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Knowledge, attitudes and practice patterns of patients with diabetes mellitus and diabetic retinopathy in an urban eye clinic in Singapore

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Abstract

Background: *Diabetes mellitus (DM) is a global health concern, the prevalence of which is predicted to increase in the coming years. Consequently, the prevalence of diabetic retinopathy (DR) is expected to rise. Therefore, identification of prevailing knowledge, attitudes and practice patterns (KAPP) of patients to address knowledge gaps and provide preventive education about DM and DR could reduce potentially sight-threatening complications. Our objectives were to assess KAPP of patients with DM and DR, factors influencing KAPP and impact of education on their KAPP.*

Methods: *A questionnaire based survey among diabetic patients in an eye clinic in Singapore. A response rate of 92.6% was achieved. Participants were administered a set of questions about KAPP on DM and DR before and after educating them about DR.*

Results: *Knowledge of DM and DR was noted in 57.0% and 29.0% of participants respectively. Good attitude and practice patterns were found in nearly 60% and above of the patients. Participants with more knowledge base had better attitude and practice patterns. Higher educational level, Indian ethnicity and longer duration of DM had a positive influence on KAPP. There was a statistically significant ($p < 0.05$) impact of education on KAPP among patients with DM and DR.*

Conclusions: *The knowledge, attitude and practice patterns among patients were variable. A low proportion of knowledge of DR was noted which increased to almost three times after education. There is a need to actively implement educational strategies among patients with DM and DR.*

Key words: *Knowledge, attitudes and practice patterns (KAPP), diabetes mellitus, diabetic retinopathy, Singapore*

Introduction

Diabetes mellitus (DM) is a major health issue. Yet, there appears to be poor knowledge about DM and diabetic retinopathy (DR) among diabetic patients.[1,2]

Several studies on knowledge, attitudes and practice patterns (KAPP) of patients with DM and DR have been published in many countries[3,4]. A local study[5] in multiethnic Singapore explored the awareness of DM and DR, while another report[1] assessed the knowledge and practice of DM. However, a sole study combining

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KAPP of patients with DM and DR among all ethnic groups is lacking. In our pilot study, we conducted an assessment of KAPP in all ethnic groups (Chinese, Indian and Malays), factors influencing KAPP and the impact of education on KAPP.

Methods

Design

Every third diabetic patient seeking eye treatment (diabetic-related or -unrelated eye problems) at an urban eye clinic in Singapore was enrolled to complete the questionnaire. One hundred valid responses out of one hundred and eight respondents were obtained, giving a response rate of 92.6%.

Participants

Any diabetic patient with good mental capacity to answer the questionnaire was included. Diabetic patient, for the purpose of this study, was defined as either using diabetic medication or had a previous physician diagnosis of diabetes.

Questionnaire

This study was conducted using an interview-based questionnaire. The text was standardized in English and Chinese. A stand-by translator was assigned for Malay and Tamil version.

The questionnaire was divided into five sections:

- Section A: Demographic information
- Section B: Socio-economic status
- Section C: Knowledge
- Section D: Attitude
- Section E: Practice Patterns

After the completion of Sections A to E, participants were educated during approximately twenty minutes about DR, using a booklet entitled *Management of Diabetic Retinopathy* written and published by the Singapore Health Promotion Board (HPB).[6] Then the questions from Sections C to E were repeated to assess the impact of education on KAPP.

Retinal photograph and diabetic retinopathy assessment

Information regarding the status of DR of patients was recorded by retinal photography. The severity of DR was categorized as defined by the Early Treatment Diabetic Retinopathy Study.[7] Additionally, participants were assessed if they correctly knew the severity of DR they had, as part of knowledge component. Correct responses were categorized when the recorded severities during retinal assessment matched patients' responses.

Definitions

Knowledge of DM: This was defined if participants:

- Have heard of DM *and*
- Agree that DM is familial.

Knowledge of DR: This was defined if participants:

- Have heard of DR *and*
- Agree vision is affected in DR.

Attitude: Good attitude was defined if participants agreed that:

- Diabetic patients should go for eye examinations *and*
- If so, the frequency would usually be annually or as per the advice of the physician.

Practice Patterns: Good practice pattern was defined if participants agreed that:

- Diabetic patients should visit an eye doctor despite good blood sugar control ***and***
- An eye doctor should be their choice of healthcare professional should they be diagnosed with DR.

Since eye health is involved, an eye doctor was designated as the gold standard of care.

Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) software version 17.0.

Univariate analysis was performed to examine the distribution of the demographic and socio-economic status of the study population as well as determinants of KAPPa such as gender, age, ethnicity, educational level, housing type and duration of DM. This was followed by multiple logistic regression analysis. The association of knowledge of DR with attitude and practice patterns was evaluated between the groups using bivariate analysis (Chi-square test). The correlation between KAPPa and the factors influencing them were evaluated using Spearman rank correlation test. Paired t-test (McNemar's test) was used to assess the impact of education on KAPPa. A two-tailed 'p' value of < 0.05 was considered statistically significant for all analyses. The 95% confidence intervals (CI) of the estimates were calculated by assuming normal approximation of binomial distribution for prevalence of one percent or more.

Ethical considerations and statement of ethics

As this was a Quality Improvement Study, no approval from the Institutional Review Board (IRB) was needed.

Results

Demographic and socio-economic data

All one hundred respondents were above 21 years (median age = 62 years; range = 28-88 years) with a slight preponderance of males comprising 56.0% of the sample population.

The majority of participants were married (81%), having primary or lower than primary education level (67%), not working (53%), earning an average household income of Singapore Dollar (SG$) 2,000 and below (71%) and living in Housing Development Board (HDB) flats (94%).

Findings on KAPP

Pre-existing knowledge of DM and DR were noted in 57 (57.0 %) and 29 (29.0%) participants respectively. Thirty-five percent of participants had combined knowledge of DM and DR. Interestingly, 21% of participants knew about DR despite not having any knowledge of DM.

The attitude that diabetic patients should go for eye examination was noted in 78 (78.0%) and that it should be done usually on an annual basis was noted in 46 out of these 78 participants (59.0%).

The practice patterns of patients that they should or will visit an ophthalmologist even if they had good blood glucose control was noted in 66 participants (66.0%). The practice of choosing an eye doctor as their healthcare professional if they were diagnosed with DR was noted in 59 participants (59.0%).

Factors influencing KAPP

a. Factors influencing knowledge of DM and DR (Table 1)

Knowledge of DM was significantly higher among *Indians compared to Chinese* [Odds Ratio (OR): 6.73; 95% confidence interval (CI) 1.59-28.39; overall p-value: 0.03]. Knowledge of DR was shown to be higher in those who had more than *ten years duration of DM compared to zero to five years duration of DM* (OR: 1.27; 95% CI: 0.38-4.24; overall p-value: 0.05).

Table 1. Associations of knowledge of DM and DR with participant characteristics, KAPP of DM and DR in a tertiary eye clinic in Singapore.

Variable	Total	Knowledge of DM			Knowledge of DR		
		n (%)	p-value	Adjusted OR[2] (95% CI[3])	n (%)	p-value	Adjusted OR (95% CI)
Gender							
Male	56	29 (51.8)	-	1.00	18 (32.1)	-	1.00
Female	44	28 (63.6)	0.10	2.36 (0.84-6.60)	11 (25.0)	0.21	0.40 (0.10-1.65)
Age group (yrs)							
21-59 yrs	41	26 (63.4)	-	1.00	12 (29.3)	-	1.00
60 yrs	59	31 (52.5)	0.30	0.61 (0.24-1.57)	17 (28.8)	0.60	0.74 (0.24-2.30)
Ethnic group			0.03			0.91	
Chinese	71	35 (49.3)	-	1.00	21 (29.6)	-	1.00
Malay	11	7 (63.6)	0.40	1.94 (0.41-9.20)	3 (27.3)	0.71	1.44 (0.22-9.67)

Variable	Total	Knowledge of DM			Knowledge of DR		
		n (%)	p-value	Adjusted OR[2] (95% CI[3])	n (%)	p-value	Adjusted OR (95% CI)
Indian	18	15 (83.3)	0.01	6.73 (1.59-28.39)	5 (27.8)	0.78	1.23 (0.30-5.01)
Educational level[4]			0.67			0.004	
No formal qualifications/ Lower primary	30	16 (53.3)	-	1.00	10 (33.3)	-	1.00
Primary (PSLE)	37	22 (59.5)	0.96	1.03 (0.31-3.43)	4 (10.8)	0.003	0.06 (0.008-0.37)
Secondary ('O'/'N' level)	18	12 (66.7)	0.52	1.59 (0.38-6.65)	8 (44.4)	0.92	0.91 (0.17-4.82)
Post-Secondary	15	7 (46.7)	0.49	0.57 (0.12-2.79)	7 (46.7)	0.76	0.75 (0.12-4.67)
Housing type			0.83			0.03	
HDB[1] 1 & 2 room(s) flat	7	4 (57.1)	-	1.00	3 (42.9)	-	1.00
HDB 3 room flat	19	11 (57.9)	0.10	1.00 (0.14-7.39)	3 (15.8)	0.07	0.11 (0.01-1.25)
HDB 4 room flat	36	19 (52.8)	0.62	0.62 (0.09-4.18)	7 (19.4)	0.12	0.16 (0.02-1.55)
HDB 5 room flat	32	19 (59.4)	0.99	0.99 (0.15-6.71)	13 (40.6)	0.10	0.10 (0.11-8.93)
Condominium and Landed Property	6	4 (66.7)	0.68	1.74 (0.13-23.38)	3 (50.0)	0.95	0.91 (0.06-13.74)
Duration of DM			0.19			0.05	
0-5 years	34	17 (50.0)		1.00	11 (32.4)	-	1.00
6-10 years	21	14 (66.7)	0.08	3.12 (0.86-11.29)	4 (19.1)	0.04	0.18 (0.04-0.90)
10 years	45	26 (57.8.)	0.23	1.88 (0.67-5.27)	14 (31.1)	0.70	1.27 (0.38-4.24)

[1]HDB: Housing Development Board
[2]OR: odds ratio
[3]95% CI: 95% confidence interval
[4]Lower primary: < 6 years of formal education.
Primary: 6 years of formal education with attainment of Primary School Leaving Examination (PSLE) qualification.

Secondary: 10-11 years of formal education with attainment of Ordinary or Normal level qualification.
Post-secondary: Attainment of advanced level and/or higher qualification.
Adjusted for gender, age, ethnic group, education, type of housing and duration of DM.

b. Factors influencing attitude (Table 2)

The attitude that diabetic patients should go for annual eye examinations was found to be significantly higher in those with *secondary education* (OR: 6.24; 95% CI: 1.03-37.78; overall p-value: 0.03) and *post-secondary education* (OR: 8.94; 95% CI: 0.96-82.96; overall p-value: 0.03) *compared to those with no formal or lower primary education*. Furthermore, those with *more than ten years duration of DM had better attitude for annual eye examination compared to those with zero to five years duration of DM* (OR: 1.33; 95% CI: 0.35-5.04; overall p-value: 0.02).

Table 2. Associations of attitude with participant characteristics, KAP of DM and DR in a tertiary eye clinic in Singapore.

Variable		Attitude						
		Participants who agreed diabetic patients should go for eye examinations				Participants who agreed diabetic patients should go for annual eye examinations		
	Total	n (%)	p-value	Adjusted OR[2] (95% CI[3])	Total	n (%)	p-value	Adjusted OR (95% CI)
Gender								
Male	56	45 (80.4)	-	1.00	45	29 (64.4)	-	1.00
Female	44	33 (75.0)	0.85	0.88 (0.25-3.15)	33	17 (51.5)	0.29	0.46 (0.11-1.95)
Age group (yrs)								
21 – 59 yrs	41	36 (87.8)	-	1.00	36	19 (52.8)	-	1.00
>60 yrs	59	42 (71.2)	0.06	0.28 (0.08-1.04)	42	27 (64.3)	0.227	2.07 (0.64-6.69)
Ethnic group			0.23				0.53	
Chinese	71	53 (74.7)	-	1.00	53	32 (60.4)	-	1.00
Malay	11	8 (72.7)	0.80	0.80 (0.14-4.48)	8	3 (37.5)	0.27	0.28 (0.03-2.63)

Variable		Attitude						
		Participants who agreed diabetic patients should go for eye examinations				Participants who agreed diabetic patients should go for annual eye examinations		
	Total	n (%)	p-value	Adjusted OR[2] (95% CI[3])	Total	n (%)	p-value	Adjusted OR (95% CI)
Indian	18	17 (94.4)	0.09	8.18 (0.71-93.94)	17	11 (64.7)	0.97	0.97 (0.23-4.07)
Educational level[4]			0.34				0.03	
No formal qualifications/ Lower primary	30	20 (66.7)	-	1.00	20	10 (50.0)	-	1.00
Primary (PSLE)	37	29 (78.4)	0.92	0.93 (0.24-3.70)	29	15 (51.7)	0.64	0.67 (0.13-3.50)
Secondary ('O'/ 'N' level)	18	15 (83.3)	0.65	1.50 (0.26-8.59)	15	11 (73.3)	0.05	6.24 (1.03-37.78)
Post-Secondary	15	14 (93.3)	0.09	9.64 (0.70-132.43)	14	10 (71.4)	0.05	8.94 (0.96-82.96)
Housing type			0.35				0.17	
HDB[1] 1 & 2 room(s) flat	7	4 (57.1)	-	1.00	4	1 (25.0)	-	1.00
HDB 3 room flat	19	14 (73.7)	0.28	3.37 (0.38-29.97)	14	11 (78.6)	0.02	55.72 (1.82-1706.42)
HDB 4 room flat	36	30 (83.3)	0.10	6.20 (0.73-52.80)	30	17 (56.7)	0.12	12.38 (0.53-287.48)
HDB 5 room flat	32	26 (81.3)	0.11	5.68 (0.67-47.78)	26	14 (53.9)	0.13	10.78 (0.51-227.66)
Condominium & Landed Property	6	4 (66.7)	0.99	0.99 (0.06-16.43)	4	3 (75.0)	0.09	32.53 (0.57-1848.67)
Duration of DM			0.11				0.02	
0-5 years	34	23 (67.7)	-	1.00	23	13 (56.5)	-	1.00

Variable		Attitude						
		Participants who agreed diabetic patients should go for eye examinations				Participants who agreed diabetic patients should go for annual eye examinations		
	Total	n (%)	p-value	Adjusted OR[2] (95% CI[3])	Total	n (%)	p-value	Adjusted OR (95% CI)
6-10 years	21	16 (76.2)	0.39	1.91 (0.44-8.34)	16	6 (37.5)	0.01	0.08 (0.01-0.56)
>10 years	45	39 (86.7)	0.04	4.03 (1.09-14.87)	39	27 (69.2)	0.68	1.33 (0.35-5.04)

[1]HDB: Housing Development Board
[2]OR: odds ratio
[3]95% CI: 95% confidence interval
[4]Lower primary: < 6 years of formal education.
Primary: 6 years of formal education with attainment of Primary School Leaving Examination (PSLE) qualification.
Secondary: 10 – 11 years of formal education with attainment of Ordinary or Normal level qualification.
Post-secondary: Attainment of Advanced level and/or higher qualification.
Adjusted for gender, age, ethnic group, education, type of housing and duration of DM.

c. Factors influencing practice patterns (Table 3)

The practice patterns of participants with regards to visiting an eye doctor despite having good glucose control was significantly higher in those who had *more than ten years duration of DM compared to zero to five years duration* (OR: 4.05, 95% CI: 1.32-12.40, overall p-value: 0.01, specific p-value: 0.01). The practice of choosing an eye doctor if participants are diagnosed with DR was significantly higher in those with *post-secondary education compared to those with no formal or lower primary education* (OR: 12.83; 95% CI: 1.83-89.83; overall p-value: 0.03).

Table 3. Associations of practice with participant characteristics, KAP of DM and DR in a tertiary eye clinic in Singapore.

Variable		Practice					
		Participants who agreed they should/will you visit an ophthalmologist despite having good blood glucose control.			Participants who would choose the ophthalmologist as their choice of healthcare profession if they were diagnosed with diabetic retinopathy.		
	Total	n (%)	p-value	Adjusted OR[2] (95% CI[3])	n (%)	p-value	Adjusted OR (95% CI)
Gender							
Male	56	40 (71.4)	-	1.00	38 (67.9)	-	1.00
Female	44	26 (59.1)	0.73	1.22 (0.39-3.82)	21 (47.7)	0.33	0.59 (0.21-1.70)
Age group (yrs)							
21 – 44 yrs	41	33 (80.5)	-	1.00	31 (75.6)	-	1.00
>60 yrs	59	33 (55.9)	0.05	0.34 (0.12-1.00)	28 (47.5)	0.10	0.43 (0.16-1.17)
Ethnic group			0.48			0.40	
Chinese	71	44 (62.0)	-	1.00	42 (59.2)	-	1.00
Malay	11	8 (72.7)	0.60	1.60 (0.27-9.36)	8 (72.7)	0.77	1.28 (0.23-7.09)
Indian	18	14 (77.8)	0.24	2.31 (0.57-9.37)	9 (50.0)	0.20	0.44 (0.13-1.56)
Educational level[4]			0.22			0.03	
No formal qualifications/ Lower primary	30	13 (43.3)	-	1.00	10 (33.3)	-	1.00
Primary (PSLE)	37	26 (70.3)	0.12	2.78 (0.77-10.08)	23 (62.2)	0.03	4.23 (1.19-15.04)
Secondary ('O'/'N' level)	18	14 (77.8)	0.13	3.45 (0.71-16.84)	13 (72.2)	0.03	5.47 (1.17-25.59)
Post-Secondary	15	13 (86.7)	0.08	6.30 (0.81-49.01)	13 (86.7)	0.01	12.83 (1.83-89.83)
Housing type			0.96			0.40	

Variable		Practice					
		Participants who agreed they should/will you visit an ophthalmologist despite having good blood glucose control.			Participants who would choose the ophthalmologist as their choice of healthcare profession if they were diagnosed with diabetic retinopathy.		
	Total	n (%)	p-value	Adjusted OR[2] (95% CI[3])	n (%)	p-value	Adjusted OR (95% CI)
HDB[1] 1 & 2 room(s) flat	7	5 (71.4)	-	1.00	4 (57.1)	-	1.00
HDB 3 room flat	19	11 (57.9)	0.74	0.67 (0.07-6.87)	13 (68.4)	0.18	4.40 (0.52-37.28)
HDB 4 room flat	36	23 (63.9)	0.84	0.79 (0.08-7.71)	21 (58.3)	0.43	2.29 (0.30-17.51)
HDB 5 room flat	32	22 (68.8)	0.98	0.97 (0.10-9.72)	18 (56.3)	0.67	1.55 (0.21-11.72)
Condominium and Landed Property	6	5 (83.3)	0.77	1.60 (0.07-36.54)	3 (50.0)	0.73	0.64 (0.05-8.55)
Duration of DM			0.01			0.65	
0-5 years	34	16 (47.1)	-	1.00	19 (55.9)	-	1.00
6-10 years	21	18 (85.7)	0.006	10.62 (1.99-56.59)	15 (71.4)	0.43	1.79 (0.43-7.42)
>10 years	45	32 (71.1)	0.01	4.05 (1.32-12.40)	25 (55.6)	0.92	0.95 (0.32-2.78)

[1] HDB: Housing Development Board
[2] OR: odds ratio
[3] 95% CI: 95% confidence interval
[4] Lower primary: < 6 years of formal education.
Primary: 6 years of formal education with attainment of Primary School Leaving Examination (PSLE) qualification.
Secondary: 10 – 11 years of formal education with attainment of Ordinary or Normal level qualification.
Post-secondary: Attainment of Advanced level and/or higher qualification.
Adjusted for gender, age, ethnic group, education, type of housing and duration of DM.

Impact of education on KAPP (Table 4):
Knowledge

Significant improvement was seen in certain domains under knowledge after education as illustrated in Table 1 and summarized below:
1. Knowledge of DM: increased from 57.0% to 74.0% (p-value: < 0.001);
2. Knowledge of DR: increased from 29.0% to 84.0% (p-value: < 0.001);
3. Participants who agreed that controlled DM can still lead to diabetic-related eye problems: increased from 35.0% to 50.0% (p-value: 0.02);
4. Participants who correctly knew that they had or did not have DR: increased from 15.0% to 33.0% (p-value: < 0.001).
After educating patients about DR, more participants attributed DM as causing other eye problems in addition to DR (Table 1). They were also more aware of the severity of their DR. However, these findings were not statistically significant.

Attitude

Significant improvements in their attitude were seen in:
1. Participants who agreed diabetic patients should go for eye examinations: increased from 78.0% to 93.0% (p-value: < 0.001);
2. On an annual basis usually: increased from 46.0% to 55.0% (p-value 0.02).

Practice Patterns

Similarly, significant improvements in their practice patterns were seen in:
1. Participants who agree that they should/will visit an eye doctor even if they had good blood glucose control: increased from 66.0% to 80.0% (p-value: 0.01);
2. Participants who would choose an eye doctor as the healthcare professional in the event they are diagnosed with DR: increased from 59.0% to 79.0% (p-value: < 0.001).
Collectively, participants with prior knowledge of DR demonstrated greater impact from education contributing to better attitude and practice patterns - showing an increment of more than 10% - in realizing the importance of having an eye examination and preferring an eye doctor for the eye examination.

Table 4. Comparison between pre- and post-KAP levels, KAP of DM and DR in a tertiary eye clinic in Singapore.

Variable	Pre-KAP	Post-KAP	p-value
	n (%)	n (%)	
Knowledge			
Knowledge of DM (n = 100)	57 (57.0)	74 (74.0)	<0.001
Knowledge of DR (n = 100)	29 (29.0)	84 (84.0)	<0.001
Participants who agreed that individuals with controlled DM can still have diabetic-related eye problems. (n = 100)	35 (35.0)	50 (50.0)	0.02
Participants who agreed that apart from retina being affected in DM, DM can still cause: (n = 100)			
Eye movements/ muscles problems	2 (2.0)	7 (7.0)	0.06

Variable	Pre-KAP	Post-KAP	p-value
	n (%)	n (%)	
Cataract	23 (23.0)	12 (12.0)	0.03
Glaucoma	7 (7.0)	20 (20.0)	0.01
All of the above	27 (27.0)	34 (34.0)	0.09
Don't know	40 (40.0)	25 (25.0)	0.01
Participants who think they know they have/ do not have Diabetic Retinopathy. (n = 88)	18(20.5)	46 (52.3)	< 0.001
Number of subjects correctly knowing they have/do not have DR. (n = 88)	15(17.1)	33(37.5)	< 0.001
Number of participants who think they know they have DR, correctly knowing the grade of Diabetic Retinopathy they have.			
n	12	35	
Correct match	4 (33.3)	9 (25.7)	0.06
Attitude			
Participants who agreed that diabetes patients should go for eye examinations. (n = 100)	78 (78.0)	93 (93.0)	< 0.001
Participants who agreed that diabetic patients should go for eye examinations: (n = 78)			
Once a year	46 (59.0)	55 (70.5)	0.02
More than once a year	32 (41.0)	23 (29.5)	
Practice			
Participants who agreed they should/ will you visit an ophthalmologist even if they had good blood glucose control. (n = 100)	66 (66.0)	80 (80.0)	0.01
Participants who would choose ophthalmologist as their choice of healthcare profession if they were diagnosed with diabetic retinopathy (n = 100)	59 (59.0)	79 (79.0)	< 0.001

Discussion

Our results indicate that the level of knowledge about DM and DR among the participants were variable. More than half of the respondents had prior knowledge of DM, but only less than one-third of them were aware of DR. This is comparable to other studies that reported poor knowledge of DR among diabetic patients. Reduced knowledge about DR could translate into greater risk of potentially sight-threatening complications from DR owing to ignorance and indifference. This is supported by the fact that participants with better knowledge of DM and DR are more likely to have correct health-seeking behavior such as better control of glycosylated haemoglobin (HbA1c) levels[8] and regular eye assessments by ophthalmic professionals.[9] The latter being especially crucial since it can reduce blindness up to 98% via early detection of DR.[9] Unfortunately, many studies have reported low utilization of ophthalmic services in diabetic patients.[10] Could this be attributed to poor knowledge or awareness, which can pose a threatening public health issues in view of the anticipated rise in the prevalence of DM and DR in Asia.[11]

In our study, the participant characteristics that led to better knowledge of DR, attitudes and practice patterns were *higher educational level* and *longer duration of DM*. A local study[5] similarly showed that a longer duration of DM was associated with better knowledge of DR. Such association could be accounted for by increased exposure to doctor-patient interaction/education and thus increased adherence to regular eye examinations.[1]. It calls for a need to inculcate knowledge, correct attitudes and practice patterns *at the beginning and/or early into the diagnosis of DM*. This is especially pertinent when the prevalence of DR is high even in newly diagnosed diabetic patients.[13]

We also found a significantly higher proportion of Singaporean Indians to have knowledge of DM compared to Singaporean Chinese. This could be due to increased awareness of DM among Indians due to its high prevalence among this ethnic group.[14]

Contrary to our expectations, we did not find any association between higher educational level and higher socio-economic status (represented by housing type) with knowledge of DR as seen in previous Asian studies.[16-18] This may be an important finding since it suggests that DR education is indeed lacking in the overall community. Interestingly, a high percentage of DR was noted in participants with post-secondary education and living in condominium/landed properties at 53.3% and 50.0% respectively.

Many KAPP studies specific[15, 19] to DM and DR have found education to positively impact KAPP. Tham *et al*.[1] found diabetic patients who had attended a diabetic education program or counselling session showed a 9.4% increase in knowledge of DM and its complications. In our study, significant improvement was seen in most of the knowledge section and all of the attitude and practice patterns sections after twenty minutes of education using the booklet. This shows that:

1. Even a short duration of education is beneficial;
2. The current educational DM and DR booklet is useful;
3. Pamphlets/booklets are useful educational tools by themselves, even

without formal educational programs or counseling sessions.

The strengths of our study include the following:

1. Being a pilot KAPP study on DM and DR across all ethnic groups in Singapore;
2. The assessment of impact of education on KAPP is another pilot initiative and highlight;
3. An excellent response rate of 92.6% in our data consolidation.

Alhough our study sample of diabetic patients is a good representation of the general DM population in Singapore,[14] the sample population could have been more, which we think is the limitation of this pilot study.

To conclude, in light of the above findings, the following recommendations can be made:

1. A fifteen to thirty minutes education using existing DM and DR educational booklet to all newly-diagnosed diabetics.
2. This can be followed-up by formal educational programs or counseling sessions.
3. Use of mass media to create awareness of DM and DR, since there is a general lack of knowledge of DM and DR among the diabetic population and possibly the general community.
4. Considerations to reduce cost of ophthalmology outpatient fees, especially for follow-up of chronic eye conditions such as DR, to encourage increased adherence to regular eye examination.

These measures may contribute to reducing DR complications and the attendant plight and menace of DR related blindness.

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