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Research Article

Cross-sectional study of glycemic control among adults with type 2 diabetes

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Abstract Type 2 diabetes mellitus is a chronic condition, a global concern, and a serious issue in Sri Lanka, where there is little data regarding the influence of dietary control, exercise, and adherence to medication behaviors among adults diabetes. In this cross-sectional, descriptive study, we identified current factors influencing glycemic control and glycemic control behavior among adults with diabetes. A total of 230 people attending diabetes clinics in a tertiary hospital and a primary care institute were administered the self-report Diabetes Information Form, assessing their socioeconomic and medical information and glycemic control behaviors. Data were analyzed by frequency distribution, percentages, mean scores, and standard deviation. The results indicated that most participants had not achieved the recommended fasting blood glucose level (< 126 mg/dL). Although dietary control was practised by 72%, regular exercise was not practised by 85%, and while 77% reported adhering to regular medication, they still had poor glycemic control. The findings highlight the need for health professionals to adopt new strategies for diabetes education to overcome issues related to misconceptions and barriers in providing diabetes care in Sri Lanka.

Key words glycemic control, glycemic control behavior, Sri Lanka, Type 2 diabetes.

INTRODUCTION

Diabetes mellitus (DM) is a major public health problem (International Diabetes Federation [IDF], 2013), with the number of people with type 2 DM (T2DM) increasing rapidly worldwide (Ramachandran *et al.*, 2012). It is estimated that T2DM prevalence will almost double in the next 25 years, and the majority of those affected will be in developing countries (Allender *et al.*, 2010), where rapid economic development, mechanization, and urbanization have led to changed lifestyles characterized by reduced physical activity and increased obesity, two factors implicated as main reasons for the increasing prevalence of T2DM in developing countries (Sicree *et al.*, 2006). According to a recent estimate by the International Diabetes Federation (2013), the South-East Asia region, consisting of India, Sri Lanka, Bangladesh, Bhutan, Mauritius, and the Maldives, has 72 million people, or 8.2% of adults with diabetes. The escalation of diabetes prevalence is creating chronic and sustained health impacts (Ounnapiruk *et al.*, 2014). In this paper, we report descriptive, cross-sectional, quantitative findings from the first part of a unique ethnographic study on diabetes in Sri Lanka. Various cultural aspects of diabetes in Sri Lanka have not been studied before using ethnography, nor has poor compliance to dietary advice, exercise, and medication-taking behavior.

Literature Review

T2DM is a metabolic condition characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both (American Diabetes Association [ADA], 2012). The management goal for patients with T2DM is to control their glycemic levels to normal or near normal levels (fasting blood glucose levels [FBS]: < 126 mg/dL [6.99 mmol/L] or glycosylated hemoglobin [HbA1c]: < 6.5% [53 mmol/mol]) (ADA, 2012). A number of studies have shown that diet control and regular physical exercise are the main behavioral changes required to achieve acceptable glycemic levels (ADA, 2012). In addition, adherence to a recommended medication regimen has also been identified as important in successfully controlling and maintaining appropriate glycemic levels (ADA, 2012). If good glycemic control can be achieved and maintained, it can reduce or delay the incidence of complications among adults with T2DM (ADA, 2012). Uncontrolled glycemic levels can cause a number of complications and socioeconomic consequences that might negatively affect the individual and their family,

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society, and healthcare systems. Uncontrolled glycemic levels significantly increase the risk of developing chronic macro-vascular complications, such as coronary heart disease and stroke, and micro-vascular complications, such as retinopathy, nephropathy, diabetes neuropathy, and diabetic foot disease (Hawthorne *et al.*, 2008). All these complications contribute to the high morbidity and mortality associated with T2DM (ADA, 2012).

The socioeconomic consequences of T2DM for individuals are many, (Ounnapiruk *et al.*, 2014), including the cost of medical care, inability to do daily jobs or lost dependence to perform activities of daily living, resulting in reduced quality of life. Additionally, such individuals need to adopt many strategies to control their blood glucose levels, including family support, which might be an additional burden for a family. The consequences of T2DM affect not only the individual and the family, but also the healthcare system, which might be burdened by spiraling costs and an increased need for care. A country is also burdened by the loss of productivity of an adult by death or disability, and costs of diabetes care are high and increasing worldwide (Ramachandran *et al.*, 2012). Therefore, glycemic control among adults with T2DM is important in order to reduce the costs of medical care due to the disease, as well as its subsequent complications.

Diabetes in Sri Lanka

In Sri Lanka, there has been a significantly high prevalence of non-communicable disease over the past few decades (Ministry of Health, 2012), with a national DM prevalence of 10.3% (Jayawardena *et al.*, 2012). Additionally, because health care is free for all in state-funded hospitals, the burden of health costs due to diabetes and its complications has become significantly high.

Poor glycemic control causes an increase in diabetes-related complications, and this was observed among adults with DM in a health area of the western province of Sri Lanka (Pinidiyapathirage *et al.*, 2011). Moreover, 76.1% were found to have suboptimal control of diabetes with a mean fasting glucose level of 190 mg/dL, and retinopathy among 204 adults with T2DM was 19.1% (Rajakumaraswamy *et al.*, 2008). Diabetes-related neuropathy among 528 patients with DM, including diagnosed cases (330 adults) and newly-diagnosed cases (198 adults), was 59.1% and 28.8%, respectively (Katulanda *et al.*, 2012). Nephropathy among 204 adults with T2DM was 78.5% (Rajakumaraswamy *et al.*, 2008). In summary, in Sri Lanka, DM is a severe health problem that needs urgent intervention to prevent or delay the onset of complications and reduce its incidence. However, most previous studies in the country have assessed the prevalence of diabetes and complications of diabetes and poor glycemic control by focusing on the biomedical model of care. We argue that this research approach is too narrow in scope to handle the complex nature of a chronic condition, such as diabetes. Different perspectives are required in order to improve health outcomes (Block, 2006); for example, nurses caring for adults with T2DM in Sri Lanka have a lot to offer in this regard, including undertaking much-needed research.

Therefore, the purpose of this study was to identify the current factors influencing glycemic control and glycemic control behavior among adults with T2DM in Sri Lanka.

METHODS

Design

A descriptive, cross-sectional design was used for this study.

Participants and setting

This study was carried out between January and March 2013 at a large teaching hospital and a primary care unit in Colombo. Tertiary and primary care centers are state provided care for a large number of patients with diabetes in Sri Lanka. The Colombo area was selected, as it has the largest number of patients with diabetes. The principal investigator (PI) instructed clinic nurses of the inclusion criteria for participants, and nurses referred them to the PI. Participant inclusion criteria were: age ≥ 18 years, diagnosed with T2DM > 6 months, had either controlled FBS levels (FBS: ≤ 126 mg/dL) or poor glycemic control (FBS: > 126 mg/dL), received diabetes care from the study sites, and had visited the DM clinic for the first time. A minimum duration of > 6 months of diagnosis was required because the participants needed some time to adapt to diabetes and to practise glycemic control behaviors previously taught by their physician or nurse, as well as time to accept their diagnosis. Patients with severe complications (e.g. stroke, myocardial infarction) and unable to speak Sinhala or English were excluded from the study. We used a convenience sample of all the outpatients who attended the clinic and met the inclusion criteria; there were 230 participants in total.

Data collection

The instrument used was the Diabetes Information Form (DIF), developed by the PI and revised by three Sri Lankan physicians expert in diabetes care. The DIF was pilot tested with 10 adults with T2DM and revised again. The DIF was administered by the PI, who wrote down the answers verbatim. The DIF seeks information on clinic identification (date, setting, clinic number, address) and demographic details (sex, age, ethnicity, religion, marital status, socioeconomic status, educational level, occupation, and average monthly income). There are 12 items regarding diabetes-related information requiring a short answer or yes/no response: duration since diagnosis of T2DM in years, family history of DM, type of medication (categorized as oral hypoglycemic, parenteral insulin, or both, or none of these), regularity of medication use, whether diet control is practised, daily dietary intake (red/brown rice, regular snacks, regular intake of fruits and vegetables), exercise (regularly, occasionally, and no response) and type of exercise (walking, cycling), and the latest values of height, weight, body mass index (BMI), FBS, and post-prandial blood glucose (PPBS), as mentioned in the medical record. Three open-ended questions are used to obtain more information regarding medication adherence,

diet control, and regular exercise: "If you do not take medication properly, what are the reasons?", "If not practising diet control what are the reasons?", and "If not exercising, what are the reasons?".

After informed consent was obtained, the DIF was administered by the PI in private at the diabetic clinics. Participants' height, weight, BMI, FBS, and PPBS were obtained from medical records.

Ethical considerations

Ethics approval was obtained from the relevant ethics committees: in Thailand, the Faculty of Nursing, Chiang Mai University, and in Sri Lanka, the Faculty of Medical Sciences, University of Sri Jayewardenepura, and the ethical clearance committee of the relevant hospital. Potential participants were given an information letter describing the purposes and processes of the study, their rights, and what was expected of them if they decided to participate. Written, informed consent was obtained in Sinhala, their native language. Throughout the study, their privacy, confidentiality, and rights were protected, and participation was entirely voluntary.

Data analysis

Data were analyzed in SPSS 16.0 (SPSS, Chicago, IL, USA) for descriptive statistics, such as frequency distribution, percentages, mean scores, and standard deviation. Demographic data, illness-related data, glycemic control, and glycemic control behaviors were described by using descriptive statistics of frequency and percentage. The χ^2-test was used to compare the association between factors related to glycemic control.

RESULTS

There were more female participants (63.5%) than males (36.5%), as shown in Table 1. The age of all participants ranged between 23 and 89 years of age, with a mean of 54.11 years (standard deviation [SD] = 10.97). Most participants (36.1%) were 50–59 years. More than half (60.2%) were educated to year 10 and above, 32.1% were housewives, and 115 (50%) had a family history of diabetes. More than half (58.7%) had been diagnosed with T2DM for 6–12 months, and most (83.9%) controlled their blood glucose levels using oral hypoglycemic agents. Nearly half (48.3%) had a normal BMI (18.0–24.9). The participants' FBS range was 64–408 mg/dL, with a mean of 175.17 (SD = 69.90); PPBS ranged from 58–765 mg/dL, with a mean of 230.10 (SD: 101.90); 71.3% had an FBS level > 126 mg/dL; and 57% had a PPBS level > 200 mg/dL. The majority of participants (71.7%) practised some dietary control. Eating red rice/brown rice with their three main meals was the most common practise (53%), followed by eating two snacks per day (31.8%), and vegetables and fruit (15.2%). Regarding exercise, the majority (85.2%) did not practise any exercise, while some exercised regularly or occasionally. Walking was the most popular exercise. With regard to medication adherence, > 76.5% reported adhering to their recommended medication regimen.

Table 1. Demographic characteristics of adults with type 2 diabetes mellitus (n = 230)

Demographic characteristics	n (%)
Sex	
Female	146 (63.5)
Male	84 (36.5)
Age (years)	
20–49	75 (32.6)
≥ 50	155 (67.4)
Educational status	
Did not attend school	6 (2.6)
Below grade 5	8 (3.5)
Grade 5–9	77 (33.5)
≥ Standard level (≥ grade 10)	139 (60.4)
Occupational	
Professional	6 (4.3)
Technical & clerical	5 (2.2)
Vendors & sellers	26 (11.1)
Skilled manual workers	38 (16.5)
Unskilled manual workers	38 (16.5)
Retired	29 (12.2)
Unemployed	14 (5.1)
Housewife	74 (32.1)

Table 2. Reasons for not practising glycemic control behaviors

Reasons	n (%)
No diet control	
Difficult to do it with busy lifestyle	35 (53.8)
Have to eat what my family likes to eat	21 (32.3)
Ignore it	9 (13.8)
Not exercising regularly	
No time with busy lifestyle	121 (61.7)
Have other disorders	34 (17.3)
Doing housework is enough exercise	21 (10.7)
Not interested	11 (5.6)
Unaware of need for exercise	9 (4.7)
Not taking medicine regularly	
Missed clinical appointment and/or misplaced doctor's prescription	16 (29.6)
Cannot take medicine with busy lifestyle	20 (37.0)
Take medicine when feeling sick	14 (25.9)
Do not care	4 (7.5)

The participants' reasons for not practising appropriate glycemic control behaviors were as follows: 38.4% of those who did not practise dietary control stated that this was difficult to do in their busy lives, and 32.3% had to eat what their family liked to eat (Table 2). Over half (61.7%) mentioned that they had no time to exercise regularly, 37% said they did not take medicine regularly, and 29.6% had missed clinical appointments and/or misplaced their doctor's prescription.

The χ^2-test was used to compare the difference between glycemic control behavior and glycemic control among participants (Table 3), and the association between factors, such as age, sex, educational status, BMI, and glycemic control

Table 3. Glycemic control among adults with type 2 diabetes mellitus categorized by glycemic control behaviors ($n = 230$)

Behaviors	Glycemic control		χ^2-test	*P*-value
	Controlled	Uncontrolled		
Dietary control				
Yes	50 (30.3%)	115 (69.7%)	0.737	0.391
No	16 (24.6%)	49 (75.4%)		
Exercise				
Yes	9 (26.4%)	25 (73.6%)	2.56	0.277
No	57 (29.0%)	139 (71%)		
Take medication regularly				
Yes	58 (32.9%)	118 (67.1%)	6.64	0.010*
No	9 (16.3%)	45 (83.7%)		

*$P < 0.05$.

Table 4. Glycemic control among adults with type 2 diabetes mellitus, categorized by factors ($n = 230$)

Factors	Glycemic control		χ^2-test	*P*-value
	Controlled	Uncontrolled		
Age (years)				
≤ 55	27 (22.7%)	92 (77.3%)	4.37	0.037*
> 55	39 (35.1%)	72 (64.9%)		
Sex				
Female	41 (28.0%)	105 (72.0%)	0.074	0.786
Male	25 (39.0%)	59 (61.0%)		
Educational status				
≤ grade 10	51 (29.1%)	124 (70.9%)	0.072	0.789
> grade 10	15 (27.2%)	40 (72.8%)		
BMI (kg/m^2)				
≤ 23.0	17 (24.63%)	52 (75.3%)	0.793	0.373
> 23.0	49 (30.4%)	112 (69.6%)		

*$P < 0.05$. BMI, body mass index.

(Table 4). There were statistically-significant associations between medication-taking behavior and glycemic control, and age and glycemic control ($P < 0.05$), but no significant differences between participants with uncontrolled glycemic levels in each age group.

DISCUSSION

This study's findings clearly indicate that the majority of the participants had poor glycemic control. More than half did not exercise, and nearly one-third had no diet control and did not take medication regularly. Results from other investigations have also reported poor glycemic control among adults with T2DM. In Jordan, of 917 adults with T2DM, 65.1% had poor glycemic control, 67.9% did not exercise, and 81.7% did not follow the prescribed meal plan (Khabatt *et al.*, 2010). In Kuwait and Saudi Arabia, 66.7% and 73%, respectively, of the studied populations had not achieved the target glycemic levels, and had suboptimal adherence to diet, exercise, and medication-taking behaviors (Akbar, 2001, Al-Sultan & Al-Zanki, 2005). In the UK, 69% of the study sample did not achieve the target glycemic control level due to poor adherence to diet, exercise, and medications (Fox *et al.*, 2006).

Even though most of our Sri Lankan participants practised some dietary control in this study, their glycemic control was inadequate. In most instances, the dietary advice they adhered to involved using little sugared or sweet-tasting food, a reduction in the quantity of sugar used in a cup of tea or other beverages, and the use of red rice instead of bread or white rice. They had the misconception that eating red/brown rice was the required form of diet control. Most Sri Lankans are used to eating a large portion of rice with smaller portions of food containing high fiber (e.g. vegetables). Dietary advice is routinely given to every patient at the diabetic clinics regarding reduction of carbohydrates, increasing fiber, and reducing fat intake. However, this study revealed that their adherence to the above advice was poor, and resulted in poor glycemic control. Many South–East Asian people with diabetes also have misconceptions about their diet (Rais, 2010); for instance, many believe that only table sugar and sweets will affect their blood glucose levels and so they avoid them, whereas complex carbohydrates, such as rice, which do not

taste sweet, are not thought to be problematic. In Taiwan, reducing highly-sugared food was the main dietary control among adults with T2DM (Lai *et al.*, 2005). The findings of this study highlight the need to address deficits or misconceptions within dietary education.

The findings also revealed that 32.3% of the participants had to eat what their family liked to eat, thus undertaking dietary control was not an easy task when there was a lack of family support. A qualitative study among 37 adults with T2DM also found that some participants could not adhere to a diabetic diet because they lacked family support (Carbone *et al.*, 2007), while Wen *et al.* (2005) found that family support affected physical-activity behaviors. Family and peer support promotes medication adherence and exercise behaviors among adults with T2DM (Chlebowy *et al.*, 2010). As family members' non-supportive behaviors have been associated with lower adherences to medication, health interventions should inform family members about DM and enhance their motivation to facilitate compliance to medication behaviors of patients with T2DM (Mayberry & Osborn, 2012).

In this study, one-third of the participants did not take their medicine as recommended, and they did not have the time to balance the medication intake times with meal times due to their "busy lifestyles". A busy lifestyle has been identified as a barrier to regularly taking prescribed medication (Daly *et al.*, 2009). Our findings highlight the need to improve the knowledge of people with diabetes about the importance of taking diabetes medication on time and in correct doses, as well as to explore ways to motivate them to do so. The majority of the participants did not exercise, and the reasons given included lack of time and having other health conditions. For those who did exercise, walking was common. Most perceived that doing a job or housework was adequate as their physical exercise, and this has been supported by evidence from another study about adults with T2DM (Mier *et al.*, 2007). It has been previously found that having neuropathy and cognitive impairment are barriers to regular physical activity (Hasseler *et al.*, 2011). Furthermore, a systematic review demonstrated that lack of time was a main barrier for individuals with diabetes to engage in regular physical activities (Korkiakangas *et al.*, 2009).

There was a significant association between age and glycemic control ($P < 0.05$) among the participants. This could be due to the fact that adults aged > 55 years are mostly retired and might have more time to practise prescribed behaviors to achieve target glycemic levels. Other studies have also reported a significant association between BMI, educational status, and glycemic control (Khabatt *et al.*, 2010, Xu *et al.*, 2010; Ahmad *et al.*, 2011). These findings were not consistent with those of this study, where BMI and educational levels were high in the majority of participants, although the glycemic control levels were poor. According to diabetes-related scientific literature, diet control, as well as taking prescribed medicine, is essential to attain glycemic control (ADA, 2012).

Our findings also revealed a statistically-significant difference between medication-taking behavior and glycemic control ($P < 0.05$). This was similar to a study where participants were more likely to follow regular medication as prescribed; most had lower HbA1c levels, but were less likely to adhere to exercise behavior (Daly *et al.*, 2009). This result is consistent with other studies, where the majority of participants were likely to take the prescribed diabetes medication without doing exercise (Xu *et al.*, 2010, Khabatt *et al.*, 2010). It could be that adults with T2DM find it easier to follow recommended medication regimens than exercising.

Limitations

This study had some limitations in the assessment of glycemic control, in that FBS and PPBS were done in different laboratories. In Sri Lanka, such testing might not have uniform standards. Other limitations in this study were that the convenience sampling might have produced a biased sample; the study was conducted in just one teaching hospital and a primary care center in the Colombo district/western province, and there is reduced ability to generalize findings to other settings in the country. A longitudinal study utilizing the questionnaire at various time points might have provided more reliable data.

Conclusions and implications for practice

The findings outlined that the majority of adults with T2DM in this study did not achieve desired glycemic control. This points to an urgent need to provide improved health education in Sri Lanka to reduce the complications associated with uncontrolled glycemia, and which involves appropriate diet control, adoption of regular exercise regimen, adherence to medication, and how a person's health behaviors affect glycemic control. Nurses and doctors in Sri Lanka need to better understand the glycemic control behaviors of their patients with T2DM, so that such health education is given in a relevant and culturally-appropriate way to improve patients' adherence behaviors, health, and well-being. A future paper will explain how the above findings were used in the second phase of the larger ethnographic study to explore in-depth the cultural values, beliefs, and glycemic control behaviors from the perspectives of the participants and significant others involved in their care.

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CONTRIBUTIONS

Study Design: TA, FW, CC, SW, ST.
Data Collection and Analysis: TA, FW, SW, ST, CC.
Manuscript Writing: TA, FW, ST, SW, CC.

REFERENCES

Ahmad B, Khalid B, Zani A, Hussain N, Quek K. Influencing factors of glycemic control in patients attending different types of urban health care settings in Malaysia. *Diabetes Clin. Pract.* 2011; **93**: e12–e14.

Akbar DH. Low rates of diabetes patients reaching good control targets. *East. Mediterr. Health J.* 2001; **4**: 671–678.

Allender S, Lacey B, Webster P *et al.* Level of urbanization and non-communicable disease risk factors in Tamil Nadu, India. *Bull. World Health Organ.* 2010; **88**: 297–304.

Al-Sultan FA, Al-Zanki N. Clinical epidemiology of Type 2 diabetes mellitus in Kuwait. *Kuwait Med. J.* 2005; **37**: 98–104.

American Diabetes Association. Standards of medical care in diabetes – 2012. *Diabetes Care* 2012; **35**: S11–S61.

Block DJ. *Healthcare Outcomes Management: Strategies for Planning and Evaluation.* London: Jones and Bartlett Publishers, 2006.

Carbone ET, Rosal MC, Torres MI, Goins KV, Bermudez OI. Diabetes self-management: perspectives of Latino patients and their health care providers. *Patient Educ. Couns.* 2007; **66**: 202–210.

Chlebowy D, Hood S, La Joie A. Facilitators and barriers to self-management of type 2 diabetes among urban African American adults: focus group findings. *Diabetes Educ.* 2010; **36**: 897–904.

Daly JM, Hartz AJ, Xu Y *et al.* An assessment of attitudes, behaviors, and outcomes of patients with type 2 diabetes. *J. Am. Board Fam. Med.* 2009; **22**: 280–290.

Fox KM, Gerber RA, Bolinder B, Chen J, Kumara S. Prevalence of inadequate glycemic control among patients with type 2 diabetes in the United Kingdom general practice research data base: a series of retrospective analysis of data from 1998 through 2002. *Clin. Ther.* 2006; **28**: 388–395.

Hasseler MK, Heide M, Indefrey S. Resources for and barriers to effective diabetes care management-experiences and perspectives of people with type 2 diabetes. *J. Public Health* 2011; **19**: 65–71.

Hawthorne K, Robles Y, Cannings JR, Edwards AG. Culturally appropriate health education for type 2 diabetes in ethnic minority groups: a systematic and narrative review of randomized controlled trials. *Diabet. Med.* 2008; **27**: 613–632.

International Diabetes Federation. *International Diabetes Federation; Diabetes Atlas* (6th edn). Belgium: International Diabetes Federation, 2013. [Cited 3 Jan 2014.] Available from URL: http://www.idf.org/sites/default/files/EN_6E_Atlas_Full_0.pdf.

Jayawardena R, Ranasinghe P, Byrne NM, Soares MJ, Katulanda P, Hills AP. Prevalence and trends of the diabetes epidemic in South Asia: a systematic review and meta-analysis. *BMC Public Health* 2012; **12**: 380. [Cited 12 Dec 2013.] Available from URL: http://www.biomedcentral.com/1471-2458/12/380.

Katulanda P, Ranasinghe P, Jayawardena R, Constantine GR, Sheriff MH, Matthews DR. The prevalence, patterns and predictors of diabetic peripheral neuropathy in a developing country. *Diabetol. Metab. Syndr.* 2012; **4**: 1–8.

Khabatt M, Khader YS, Al-Khawaldeh A, Ajlouni K. Factors associated with poor glycemic control among adults with type 2 diabetes. *J. Diab. Comp.* 2010; **24**: 84–89.

Korkiakangas EE, Alahuhta MA, Laitinen JH. Barriers to regular exercise among adults at high risk or diagnosed with type 2 diabetes: a systematic review. *Health Promot. Int.* 2009; **24**: 416–426.

Lai WA, Lew-Ting CY, Chiet C. How diabetic patients think about and manage their illness in Taiwan. *Diabet Med.* 2005; **22**: 286–292.

Mayberry LS, Osborn CY. Family support, medication adherence and glycemic control among adults with type 2 diabetes. *Diabetes Care* 2012; **35**: 1239–1245.

Mier N, Medina AA, Ory MG. Mexican Americans with type 2 diabetes: perspectives on definitions, motivators, and programs of physical activity. *Preventing Chronic Dis. Public Health Res., Pract. Policy* 2007; **4**: 1–7.

Ministry of Health. *Annual Health Bulletin.* Colombo: Ministry of Health, 2012.

Ounnapiruk L, Wirojratana V, Meehatchai N, Turale S. Effectiveness of a behavior modification program for older people with uncontrolled Type 2 Diabetes. *Nurs. Health Sci.* 2014; **16**: 216–223.

Pinidiyapathirage M, Warnakulasuriya T, Kasturiratne K *et al.* Comparison of urban diabetics with optimal and suboptimal control. *J. Epidemiol. Community Health* 2011; **65** (Suppl. 1): A312.

Rais A. *Is It Really God's Will?* London: Diabetes UK, 2010. [Cited 30 Nov 2013.] Available from URL: http://www.diabetes.org.uk/How_we_help/Magazines/Balance/Past-issues/Archived-issues-and-articles/JulyAugust-2010/Is-it-really-Gods-will/.

Rajakumaraswamy N, Rajapakse I, Fernando DS. The frequency of cognitive dysfunction in elderly Sri Lankans with type 2 diabetes mellitus. *Int. J. Geriatr. Psychiatry* 2008; **23**: 1205–1206.

Ramachandran A, Senehelatha C, Shettty A, Nanditha N. Trends in prevalence of diabetes in Asian countries. *World J. Diabetes* 2012; **15**: 110–117.

International Diabetes Federation. Diabetes IDF Diabetes Atlas, 6th edn. 2013. [Cited 3 Dec 2013.] Available from URL: http://www.idf.org/sites/default/files/EN_6E_Atlas_Full_0.pdf.

Sicree R, Shaw, J, Zimmet P. Diabetes and Impaired glucose tolerance. In D. Gan (ed.), *Diabetes atlas (3rd ed.)*. Belgium: International Diabetes Federation, 2006; 15–103.

Wen L, Shepherd M, Parchman M. Family support, diet and exercise among older Mexican Americans with type 2 diabetes. *Diabetes Educ.* 2005; **30**: 980–993.

Xu Y, Pan W, Liu H. Self-management of Chinese Americans with type 2 diabetes. *Nurs. Health Sci.* 2010; **12**: 228–234.