 – 60)	158	57.9
Self-management behavior		
Poor (30 – 70)	0	0.0
Moderate (71 – 110)	65	23.8
Good (111 – 150)	208	76.2
External factors		
Social Support	Mean = 25.4	SD = 3.9
Poor (25 – 58)	0	0.0
Moderate (59 – 92)	21	7.7
Good (93 – 125)	251	92.3
Physical factors		
Level of flood (meters)		
None	62	23.0
< 1	60	22.3
1-2	115	42.8
> 2	32	11.9
Distance to hospital (km.)		
< 5	86	41.2
5 - 8	63	30.1
9 - 12	28	13.4
> 12	32	15.3

Table 5 Association between study factors and complications of diabetic patients

Factors	No Complications		Complications		x^2	p-value
		%		%		
Personal factor						
Age (years)						
≤ 40	10	52.6	9	47.4	13.38	0.01*
41-60	113	80.7	27	19.3		
> 60	104	87.4	15	12.6		
Level of stress due to flooding						
Low	40	70.2	17	29.8	9.33	0.01*
Moderate	109	79.0	29	21.0		
High	58	92.1	5	7.9		
Exercise						
Poor	20	100.0	0	0.0	9.11	0.01*
Fair	65	73.0	24	27.0		
Good	132	83.5	26	16.5		
Blood Pressure (mmHg.)						
Optimal (< 120/< 80)	4	44.4	5	56.6	36.92	0.01*
Normal (≥ 120/≥ 80 - 130/85)	77	68.1	36	31.9		
High (>130/>85)	146	93.6	10	6.4		
FBS (mg %)						
Low (<100)	13	72.2	5	27.8	11.02	0.01*
Normal (100-125)	48	98.0	1	2.0		
High (>125)	166	78.7	45	21.6		
Cholesterol (mg %)						
Desirable (< 200)	59	72.8	22	27.2	1.84	0.40
Borderline high (200-239)	47	82.5	10	17.5		
High (≥ 240)	30	78.9	8	21.1		
Triglyceride (mg %)						
Desirable (<150)	75	80.6	18	19.4	1.76	0.62
Borderline high (150-199)	23	69.7	10	30.3		
High (200-499)	34	75.6	11	24.4		
High Over (≥ 500)	3	75.0	1	25.0		
LDL cholesterol (mg %)						
Optimal (< 100)	36	83.7	7	16.3	2.90	0.58
Near optimal (100-129)	38	70.4	16	29.6		
Borderline high (130-159)	19	73.1	7	26.9		
Near high (160-189)	29	80.6	7	19.4		
High (≥190)	9	75.0	3	25.0		
BMI (kg/m^2)						
Under weight (<18.5)	5	71.4	2	28.6	0.89	0.64
Healthy weight (18.5-24.9)	83	83.8	16	16.2		
Over weight (≥25.0)	139	80.8	33	19.2		

*Significant at p-value < 0.01

Table 6 Adjusted odds ratios for occurrence of complications in diabetic patients

Factors	Adj. Odds Ratio	95% CI		p-value
		Lower	Upper	
Age (year)				
≤ 60	1			
> 60	0.87	0.32	2.35	0.091
Level of stress				
Low/Moderate	1			
High	6.42	1.74	23.62	0.005**
Exercise				
Fair	1			
Poor/Good	0.91	0.34	2.44	0.850
FBS level				
Normal	1			
Low/High	13.58	1.64	112.51	0.016*
Cholesterol level				
Desirable	1			
Borderline High/High	0.45	0.15	1.32	0.145
Triglyceride level				
Desirable	1			
Borderline high/High and over	1.07	0.40	2.89	0.890
LDL-Cholesterol level				
Desirable	1			
Undesirable	3.50	1.94	13.05	0.042*
BMI level				
Normal weight	1			
Underweight/Overweight	1.14	0.37	3.50	0.822
Blood Pressure level				
Normal	1			
Optimal/High	0.39	0.14	1.08	0.072

Significant at *p-value < 0.05;   ** p-value < 0.01

By using multiple logistic regression, adjusted odds ratios with 95% confidence interval of predicting factors were presented in Table 6. It was found that factors associated with occurrence of complications were the level of stress due to flooding, FBS level, and LDL level. Patients with high level of stress were 6.4 times more likely to have diabetic complications than those with low/moderate level (95% CI: 1.742– 23.620). For patients with abnormal level of fasting blood sugar (low/high), the risk of diabetic complications were 13.5 times higher than the risk for those with normal level (95% CI: 1.639 – 112.520). Moreover, patients with abnormal LDL level (near optimal / borderline high / high / high over) had 3.498 times greater risk to have diabetic complications than those who had normal LDL level (95% CI: 1.937 – 13.051).

Discussion

The study found that most diabetic patients are females. This data is consistency with a study of Diabetic patients in Bangkruay Hospital in Nonthanuri province[13]. Duration of diabetes was 6 years on average. Majority of them (77.4%) had underlying disease, such as Diabetic patients have several contributing factors[14] such as high level of plasma volume, which caused by osmotic effect of high fasting blood sugar, sodium overload, which is possibly caused by an atrial natriuretic peptide hormone, prostaglandins, which functions to balance sodium level, and loss of kidney function that reduces excretion of sodium and water.

Considering external factors such as level of flood and distance to hospital, it was found that 115 patients (41.4%) had 1-2 meter height of flood and 173 patients (62.2%) had less than 10 kilometer distance to hospital, and most patients had good social support (90.3%). This result correlates with the study of Wannee Chansawang and Usanee Petchratachart (2005)[15], who studied about the factors that affect health care of diabetic patients in Namom, Songkla. This study found that health care such as diet control, exercise, stress management, medication, and treatment to control complications at moderate level showed positive feedback from sample size towards health care, knowledge and good attitude. Consequently, this resulted in optimistic self-management of patients. Regarding to level of stress due to flooding, exercise and distance to hospital were significantly related to complications in diabetic patients. This result supports the findings of Ram Rangsarn (2012)[16], who showed that higher blood pressure were more likely to have acute complications in diabetic patients. This might be because people with the condition have higher risk for controlling blood sugar level than people with normal blood pressure[17, 18]. These complications can be avoided by checking blood pressure regularly and treating hypertension as soon as it is diagnosed[19,20]. Data analysis in this study was used to find probability of occurrence of complications in diabetic patients during the worst flood. The results of this study incorporated variables that were statistically significant into an equation to predict possibility of complications, which were level of stress due to flooding, level of FBS, level of LDL. Fasting blood glucose level was the most significant variable, used to predict the possibility of complications during the great flood period. Equation to predict possibility of complications was w = 0.78 - 1.216(level of stress

due to flooding) + 0.01(level of FBS) + 0.021 (level of LDL).

A proper logistic regression equation to predict possibility of complication is (complications) = 1/1+e-w (Chi-square = 6.017 sig. = 0.645).

This was associated with the study of Jiraporn Dechma (2010)[10] who studied factors to predict complication possibility in Type II diabetic patients with hyperglycemia. Her study found that possible predictive factor of hyperglycemia was proper self-care of the patient. This was shown by a change in blood glucose level at 3.0%, and related to the study of Srisuda Sitprecha (2013), named "Diabetic dyslipidemia: Emergency in Endocrine system". This study showed that abnormality of LDL was related to insulin resistance and deinsulin.21 Moreover, it was also related to the study of William, et al (2006)[2], with the study named "The Hurricane Katrina Aftermath and Its Impact on Diabetes Care." which emphasized that providing information about knowledge, self-care, and stress management is necessary to prevent diabetic complications. In 2007, "American Diabetes Association Statement on Emergency and Disaster Preparedness." launched out study, named the Disaster Response Task Force[22]. This study explained the importance of patient's self-care such as preparation for emergency set, and personnel factor such as preparation of staff for emergency case; which was coincidentally similar to the study of Tang and Gu, (2012)[23]. Tang and Gu were interested in "The Association between Early Blood Glucose Fluctuation and Prognosis in Critically Ill Patients". They found out that the early fluctuation of blood glucose was a significant independent risk factor of mortality in critically ill patients. This implied that controlling the early fluctuation of blood glucose concentration might improve the patients' outcome. Therefore, controlling blood glucose to normal level was needed in all situations.

International Diabetes Federation and International Society of Nephrology also supported normal blood glucose level control to prevent possible complication. In order to control the level of blood glucose, regular follow-up in blood glucose level and LDL level should be done. American Diabetes Association recommended glucose level before meal be 90-130 mg/dl; plasma glucose level after meal 1-2 hours be less than 180 mg/dl; level of triglyceride be less than 150 mg/dl; level of Cholesterol be less than 200 mg/dl; level of LDL-cholesterol be less than 100 mg/dl; and HDL-cholesterol be equal or more than 40 mg/dl.

In conclusion, the final three predictive factors in occurrence complications of this study were 1) Level of stress due to flooding, 2) level of Fasting Blood Sugar (FBS), and 3) level of low-density lipoprotein (LDL). These factors explained 35.2% of occurrence of complications of diabetic patients during the great flood in the year 2011 in Phra Nakhon Si Ayutthaya Province.

Research limitations

This study had multiple variables which caused a flood of data in numbers of questions and details and time consumption. A number of participants might not be large enough to reduce the amount of error of the result. However, numerous statistical methods were also adopted to improve an accuracy of the data.

Recommendations for implementation

The solutions for these three important factors from the result of the study should be considered as treatment along with the continuous medication for more effective curing process. We suggested that proper health diet, regular exercise support be the solution. In addition, mental health team was needed as diabetic patients had higher tendency to be anxious that would affect glucose level and increase chances of complications.

Recommendation for further research

This study produced result that identified certain promising variables that influenced the occurrence of diabetic complication. Further research should focus on occurrence complications of other frequent chronic diseases.

Acknowledgements

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