Vol.3, No.3, 150-155 (2013)
http://dx.doi.org/10.4236/jdm.2013.33023

Journal of Diabetes Mellitus

Importance of regional differences in the features of type 2 diabetes mellitus in one and the same country—The example of Thailand

Supattra Srivanichakorn[1], Tassanee Yana[1], Pattara Sanchaisuriya[2], Yu Yu Maw[3,4], Frank Peter Schelp[4*]

[1]ASEAN Institute for Health Development, Mahidol University, Bangkok, Thailand
[2]Department of Nutrition, Faculty of Public Health, Khon Kaen University, Khon Kaen, Thailand
[3]Institute of Tropical Medicine, Charité—University Medicine Berlin, Berlin, Germany
[4]Faculty of Public Health, Khon Kaen University, Khon Kaen, Thailand; *Corresponding Author: f_schelp@kku.ac.th

Received 14 June 2013; revised 12 July 2013; accepted 19 July 2013

ABSTRACT

Background: A dataset from a nationwide assessment of type 2 diabetes mellitus (T2DM) patients from Thailand was reassessed. Objective: Prevalence of T2DM is highest in the northeast of Thailand and the intention of the study was to assess whether the clinical picture and behavior of patients from the northeast differ from the rest of the country. Materials and Methods: The variables of two groups of patients *i.e.* those from the northeast of Thailand and patients from the remaining three other regions, with the exception of Bangkok, were compared. The dataset consisted out of clinical laboratory data and the results of a questionnaire recording knowledge and admitted compliance of patients. Results: A higher proportion of patients from the northeast have elevated triglyceride levels and lower high density lipoprotein (HDL) fractions in comparison with the patients derived from the other three regions. The northeasterners know very well and better than the patients of the other regions how to take care of them while having T2DM yet the proportion of those with glycated hemoglobin (HbA1c) values over 6.4% was higher for them than for the other group of patients. Conclusion: In depth investigation by health educators would be useful in order to find out how the relationship between knowledge and practice could be improved for patients from the northeast of Thailand.

Keywords: Diabetes; Patients; Compliance; Thailand

1. INTRODUCTION

The health delivery system of middle income countries like Thailand is challenged by chronic diseases, while also still dealing with problems related to infectious illnesses [1]. The prevention of diseases requires the compliance of the population at risk which is especially true for primary and secondary prevention of chronic diseases such as type 2 diabetes mellitus (T2DM) [2]. It is important for health authorities to consider also regional and local differences in the risk factor for T2DM and the behavioral pattern of different population groups within one and the same country under their responsibility in order to adequately implement measures for primary and secondary prevention to cope with T2DM. Thailand commonly is dived in four regions with distinctive geographical and cultural differences. From all the four regions of the country the prevalence of T2DM in the northeast exceeds the other three regions [3]. In a foregoing publication [4] the laboratory results from over 4000 patients with T2DM from all over Thailand was reported. A questionnaire also assessed from a subsample of approximately 2800 individuals investigated how patients understand the character of the disease they are suffering from and how they observe the advice given to them in terms of taking medicine and taking appropriate care of them. Ninety percent of the patients claimed that they took their medicine as told and 80% seemed to know well how to take care of them. Sixty percent of all the patients, from whom the sub-sample had been taken,

had glycated hemoglobin (HbA1c) levels above 7% in addition to the high proportion of patients with high triglyceride and low high density lipid (HDL) levels [4]. Obviously, the result of the questionnaire contradicted the laboratory findings and the situation of T2DM patients in Thailand was not as favorable as the results of the questionnaire seemed to imply. The data set, the foregoing investigation was based upon, was re-assessed for this contribution in comparing the results obtained from T2DM patients from the northeast of Thailand with the combined results from the patients of the other three regions with the exception of Bangkok. The objective of this study was to find out whether the higher prevalence of T2DM in the northeast in comparison with the rest of Thailand is due to differences in the clinical features of the patients indicated by the laboratory results and aggravated by a lower health status of the patients somehow masked by the false impression of a good compliance there.

2. MATERIALS AND METHODS

Laboratory results from approximately 4832 T2DM patients had been derived from 11 provinces of Thailand. A sub-sample of 2892 patients answered a questionnaire. Details of the sampling technique are given in the preceding publication [4]. Laboratory variables as well as weight and height data were used from the last visit of the patients to the respective health provider at the end of the project.

The results derived from the blood of the patients are based on the determination undertaken in a Bangkok central laboratory and details about the methods used and transforming the results into categories by setting cutoff points are given in a previous publication as well [5]. A change was made from the foregoing procedures in categorizing glycated hemoglobin (HbA1c) according to recent suggestions to use as cutoff point 6.5% in order to identify "abnormal" values [6].

The second and the third category refer to the first and the third quartile of the distribution of HbA1c for all patients under survey. In the case of three categories for the clinical laboratory findings the data had been collapsed to two categories taken the first category as 1 in the binary multivariate assessment. For data management and statistical analysis the Minitab statistical software version 12 was used and procedures in general were followed as explained in the foregoing publications [4,5].

The study was approved by the Ethical Review Committee for Research in Human Subjects, Faculty of Medicine, Ramathibodee Hospital, Mahidol University, Bangkok, Thailand.

3. RESULTS

Table 1 displays the proportion of females and males of the patients investigated, together with age, duration of years known to have T2DM and the nutritional status assessed by the BMI. The results are given separately for the northeast of Thailand and the other three regions of the country. In general female patients outnumber males considerably but the proportion of females in the northeast is even significantly higher compared with the other regions. In general the majority of T2DM patients are 65 years old and younger but the proportion of patients above 65 years old are slightly but significantly higher in the northeast. Knowing since when the disease was diagnosed differs between the regions and the proportion of those knowing that they have the disease with 53% is higher in the northeast compared with 47% of the patients from the rest of Thailand. The proportion of patients with overweight and obesity from three regions of Thailand is significantly higher compared with the northeast.

Over 50% of patients from all four regions have "normal" microalbumin levels and the LDL lipid fractions of over 95% of patients are below 200 mg/dl and significant differences between regions could not be observed (**Table 2**). Creatinine values over 1.5 mg/dl from the northeast account for almost 15% and for the other regions for about 12%. The difference is statistically significant. Cholesterol and triglycerides levels of a high proportion of patients are above the cut-off point considered to distinguish between normal and pathologically elevated.

Table 1. Characteristics of study groups.

Variables	Northeast (NE)		Other regions		x^2-Test
	N	Percent	N	Percent	p-value[a]
Female	1512	74.63	1779	67.31	0.000
Male	514	25.37	864	32.69	
Age (years)					
<66	1662	71.36	1436	74.25	0.035
≥66	667	28.64	498	25.75	
Duration (years)					
<5	867	47.25	1051	52.47	0.001
≥5	968	52.75	952	47.53	
BMI (kg/m^2)					
<23	567	32.81	495	24.61	0.000
23 - 24	334	19.33	404	20.09	
25 - <30	647	37.44	783	38.94	
30+	180	10.42	329	16.36	

[a]Statistically significant differences in the distribution of proportions of gender, age, duration of diabetes and nutritional status according to body mass index between the NE of Thailand and other regions.

Table 2. Biochemical determinants of study groups.

Variable	Northeast (NE)		Other regions		x^2-Test.
	N	Percent	N	Percent	p-value[a]
Creatinine (mg/dl)					
<1.5	1484	85.39	2254	88.22	0.007
≥1.5	254	14.61	301	11.78	
Microalbumin (mg/dl)					
<30	932	56.31	1301	54.30	0.420
30 - <300	606	36.62	914	38.00	
≥300	117	7.07	185	7.69	
Cholesterol (mg/dl)					
<200	973	55.98	1316	51.51	0.003
200 - <250	568	32.68	875	34.25	
≥250	197	11.33	364	14.25	
Triglycerides (mg/dl)					
<150	569	33.10	1247	48.88	0.000
150 - <400	950	55.26	1170	45.86	
≥400	200	11.63	134	5.25	
HDL (mg/dl)					
<45	1079	62.08	1114	43.60	0.000
45 - <65	589	33.89	1189	46.54	
≥65	70	4.03	252	9.86	
LDL (mg/dl)					
<200	1695	98.20	2481	97.45	0.101
≥200	31	1.80	65	2.55	
HbA1c (%)					
<6.5%	335	19.5	646	25.5	0.000
6.5% - 8.7	908	52.8	1244	49.1	
≥8.8%	467	27.7	642	25.4	

[a]Statistically significant differences in the distribution of proportions of biochemical variables between the NE of Thailand and other regions except for microalbuminuria and LDL.

values. While the proportion of patients with elevated cholesterol levels is somewhat lower in the northeast, the proportion of patients from the northeast with high triglycerides levels exceeds those from the other regions. The proportion of patients with abnormal low HDL levels is significantly higher for the northeast in comparison with the other regions. The proportions of patients from the northeast with HbA1c values of 6.5% and higher generally and statistically significantly exceed those from the other regions.

Residence in one of the two categories of the regions, sex, age and triglycerides significantly determine the variation of HbA1c in a multivariate binary logistic regression (**Table 3**). Cholesterol, HDL and LDL lipid fractions had no significant influence on the variation of the dependent variable being HbA1c.

The results of the analysis of important answers derived from the questionnaire applied to a sub-sample of the study participants are given in **Tables 4** and **5**. **Table 4** shows that the proportion of illiterate patients in the northeast is insignificant with about 4% in contrast to about 18% for the remaining three regions. The majority of patients of the northeast attended elementary schools and the proportion of those with secondary or higher education is slightly higher for patients from the rest of the country compared to the northeast.

The results of the remaining four questions as given in **Table 5** deal with the compliance of the patients. The overwhelming majority of patients said that they take medicine as advised by the doctor and consume food and exercise so that they can prevent T2DM to become worse. No significant difference for these issues is observed between the two categories of regions. However almost 40% of patients from the northeast admit that they not always keep their appointments with the doctor but a slightly higher proportion of patients from the northeast give the impression that they take good care of themselves while having T2DM in comparison with the other regions.

A substantial proportion of respondents are not quite sure about the possible complications ensue from not controlling T2DM properly. That heart- and eye disease

Table 3. Multivariate binary logistic regression with region, sex, age and lipid pattern as independent and HbA1c[a] as dependent variable.

Variables	OR Adj.	95% C.I.	p-Value
Region	0.81	0.70 - 0.94	0.004[c]
Sex	1.36	1.16 - 1.59	0.000[c]
Age	1.24	1.06 - 1.46	0.008[c]
BMI	0.90	0.77 - 1.05	0.190
Cholesterol	1.16	1.00 - 1.34	0.057
Triglyceride	1.53	1.31 - 1.79	0.000[c]
HDL	0.88	0.76 - 1.03	0.117
LDL	0.97	0.60 - 1.58	0.907

[a]Categories for HbA1c < 6.5% and ≥6.5%; 1 is set for NE regions, female, lipid fractions to the lowest category (see **Tables 1** and **2**). [c]Variables region, sex, age and triglyceride significantly contributed the variation of the dependent variable (3215 cases were used and 1617 cases contained missing values; log-likelihood = −2176.154; test that all slopes are zero: G = 77.522, DF = 8, p-value = 0.000).

Table 4. Questionnaire: asking about age, education and compliance.

Variables/ Questions	Northeast		Other regions		X^2 test.
	N	Percent	N	Percent	p-value[c]
Education					
Illiterate	48	4.26	303	17.19	
Primary	966	85.79	1231	69.82	0.000
Secondary	40	3.55	82	4.65	
High+	72	6.39	147	8.34	
Take medicine as doctor advised?					
Usually no	112	9.95	179	10.18	0.838
Usually yes	1014	90.05	1579	89.82	
Visiting doctor according to appointment					
Usually not	434	38.61	161	9.17	0.000
Usually yes	690	61.39	1595	90.83	
Food intake adjusted to having DM					
Not adjusted	459	40.91	675	38.42	0.182
Adjusted	663	59.09	1082	61.58	
Having DM how you take care of yourself?					
Wrong answer[a]	154	13.68	373	21.15	0.000
Correct[b]	972	86.32	1391	78.85	

[a]Take care personally for DM as long as blood glucose is high, as long as weight increases, inject insulin before next meal, don't know; [b]Even blood glucose levels are normal I will continue to be careful with my food intake and will exercise regularly; [c]Education and answers about appointment with doctor and taking care of her or himself significantly differed between groups.

are connected to T2DM are known by over 50% of those being questioned but that the kidney can be affected and that patients might suffer from hypertension is not so well known and as far as kidney diseases are concerned this is even less so from patients from the northeast (**Table 5**). Also a lower proportion of patients from the northeast in comparison from the other regions know that vision impairment might be a complication of T2DM.

Over 90% of the respondents are satisfied with the health service they receive. The proportion of patients visited by village health volunteers are slightly higher in the northeast compared with the other regions. Allover 70% of all patients are satisfied with their health status but a significantly higher proportion of patients of the northeast (about 60%) are considering the quality of their life as not so good but they are joined in this sentiment by 55% of their counterparts from the rest of the country.

Table 5. Questionnaire: Know-how about DM, satisfaction with health delivery system, perception of health status and quality of life.

Variables/ Questions	Northeast		Other regions		X^2 test.
	N	Percent	N	Percent	p-value[a]
Do you know that heart diseases can be a complication of DM?					
Don't know	402	42.54	673	46.90	0.073
Know	543	57.46	762	53.10	
Do you know that kidney diseases can be a complication of DM?					
Don't know	571	60.42	766	53.27	0.001
Know	374	39.58	672	46.73	
Do you know that hypertension can be a complication of DM?					
Don't know	596	63.07	883	61.45	0.425
Know	349	36.93	554	38.55	
Do you know that eye diseases can be a complication of DM?					
Don't know	399	42.27	504	35.12	0.000
Know	545	57.73	931	64.88	
Are you satisfied with the health service you receive?					
Not 100%	55	4.89	104	5.90	0.244
Yes	1070	95.11	1658	94.10	
Does the village health volunteer (VHV) visit your house often?					
Not often	681	60.48	1304	74.47	0.000
Often	445	39.52	447	25.53	
Are you satisfied with your health status?					
Not 100%	320	28.42	499	28.45	0.968
Yes	806	71.58	1255	71.55	
How do you consider your quality of life?					
Not so good	670	59.50	977	55.42	0.031
Good	456	40.50	786	44.58	

[a]Knowing about complications in connection with kidney and eye disease as well as VHV visiting and quality of life statistically significantly differed between groups.

4. DISCUSSION

In a preceding publication considering all four regions of Thailand and using the same dataset as for this contribution [4], concluded that the T2DM patients admitted to a good compliance in coping with their disease which however contrasted with their actual health status. Since T2DM prevalence in the northeast seems to be higher then in the rest of the country [3] this reassessment of the

data intended to find out whether patients from the northeast, probably are more at risk to have an impaired health status in comparison to the rest of Thailand and whether this is linked to their behavior as well.

The most obvious difference between T2DM patients from the northeast in comparison with the patients from the other regions is that the lipid pattern differs in that the proportions of patients from the northeast with elevated triglycerides are more frequent than those with elevated cholesterol values. The observation that elevated triglyceride levels exceeds elevated cholesterol levels in population groups in the northeast was reported from a number of districts from the northeastern Khon Kaen province some time ago [7] as well as in comparing individuals from Bangkok with those from the rural northeast [8] and this supports the validity of the findings as given here for T2DM patients.

The results of the multivariate assessment as displayed in **Table 3** shows that the residence of the patients has a significant influence whether HbA1c is in the "normal" or "abnormal" range, while in the forgoing assessment, not distinguishing between regions, triglycerides and cholesterol was related to HbA1c [4]. This no longer is true for the multivariate assessment here, where only triglycerides are significantly contributing to the variation of HbA1c and no longer cholesterol. A high carbohydrate intake, such as it is the case for sticky rice, the stable food in the northeast, induces elevated triglyceride [9] especially considering that dishes with sticky rice have a high glycemic index [10]. When including into a model of a multivariate logistic regression, besides a BMI higher than 23, hypertension, a fasting plasma glucose over 100 mg/dl and HbA1c levels of 5.5% to 6.4% as well as triglyceride levels of 150 mg/dl double the risk to develop T2DM, as it recently could be demonstrated for a middle-aged Korean cohort [11]. It will be safe to assume that high triglyceride levels are also a health hazard for T2DM patients from the northeast of Thailand and this is indicated by a significantly higher proportions of patients from the northeast having HbA1c levels of 6.5% and over in comparison with patients from the other three regions.

The proportion of patients with elevated microalbumin does not differ between patients from the northeast and the rest of Thailand. A slightly but significantly higher proportion of patients from the northeast in comparison with the other patients have creatinine levels of 1.5 mg/dl and above. It might be worthwhile to investigate further whether the risk for renal complications for patients from the northeast is higher than for the rest of the country.

It appears that illiteracy for the patients from the Northeast is rather low in comparison with the other three regions. However this effect is due to a rather high proportion of illiteracy in the South (unpublished results). The basic educational level of the patients is sufficient and the majority seems to have basic knowledge about the disease at least as far as the effect of T2DM on the heart and the eyes is concerned. Other dangerous developments in the course of T2DM in terms of the heart and kidney diseases and hypertension are not so well known.

The overwhelming majority of patients give the correct answers when being asked—"how to take correct care of you?" The proportion of correct answers is even higher for patients from the northeast than for those from the other regions. The answers contradict the finding that the overwhelming majority of patients have HbA1c values of 6.5% and over.

Villagers in the northeast seem to have a good knowledge about health risks [12] and might very well know how to give the correct answer when asked what they should and what they should not do. It might be important to find out how the answers reflect the reality and how well the compliance in reality is. The question is whether the patients want to please the health officials asking them. Somehow it is suspicious that 95% of patients are satisfied with the health service and over 70% with their health status and give the impression that they take the medicine as advised. The validity of this answer is not reflected by the HbA1c values obtained.

Unfortunately it was not possible to link the data set from the laboratory result and the answers derived from the questionnaire. But as it was pointed out in the foregoing publication [4] it can be well assumed that the sub sample answering the questionnaire is a representative sample of the whole group of patients investigated.

Only the northeasterners admit to almost 40% that they do not regularly visit the doctor according to the appointment but it is difficult to conclude that this is the main factor explaining the otherwise admitted good compliance in contrast to their insufficient health status.

The re-assessment of the original dataset disclosed important differences considering the T2DM features of the population in an area of a higher prevalence in comparison with those T2DM patients in the other regions of Thailand. The difference basically is due to the predominant dietary pattern in the northeast of the country being sticky rice as stable food. The comparably high glycaemic index of sticky rice results in generally higher triglyceride levels in comparison with the lipid pattern of the other regions. The population is astonishingly well informed about the disease with the contradictory result in that correct answers as far healthy behavior is concerned are given which however don't reflect the reality. Health education obviously results in a strange situation which needs further investigations. It will not be possible to try to change the dietary pattern within the northeastern region so that advice given must concentrate on a reduction of the energy intake, avoidance of too many

fruits especially during the rainy season and increase of physical activities.

REFERENCES

[1] WHO (2005) Preventing chronic diseases: A vital investment.

[2] Healey, B. and Zimmerman Jr., R. (2010) The new world of health promotion. Jones & Bartlett Publishers, Sudbury.

[3] Aekplakorn, W., *et al.* (2007) Prevalence and management of diabetes and associated risk factors by regions of Thailand: Third national health examination survey 2004. *Diabetes Care*, **30**, 2007-2012. doi:10.2337/dc06-2319

[4] Srivanichakorn, S., *et al.* (2011) Health status of diabetes type 2 patients in Thailand contradicts their perception and admitted compliance. *Primary Care Diabetes*, **5**, 195-201. doi:10.1016/j.pcd.2011.02.005

[5] Aekplakorn, W., Srivanichakorn, S., and Sangwatanaroj, S. (2009) Microalbuminuria and metabolic risk factors in patients with type 2 diabetes in primary care setting in Thailand. *Diabetes Research Clinical Practice*, **84**, 92-98. doi:10.1016/j.diabres.2008.12.020

[6] Report of a World Health Organization Consultation (2011) Use of glycated haemoglobin (HbA1c) in the diagnosis of diabetes mellitus. *Diabetes Research Clinical Practice*, **93**, 299-309.

[7] Chaisiri, K., *et al.* (1998) Nutritional status and serum lipids of a rural population in Northeast Thailand—An example of health transition. *International Journal of Vitamin and Nutrition Research*, **68**, 196-202.

[8] Pongpaew, P., *et al.* (1978) Serum lipid pattern in urban and rural Thai population. *Journal of Nutritional Science and Vitaminology* (*Tokyo*), **24**, 289-296. doi:10.3177/jnsv.24.289

[9] Parks, E.J. and Hellerstein, M.K. (2000) Carbohydrate-induced hypertriacylglycerolemia: Historical perspective and review of biological mechanisms. *American Journal of Clinical Nutrition*, **71**, 412-433. PMid:10648253

[10] Chen, Y.J., *et al.* (2010) Glycemic index and glycemic load of selected Chinese traditional foods. *World Journal of Gastroenterology*, **16**, 1512-1517. doi:10.3748/wjg.v16.i12.1512

[11] Lim, N.K., *et al.* (2012) A Risk Score for Predicting the Incidence of type 2 diabetes in a middle-aged Korean cohort. *Circulation Journal*, **76**, 1904-1910. doi:10.1253/circj.CJ-11-1236

[12] Immuong, U., Charerntanyarak, L. and Furu, P. (2009) Community perceptions of health determinants in Khon Kaen Province, Thaland. *Southeast Asian Journal of Tropical Medicine and Public Health*, **40**, 380-391.

