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DIABETES MELLITUS COMPLICATIONS AMONG SRI LANKAN ADULTS ADMITTED TO TWO GOVERNMENT HOSPITALS : A CROSS SECTIONAL STUDY

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ABSTRACT

This study identified significant numbers of diabetic patients diagnosed with Diabetes Mellitus visiting diabetic clinics in selected hospitals in the east province of Sri Lanka; and identified complications and co-morbidities of their Diabetes Mellitus. A descriptive cross sectional study design used convenient sampling technique. A total of 200 patients were conveniently selected as respondents for the self administered questionnaire. The overall data across two sections indicate that the evidence of Type 11 Diabetes Mellitus was 51.42% since the 48.6% were co-morbidities. The identified co-morbidities were type 1 diabetic wound having 143 (71.5%) patients, 120 (60.0%) visual impairment, 144 (72.0%) hypertension, 38 (19.0%) renal impairment, 30 (15.0%) recurrent infection, and 36 (18.0%) cardiac diseases. Of the 200 patients, 30.70% (n=149) had acquired complications of Diabetes Mellitus. Out of the 149 patients with Diabetes Mellitus complications, 108 (54%) patients were identified with diabetic wound, 87 (43.5%) with hypertension, 112 (56%) with visual complications, 66 (33%) with hyperlipidemia, 45 (22.5%) with renal impairment, 23 (11.5%) with recurrent infection; while cardiac disease, hypoglycemia, hyperglycemia are complications identified from the 36 (18.0%), 44 (22.0%), and 83 (41.5%) respondents respectively.

Keywords: Diabetes Mellitus, Cross-sectional study, Diabetes complication, Medical nursing, Sri Lanka

INTRODUCTION

(A) Background

One in five adults have either diabetes or pre-diabetes and one-third of those with diabetes are undiagnosed in Sri Lanka (Katulanda *et al.*, 2008; Wanninayaka, 2015; Smith, 2010). According to Health Ministry of Sri Lanka, 10.2% of the total population suffers from diabetes (Jayasekera, 2013).

Diabetes can adversely affect almost every organ in the body - from brain cells to liver (O'Sullivan *et al.*, 2009). Katulanda *et al.*, (2008) gauged complications of adult Sri Lankans who had diabetes (of all types) and pre-diabetes. Katulanda *et al.*, (2008) said that diabetes is reaching epidemic proportions in Sri Lanka with three persons dying of its complications every day. In the 1990s the number of daily hospitalizations in Sri Lanka was due to diabetes related complications from 500 to 550, but today, the figure has almost doubled (Katulanda *et al.*, 2008; Wanninayaka, 2015).

There has been a rapid increase in the number of diabetic patients in Sri Lanka during the past 20 years (Katulanda *et al.*, 2008). The available statistics and the current trend is going to be up to 50% of Sri Lanka's population who will eventually suffer from diabetes by the year 2050 (Jayasekera, 2013). At present, 10% to 15% of school children also suffer from diabetes and noted that annually around 700 persons have their limbs amputated, with around 100 such amputations carried out at the Colombo National Hospital alone (Katulanda *et al.*, 2008).

(B) Objectives of the study

On account of these issues, it is hoped to:

1. Identify patients diagnosed with Diabetes Mellitus.
2. Identify their complications and co-morbidities.

(C) Variables

The causative variables are Diabetes Mellitus among

adults while the effect variable is its complications.

(D) Hypotheses

There are significant evidences of diagnosed Diabetes Mellitus among adults leading to complications among Sri Lankans.

(E) Scope and limitations

Only Ashraff Memorial hospital and the district of hospital Karaitivu were the hospitals used since it is open for research observation once a week. It took time to collect data from patients due to the increased number of admitted diabetes patients and limited clinic days. Only patients admitted from April to October 2016 were enrolled. Age and gender was not delimited however; it was limited only to those who can understand English. Sinhala speaking patients were eliminated due to language barriers, which is why consent forms used, are in the English language. Most of the respondents (n=150) enrolled from *Ashraff Memorial* were Muslim patients while enrolled respondents with different cultures and religious affiliations were from *Karaitivu district hospital's* clinic (n=150). A total of n=100 respondents did not pursue with answering the self administered questionnaire leaving n=200 respondents only.

LITERATURE REVIEW

(A) Keywords used on search engines were "Wide spread of diabetic complication"; "adult DMs" and "adult diabetic patients". The review will be divided into themes – diabetic complications and co-morbidities of diabetes mellitus.

(B) Diabetic Complications

A study done by William *et al.*, (2010) on "Wide spread of diabetic complication among adult community members" in four provinces was found having a serious wide spread of diabetic complication of diabetes among adult community. William *et al.*, (2010) found complications of diabetes, having 30.2% of the 3,050 populations were hypertension, hypoglycemia, hyperlipidemia and high blood pressure.

A study done on "Wide spread of diabetic complication among adult patients in a Tertiary Care Hospital" in India shows significant evidence of diabetic complication scores were female gender (Mizra *et al.*, 2009). Only 46.5% respondents said that

diabetes complications are preventable and only 28.7% were aware of the causes of diabetes complications such as renal impairment and recurrent infection (Mizra *et al.*, 2009).

Diabetes is the most common cause of non-traumatic lower limb amputations due to complications such as diabetic wounds (Moodley, 2007). However, Moodley (2007) added that only 57.4% of the patients' feet are affected in diabetes making is preventable.

The most common cause of death amongst diabetics is cardiovascular disease (Heisler *et al.*, 2005). However, Heisler *et al.*, (2005) said that only 64.4% of the subjects knew that diabetes affects the heart as a complication.

Diabetes is also a leading cause of end-stage renal disease (Fitzgerald *et al.*, 1998). In the present study, 26.7% of the patients did not know that diabetes affects the kidneys in this study; only 51.5% patients actually knew the symptoms of hypoglycemia (Fitzgerald *et al.*, 1998).

Katulanda *et al.*, (2008) stated that the Western Province of Sri Lanka had the highest rates of incidence of diabetes complications while the Uva Province had the lowest. Also the relatively low incidence of type 1, insulin dependent diabetes (4.4% in Sri Lanka) was mostly women (10.9%) than men (9.8%) .

(C) Co-morbidities of Diabetes Mellitus

The co-morbidities of Diabetes Mellitus are cerebrovascular strokes, cardiovascular diseases, renal shutdown, renal impairment, renal failure, blood dyscrasias and cancer (William *et al.*, 2010).

Diabetes is no longer perceived as a western killer disease; instead its prevalence in Asia has begun to outstrip that of western countries causing a lot of co-morbidities (Katulanda *et al.*, 2008). It is estimated that nearly 80% of the global population with diabetes live in both undeveloped and developing countries (O'Sullivan *et al.*, 2009). This makes Sri Lanka particularly vulnerable as our population expands and begins to adopt a more urban lifestyle (Wanninayaka, 2015).

Co-morbidities for Diabetes Mellitus' are mostly found among the southern Asians (Mizra *et al.*, 2009). Since co-morbidities of Diabetes Mellitus are a life-long problems for southern Asians race the quality of

individual life can be improved if managed properly with respect to culture (Michel *et al*., 2008). Optimum management of the co-morbidities of Diabetes Mellitus requires an individual to be aware of the nature and consequence of the disease, its risk factors, dimensions of treatment and its co-morbidities (Michel *et al*., 2008).

Fifty percent or more of the people with co-morbidities of diabetes die of cardio vascular disease, heart and strokes (O'Sullivan *et al*., 2009; Fitzgerald *et al*., 1998). Globally diabetes is responsible for over 1 million amputations each year (Moodley, 2007). Around 2.5 million each year, or 20% of people with co-morbidities of diabetes die of renal failure (Heisler *et al*., 2005). On average, people with co-morbidities of

METHODOLOGY

(A) Study design: Quantitative cross sectional observational study.

(B) Study area: The Ashraff Memorial hospital and the district of hospital Karaitivu were selected found on the eastern part of Sri Lanka.

(C) Study population: 200 Diabetic patients who are attending the diabetic clinics at above mentioned hospitals. Only patients who can read in English were selected.

(D) Sampling technique: Convenience sampling techniques were used to select the 200 study populations.

(E) Sample size: The breakdown of the 200 diabetic patients (50 samples from District Hospital, Karaitivu and 150 samples from Ashraff Memorial Hospital, Kalmunai). The calculations used to get the population is

Σ - Sum of all the values

μ - Mean (Average)

σ - Standard deviation

n - Population

x - Total

$$\sigma = \sqrt{\frac{\Sigma\ (x-\mu)}{n}}$$

(F) Study instruments:
Self-administered questionnaire was used.

(G) Data collection procedures:
Six month from April 2016 – October 2016

Questionnaire was given on the spot and immediately retrieved after subjects answered completely.

(H) Data analysis:

Data recorded and entered into statistical software SPSS version 21 before analysis. The confidence was set at 95% with margin of error at 5%. Central tendencies used percentile ranking and frequencies of the population. Mean and standard deviations were used in order to analyze the saturation of the variables.

(I) Ethical consideration

The ethical clearance obtained from the Ethical Review Committee, Lincoln University College. The permission obtained from the head of the institutions and relevant consultants and staff from Ashraff Memorial Hospital and District Hospital, Karaitivu & approval was given by the Ministry of Health. Consent was taken from patients. It was also explained that, they were free to withdraw from this study at any time, and it will not affect their treatment or care anyway. Data collected from the patients were kept confidentially.

RESULTS

Table 1 is the distribution of the study populations' demography.

This study included 200 Diabetes Mellitus patients. Out of 200 patients 117 (58.5%) patients were below 51 – 60 age groups, 176 (88.0%) were married, 175 (87.5%) were Muslims, 22 (11.0%) were Hindu, 2 (1%) Buddhist, 1 (0.5%) Christian and 121 (60.5%) were low in education level.

Table 1: Demographic Distribution

Demography	%	n
Age		
< 50 years	38.5	77
50 – 60 years	58.5	117
> 60years	3.0	6
Civil status		
Ma rried	88	176
Single	12	24
Occupation		
Self	57	114
Government servant	13.0	26
Private	30	60

Demography	%	n
Religion		
Buddhist	1.0	2
Hindu	11.0	22
Islam	87.5	175
Christian	0.5	1
Education level		
< grade 5	60.5	121
Grade 6 – 10	18.0	36
O/L	8.5	17
A/L	7.0	14
Diploma/Degree/Graduation	6.0	12

Table 2 identified Diabetes Mellitus cases. In our sample, more than half (53%) patients with short term history (<5 years), 49 (24.5%) patients had more than 10 year history of Diabetes Mellitus. One hundred and seventy six (88.0%) patients initially treated with oral hypoglycemic drugs, 131 (65.5%) patients treated with diet control and exercise and 33 (16.5%) patients initially treated with Insulin therapy.

About 124 (62.0%) patients had knowledge of every type of diabetes, they knew there are types in diabetes, but they did not know about each types of diabetes. Out of this 124 (62.0%), 97 (48.5%) patients were had knowledge on type II Diabetes.

About 180 (90.0%) patients had knowledge on any one of the control method. Within the 180 (90.0%), 166 (83.0%) patients knew diet control method, 167 (83.5%) patients knew diet control and drugs treatment method, 54 (27%) patients knew exercise is also one of the control method with other treatment. Only 5 (2.5%) patients explained the Ayurvedic control methods of Diabetes Mellitus.

With reference to the 172 (86%) patients were identified on even one hyperglycemic symptom. Within this 172 (86%), 24 (12.0%) and 88 (44.0%) patients were aware of the symptoms of Diabetes Mellitus and 60 (30.0%) patients were highly knowledgeable of their disease.

About 186 (93%) patients were identified to have hypoglycemic symptom. Within this 186 (93%), 32

(16.0%) patients knew 1 symptom, 65 (32.5%) patients knew 2 symptoms and 89 (44.5%) patients knew 3 symptoms.

Table 2: Diabetes Mellitus cases

Variables		N (Percentage)
Duration of DM		
< 5years		106 (53.0)
5 – 10 years		45(22.5)
>10 years		49(24.5)
First treatment of diagnosed DM		
Insulin		33(16.5)
Oral drugs		176 (88.0)
Diet control &exercise		131 (65.5)
No treatment		2 (1.0)
Family history of DM		
Present		127 (63.5)
Father		27(13.5)
Mother		50(25.0)
Brothers/Sisters		69(34.5)
Others relatives		8 (4.0)
Not present		73(36. 5)
DM Type		
Known		124 (62.0)
Type I		29(14.5)
Type II		97(48.5)
Other type		9 (4.5)
Not known		76(38.0)
Control method		
Known		180 (90.0)
Diet		166 (83.0)
Drugs and Insulin		167 (83.5)
Exercise		54(27.0)
Other method		5 (2.5)
Not known		20(10.0)
Hypoglycemic symptoms		
Known	1 symptom	24(12.0)
	2 symptom	88(44.0)
	3 symptom	60(30.0)
Unaware		28(14.0)
Hyperglycemic symptoms		
Known	1 symptom	32(16.0)
	2 symptom	65(32.5)
	3 symptom	89(44.5)
Unaware		14(7.0)

DM- Diabetes Mellitus

Table 3: Complications of Diabetes Mellitus

Effect Variables	N	%
Complication		
Yes	149	(74.5)
Diabetic wound	108	(54.0)
High blood pressure	87	(43.5)
Vision problem	112	(56.0)
Hyperlipidemia	66	(33.0)
Renal impairment	45	(22.5)
Recurrent infection	23	(11.5)
Cardiac disease	36	(18.0)
Hypoglycemia	44	(22.0)
Hyperglycemia	83	(41.5)
Other disease	7	(3.5)
Not sure	38	(19.0)
No	13	(6.5)
History of complications		
Present	175	(87.5)
Heart disease	45	(22.5)
Diabetic wound	53	(26.5)
Renal impairment	5	(2.5)
Recurrent infection	14	(7.0)
Sensory organ problems	83	(41.5)
High blood pressure	124	(62.0)
Other problems	18	(9.0)
Not present	25	(12.5)

DM- Diabetes Mellitus

Table 4: Co-morbidities of Diabetes Mellitus

Variables	No (Percentage)
Diabetic wound	
Known	143 (71.5)
Not Known	57 (28.5)
Vision problem	
Known	120 (60.0)
Not Known	80 (40.0)
Hypertens ion	
Known	144 (72.0)
Not Known	76 (38.0)
Hyperlipidemia	
Known	105 (52.5)
Not Known	95 (47.5)
Renal impairment	
Known	38 (19.0)
Not Known	162 (81.0)
Recurrent infection	
Known	30 (15.0)
Not Known	170 (85.0)
Cardiac disease	
Known	36 (18.0)
Not Kn own	164 (82.0)
Hypoglycemia	
Known	135 (67.5)
Not Known	65 (32.5)
Hyperglycemia	
Known	133 (66.5)
Not Known	67 (33.5)

Table 3 describes the evidence on complication of Diabetes Mellitus. Investigate on the significant evidence of complication of diabetes mellitus in our 200 patients, 149 (74.5%) patients had identify that, diabetes will cause any problem. Within the 149 patients, 108 (54%) patients were identified of diabetic wound, 87 (43.5%) with hypertension, 112 (56%) patient with visual complications, 66 (33%) patients had hyperlipidemia, 45 (22.5%) patients had renal impairment, 23 (11.5%) patients had recurrent infection. Cardiac disease, Hypoglycemia, Hyperglycemia are complications stated by 36 (18.0%), 44 (22.0%), and 83 (41.5%) patients respectively. Seven (3.5%) patients explained other complications.

Within the 200 patients 175 (87.5%) patients has at least one of the complication mentioned above. Details are as follows, 124 (62%) patients had Hypertension, and 83 (41.5%) patients were with visual impairment, 53 (26.5%) patients had experienced wounds, 46 (22.5%) patients have heart diseases, and small amount of patients had renal impairment, recurrent infection and other complications.

According to table 4, 143 (71.5%) patients were identified with diabetic wound, 120 (60.0%) patients have vision problem. And also 144 (72.0%), 105 (52.5%), 38 (19.0%), 30 (15.0%), 36 (18.0%), 135 (67.5%), and 135 (67.5%) patients were identified with Hypertension, Hyperlipidemia, Renal impairment, recurrent infection, Cardiac disease, Hypoglycemia, and Hyperglycemia respectively.

Diabetes Mellitus complications by age was identified in table 5 with patients having foot ulcer prevention mean percentage was 33.71%, vision problem prevention having 42.25%, mean hypertension prevention evidence was 43.75%, mean hyperlipidaemia prevention was 27.00%, mean renal problem prevention evidence was 9.33%, mean recurrent infection prevention

evidence was 8.00%, mean heart disease prevention evidence was 9.00%, mean hyperglycemia prevention evidence was 33.00%, and mean hypoglycemia prevention evidence was 29.00%.

Table 5: Diabetes Mellitus complications by age

Complication	N (Percentage)			Mean
	40-50 years	50-75 years	> 75 years	%
Foot ulcer	144 (72.0)	42(21.0)	14(7.0)	33.71
Vision problem	82 (41.0)	67(33.5)	51(25.5)	42.25
Hypertension	78(39.0)	69(34.5)	53(26.5)	43.75
Hyperlipidemia	156 (78.0)	27(13.5)	17(8.5)	27.00
Renal impairment	184 (92.0)	11(5.5)	5 (2.5)	9.33
Recurrent infection	184 (92.0)	9 (4.5)	7 (3.5)	8.00
Cardiac disease	185 (92.5)	11(5.5)	4 (2.0)	9.00
Hyperglycemia	139 (69.5)	42(21.0)	19(9.5)	33.00
Hypoglycemia	125 (62.5)	73(36.5)	2(1.0)	29.00

Chi-square = 920.003, df = 585, p < 0.001 between age and diabetes mellitus
Chi-square = 493.251, df = 405, p = 0.002 between complications and diabetes mellitus

There was a significant association between age and Diabetes Mellitus evidence (Chi-square = 920.003, $df = 585$, $p < 0.001$). There was very strong evidence of a relationship between age and Diabetes, and also there was a strong significant association between education level and diabetes evidence (Chi- Square = 91.189, $df = 52$, $p = 0.001$).

There was a significant association between complication evidence and Diabetes Mellitus (Chi-square = 493.251, $df = 405$, $p = 0.002$), and also there was a strong significant association between education level and complication evidence of diabetes mellitus (Chi- Square = 102.134, $df = 36$, $p < 0.001$).

DISCUSSION

The 200 patient-respondents admitted to Ashraff Memorial hospital and Karaitivu District Hospital in the Eastern part of Sri Lanka usually had a lot of Diabetes Mellitus complications but the respondents only selected a few problems which they want this research to publish. Blood tests, blood pressure monitoring, and other investigations found on their records were used to validate the answers of the respondents. Handouts, leaflets, books, audio, video, visual aids were used to explain further the terminologies that the patients were not familiar with. Most of the respondents fail to obtain the basic knowledge to have clearly understood their diseases and its complications. This resulted in a questionable outcome of the findings; however, the strength of this study method is the availability of physician diagnosis found on the respondents' charts.

With regards to the method of this research, some patients answered the questionnaires and withdrawn from middle of the session without communication (n=100). It was difficult to explain the questionnaire and give more information of the terminologies used, which is why we ended up in 200 total patient respondents only. It was also difficult to manage the time to spend with the respondents. Nevertheless, 200 populations is the strength of this design. Having a cross sectional study design is also appropriate to identify the prevalence.

With regards to the findings and results, the overall identified diabetes mellitus cases were 99% accurate. Reasons for the above score were due to the respondents' perception and awareness of diabetes and their diagnosis from their hospitals' records. Looking back at the findings of the study, 124 (62.0%) patients have hypertension as their perceived current problem. There were also some questionable results where 53.5% of the patients reported that cardiovascular disease was their perceived potential complication of diabetes mellitus. Despite of difficulties of validating the respondents' self reported perceived answers, the researchers were able to countercheck the patients' records giving 99% reliable results.

CONCLUSION

(A) Summary

The overall data across the two sections (Ashraff Memorial hospital and Karaitivu District Hospital) indicate that evidence of Diabetes Mellitus was 51.42% obtained from the patients. In details 85 (42.5%) patients had below 50% probability, 104 (52%) patients had 50-75% and only 11 (22%) patients had more than 75% probable of evidences of Diabetes Mellitus in the eastern province of Sri Lanka.

Table 6: Summary of the identified Diabetes Mellitus

Total 51.42%	No (Percentage)
Probable evidences	
< 50 %	85(42.5)
50 % – 75%	104(52.0)
> 75%	11(5.5)

Confidence at 95%, df = 52, p = 0.01

Complication evidence was identified to be 30.70% in total. In details 171 (85.5%) patients had below 50% probability, 18 (9%) patients had 50%-75% probable evidence of complications and only 11 (5.50%) patients had more than 75% probable complication evidence of diabetes mellitus.

Table 7: Total % of DM Complication

Total 30.70%	No (Percentage)
Probable evidences	
< 50 %	171(85.5)
50 % –75%	18 (9.0)
> 75%	11 (5.5)

Confidence at 95%, df = 36, p < 0.001

There are significant evidences of diagnosed Diabetes Mellitus among adults leading to complications admitted to a government hospital in the eastern part of Sri Lanka.

(B) RECOMMENDATIONS

Diabetes mellitus, if untreated, may cause life-threatening complications (Gulabani *et al*., 2008). Awareness programs and dissemination of informations can help people assess the risk of diabetes (Hoque *et al*., 2009). In addition, it is important to motivate diabetic patients to seek proper treatment and care, and inspire them to take charge of their disease (Duckworth *et al*.,

2009). It is therefore in the interest of Sri Lanka to design and develop a comprehensive health promotion strategy for diabetes mellitus and its related risk factors. It is equally important to design and implement suitable diagnostic, management and treatment protocols for the people with diabetes (Duckworth *et al.*, 2009; Maina *et al*., 2010).

Sri Lanka should pose a major adults health challenge among diabetic patients. Adults with diabetes are at an increased risk for many serious health conditions, including high blood pressure, vision problem, high lipidemia, renal impairment, recurrent infection, cardiac disease, hypoglycemia, and hyperglycemia (Duckworth *et al*., 2009). Adults with diabetes also may experience social stigmatization and discrimination, as well as psychological problems therefore must join support groups that involve relaxation therapy and psychological counselling to limit depression episodes (Smith, 2010).

This study confirms that patient evidence about the disease, treatment, and complications of diabetes is limited, especially with regard to preventive aspects. There is a definite need to empower patients with the evidence required to help them obtain maximum benefit from their treatment for diabetes.

REFERENCES

Duckworth, W., Abraira, C., Moritz, T., Reda, D., Emanuele, N., Reaven, P. D., Zieve, F. J., Marks, J., Davis, S. N., Hayward, R., Warren, S. R., Goldman, S., McCarren, M., Vitek, M. E., Henderson, W. G. & Huang, G. D. (2009). Glucose Control and Vascular Complications in Veterans with Type 2 Diabetes. *The New England Journal of Medicine*, 360(2), pp 29-139.

Fitgerald, J. T., Funnell, M. M., Hess, G. E., Barr, P. A, Anderson, R. M., Hiss, R. G. & Davis, W. K. (1998). The reliability and validity of a brief diabetes knowledge test. *Diabetes Care*, 21(5), pp 706–10.

Gulabani, M., John, M. & Isaac, R. (2008). Knowledge of Diabetes, its Treatment and Complications amongst Diabetic Patients in a Tertiary Care Hospital. *Indian Journal of Community Medicine*, 33(3), pp 204-206.

Heisler, M., Pietee, J. D., Spencer, M., Kieffer, E. & Vijan, S. (2005). The relationship between knowledge of recent HbA1c values and diabetes care understanding and self-management. *Diabetes Care*, 28(4), pp 816–822.

Hoque, M. H., Islam, M. S., Khan, M. A. M. & Ahasan, H. N. (2009). Knowledge of diabetic complications in a diabetic population. *Journal of Medicine*, 10(2), pp 90-93.

Jayasekera, S. A. (2013). Health Ministry to control use of sugar. Daily Mirror. Retrieved from: http://www.dailymirror.lk/news/25026-health-ministry-to-ensure-caa-set-standards-enforced.html

Katulanda, P., Constantine, G. R., Mahesh, J. G., Sheriff, R., Seneviratne, R. D., Wijeratne, S., Wijesuriya, M.,

McCarthy, M. I., Adler, A. I. & Matthews, D. R. (2008). Prevalence and projections of diabetes and pre-diabetes in adults in Sri Lanka. Sri Lanka Diabetes, Cardiovascular Study. *Diabetic Medicine*, 25(9), pp 1062-9.

Maina, W. K., Ndegwa, Z. M., Njenga, E. W. & Muchemi, E. W. (2010). Knowledge, attitude and practices related to diabetes among community members in four provinces in Kenya: a cross-sectional study. *The Pan African Medical Journal*, 19(1), pp 15-18.

Michel, G., Mary, J. & Rajesh, I. (2008). Knowledge on Diabetes, Its Treatment and Complications among Diabetic Patients in a tertiary Care Hospital. *Indian Journal of Community Medicine*, 33(3), pp 204-206.

Mirza, A. H., Sirajul Islam, M. D., Abdul, M. K. & Hamnazul, A. (2009). Knowledge of diabetic complications in a diabetic population. *Journal of Medicine*, 2009(10), pp 90-93.

Moodley, L.M. & Rambiritch, V. (2007). An assessment of the level of knowledge about diabetes mellitus among diabetic patients in a primary healthcare setting. *South African Family Practice*, 49(10), pp 54-59.

O'Sullivan, E. P., Bhargava, A., O'Callghan, M., Buckley, U., De Faoite, T., Moynihan, K., Thabit, H., Walsh, C. H. & Sreenan, S. (2009). Awareness of diabetes complications in an Irish population. *Irish Journal of Medical Science*, 178(4), pp 401-6.

Smith, D. (2010, June 21). Rising diabetes in Sri Lanka. Sunday Times. Retrieved from: http://www.sundaytimes.lk/090621/MediScene/mediscene_7.html

Wanninayaka, D. (2016). Health Ministry to control use of sugar. Colombo: Ministry of Health, Sri Lanka.

William, K. M., Zachary, M. N., Eva, W. N. & Eva, W. M. (2010). Knowledge, attitude and practices related to diabetes among community members in four provinces in Kenya. *Pan African Medical Journal*, 7:2, Epub.