Effectiveness of screening for diabetic retinopathy by non-specialist doctors: the importance of physician-ophthalmologist collaboration in the prevention of blindness. Sri Lanka Young Diabetes Study (SLYDS)

N P Wijesinghe[1], M Jayaweera[2], W M U AWijetunga[2], H A Dissanayake[2], D RMatthews[2], S Pathirana [1], P Katulanda[2,3]

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Abstract

Introduction: Diabetes retinopathy (DR) is the fourth leading cause for blindness worldwide. Screening is vital for its early detection and prevention of blindness. However screening all diabetic patients by specialists is impossible, particularly in resource poor settings such as Sri Lanka. We aimed to compare the agreement between non-specialist doctors and specialist ophthalmologists in diagnosing DR and planning follow up.

Methods: A descriptive study was conducted with a cohort of patients randomly recruited from the Sri Lanka Young Diabetes Study (SLYDS). They were examined by a group of non-specialist doctors by direct ophthalmoscopy after mydriasis, and specialists (by slit lamp biomicroscopy) who were blinded to non-specialist doctors' finding. Agreement between DR grading according to International Clinical Diabetic Retinopathy Disease Severity Scale, and follow up decisions, by non-specialist and specialist doctors were assessed with kappa statistic, using SPSS-16.

Results: Our study included 658 participants (males 36%, mean age 37.1 years, mean duration of diabetes 5.22 years (± 4.04), mean HbA1c 8.1% (±2.04)) and 123 (18.7%) had diabetes retinopathy and 54 (8.3%) required early referral. Exact agreement between ophthalmologists and non specialist doctors in determining absence or presence of diabetes retinopathy was 0.82 (Kappa 0.48, $p < 0.001$) while the agreement in diagnosing the grade of retinopathy was 0.76 (Kappa 0.347, $p < 0.001$). Junior doctors detected DR with a sensitivity and specificity of 0.68 and 0.86 respectively. Exact agreement on follow up decision was 0.92 (Kappa 0.48, $p < 0.001$), with 0.52 sensitivity and 0.96 specificity in decision for early referral.

Conclusion: Non-specialist doctors can identify DR with reasonable sensitivity. This should be encouraged in primary care, particularly in resource poor settings. Referring patients with any form of DR to a specialist should be recommended to prevent those with severe degrees of retinopathy from being missed for appropriate specialist care.

Introduction

According to the estimates of the International Diabetes Federation (IDF) 371 million people are affected by diabetes worldwide and 70 million of these live in the South East Asian region (1). Diabetes mellitus is the fourth leading cause of blindness in the world (2). There are approximately 93 million people with diabetic retinopathy (DR), 17 million with proliferative DR, 21 million with diabetic macular edema, and 28 million with vision threatening DR worldwide (3). The problem is expected to become worse due to the exponential increase of diabetes mellitus especially in the resource-limited nations such as Sri Lanka and India (4,5) in the South East Asian region, where 1 in 5 would have either diabetes or prediabetes. (1). The most frequent ocular complication of diabetes mellitus is diabetic retinopathy. The IDF estimates that there will be 552 million people with diabetes in the world by the year 2030 (1). Hence diabetic retinopathy will have

[1]*National Eye Hospital of Sri Lanka,* [2]*Diabetes Research Unit, Department of Clinical Medicine, Faculty of Medicine, University of Colombo, Colombo, Sri Lanka,* [3]*Oxford Centre for Diabetes, Endocrinology and Metabolism, University of Oxford, Oxford, UK.*

the potential to become the leading cause of blindness and a serious public heath problem.

Diabetic retinopathy is virtually symptomless until significant irreversible visual loss occurs. Strict glycaemic control has been shown to be effective in preventing retinopathy in a significant proportion of people with diabetes (6,7). However, retinopathy still occurs in another significant proportion with time. Early detection by screening and effective secondary prevention strategies such as laser photocoagulation and newer treatments including intra vitreal anti Vascular Endothelial Growth Factor (VEGF) are known to reduce the risk of blindness or severe visual impairment (8). Many studies have demonstrated the benefit of screening and treatment of diabetic retinopathy and its cost effectiveness both in type 1 and type 2 diabetes (9-12). A study by Javitt et al showed that by appropriate care, more than 79,000 person-years of sight would be saved (9).

Screening for diabetic retinopathy can be performed by retinal photography, direct and/or indirect ophthalmoscopic examination (13). Retinal photography is costly and available only in a very limited number of centers in Sri Lanka and other developing countries (14). Even after photography, experienced graders are needed for proper grading of diabetic retinopathy. In addition there is a serious mismatch between the number of patients and the number of health care workers trained to evaluate and treat the disorder. According to the latest prevalence estimates Sri Lanka has about 2 million patients with diabetes (3). Accordingly ophthalmologist to diabetic patient ratio is about 1:30000. Hence it is not practical for every diabetic patient to be examined by a specialist in Sri Lanka. The situation is same or even worse in many other developing countries.

If screening for retinopathy can be undertaken by non-specialist junior doctors such as house officers, senior house officers, district medical officers, and general practitioners at primary care level with acceptable sensitivity and specificity to identify those who need further care by specialists, it will make a tremendous impact on the care of diabetic patients in resource poor countries including Sri Lanka.

The objective of this study was to determine whether non-specialist doctors can screen diabetic patients for retinopathy with acceptable sensitivity and specificity and whether such doctors can reliably identify patients who need further specialist assessment and intervention.

Methods

The study was carried out in the Diabetes Research Unit, Department of Clinical Medicine, Faculty of Medicine, University of Colombo and the National Eye Hospital, Colombo. Diabetic subjects with the age at diagnosis between 16 to 40 years of age, who were recruited to the Sri Lanka Young Diabetic Study (SLYDS) were absorbed to this study after informed written consent. Patients with a history of glaucoma, dense cataract or corneal opacities were excluded, as it was difficult to perform retinal screening by non-specialist doctors.

Each patient was examined in duplicate by a team of junior medical graduates without specialized experience in ophthalmology and by a specialist team comprising a specialist and a specialist registrar. The junior medical graduates were trained in the detection of different categories of diabetic retinopathy and decision-making in a single day session.

All recruited subjects had their pupils dilated with mydriatic drops (tropicamide 1%) and were screened by the junior medical graduates by direct ophthalmoscopy. The findings were documented in a standard data sheet according to International Clinical Diabetic Retinopathy Disease Severity Scale (13) (normal, mild NPDR, Moderate NPDR, severe NPDR, proliferative DR and clinically significant macular edema). The level of the retinopathy was based on the findings of the more severely affected eye. At the end of the examination the examiner had to determine whether the subject could be followed up in the regular diabetes clinic, whether he or she needed early or urgent ophthalmic referral. The subjects with no retinopathy or mild non-proliferative retinopathy (NPDR) were considered for routine follow up, those with moderate or severe non-proliferative retinopathy with or without maculopathy were considered for early ophthamological referral and the subjects with retinal detachment, vitreous haemorrhage or proliferative diabetic retinopathy were considered for urgent ophthalmological referral. This decision was indicated in the data sheet.

All these patients were reexamined on the same day within one or two hours by the specialist team at the National Eye Hospital, Colombo (situated at a separate location within walking distance) by indirect ophthalmoscopic examination using slit lamp biomicroscopy. The specialist team was blinded to the findings of the non-specialists. These findings and the decision about further course of action were recorded in a separate identical data sheet.

The final diagnosis of diabetic retinopathy level for each patient was made upon the findings of the specialist (ophthalmology) on the more severely affected eye. The competence of junior doctors in detecting retinopathy and making a decision for further course of action was compared with that of the specialists' findings and decisions. The control of diabetes in this group of patients was assessed by investigating them for HbA1c. The data of patients were analyzed using SPSS version 16 and the agreement was assessed using the kappa statistic.

Results

The total number of patients was 658. The mean HbA1c was 8.10% (± 2.04), which indicated that the control of diabetes was not satisfactory. There were 123 patients (18.7%) with any degree of diabetic retinopathy. Overall 55 (8.3%) needed early referral.

The demographic characteristics of the patients are shown in Table 1.

When the findings were analyzed according to the presence or absence of diabetic retinopathy disregarding the degree of retinopathy, the agreement of any degree of diabetic retinopathy was 82.4% between the non-specialist junior doctor and the specialist team; kappa 0.48 ($p<0.001$) (Table 2). In 77 (11.7%), the junior doctors over diagnosed and in 39 (5.9%) under diagnosed diabetic retinopathy. The sensitivity for detecting diabetes retinopathy by the junior doctors was 0.68 and the specificity was 0.86.

In contrast to the presence of any degree of diabetic retinopathy as shown above, the exact agreement in the diagnosis of different types of diabetic retinopathy between ophthalmologists and junior doctor was 0.76, kappa 0.347.

The exact agreement on the decision for further follow up action of the subjects between the ophthalmologist and junior doctor was 0.92, kappa 0.48 ($p<0.001$). The sensitivity of picking up cases for early referral to ophthalmologist by the junior doctor was 0.52 and the specificity 0.96 (Table 4). Out of the 54 patients who needed early referral 26 had been missed and 26 of the 599 patients who really needed regular follow-up has been decided for early referral by the non-specialist doctor.

Table 1. Demographic characteristics of the patients

Total number of patients	658
Male	246 (36.0%)
Female	437 (64.0%)
Average age	37.1 years
Duration of diabetes	5.22 years (± 4.04)
Prevalence of diabetic retinopathy	123 (18.7%)

Table 2. Agreement on presence of diabetic retinopathy by ophthalmologist and junior doctor

		Retinopathy according to Specialist		
		Present	Absent	Total
Retinopathy according to non-specialists	Present	84	77	161
	Absent	39	458	497
	Total	123	535	658

Exact agreement: 0.82; Kappa: 0.48 ($p < 0.001$)

Table 3. The agreement of different types of diabetic retinopathy on fundus examination by ophthalmologist and non-specialist doctor

Examination findings of non-specialist doctor	**Examination findings of ophthalmologist**						
	Normal	Mild NPDR NPDR	Moderate NPDR	Severe NPDR	PDR	CSME	Total
Normal	458	33	5	0	0	1	497
Mild NPDR	72	31	18	0	0	7	128
Moderate NPDR	3	4	11	1	0	2	21
Severe NPDR	0	0	3	0	0	0	3
PDR	0	0	0	0	0	0	0
CSME	2	2	3	0	0	2	9
Total	535	70	40	1	0	12	658

Exact agreement: 0.76; Kappa: 0.347 ($p< 0.001$)

Table 4. Agreement on the follow up plan by ophthalmologist and non-specialists

		Follow up plan by Specialist		
		Regular follow up	Early referral	Total
Follow-up plan by non-specialists	Regular follow up	573	26	599
	Early referral	26	28	54
	Total	599	54	653

Exact agreement: 0.92, Sensitivity: 0.52, Specificity: 0.96, Kappa: 0.48 ($p < 0.001$)

Discussion

It is well established that screening and early treatment of diabetic retinopathy help prevent blindness. However, the diagnosis is often established late. The purpose of this study was to determine whether non-specialist doctors in primary and secondary care (house officers, senior house officers and general practitioners) can screen diabetic patients for retinopathy with acceptable sensitivity and specificity and to determine whether such doctors can reliably identify patients who need further specialist assessment for intervention.

In this study we demonstrated that eye screening by pupillary dilatation could be practically performed with ease by non-specialist practitioners. There is a reasonably high degree of agreement of the examination findings with an acceptable sensitivity (68%) and specificity (86%) for detection of the presence of diabetic retinopathy. The exact agreement was 82%. The kappa statistic was 0.48 which showed a moderate agreement.

Under diagnosis or non-diagnosis of relatively severe degrees of diabetic retinopathy was high (CSME 83.3%, severe NPDR 100%, moderate NPDR 57.5%). Out of the 12 patients with either CSME or severe NPDR, the junior doctors missed 09, which was unacceptable. The rate of under diagnosis or non-diagnosis of mild NPDR was 47.1%, which was better compared with the severe degrees of diabetic retinopathy. The exact agreement was 76%. The kappa statistic was 0.35, which showed a fair agreement.

The decision-making capability for further action after screening by the non-specialist doctors had high agreement (92%) and specificity (0.96) although the sensitivity (0.52) was low. A considerable 26/54 (48%) percentage of subjects who needed early referral were not correctly identified. The kappa statistic was 0.48, which showed a moderate agreement.

It is evident from the results that the specificity of diagnosing any form of diabetic retinopathy, identifying the exact degree of diabetic retinopathy and the action by the junior doctors was consistently high while the sensitivity was relatively low. So the junior doctors had tended to under diagnose rather than over diagnose which will lead to patients not getting the optimum treatment that they deserve.

Although junior doctors can be used to screen diabetic patients for retinopathy, they should be instructed to make an early referral to the ophthalmologist regardless of the degree of retinopathy when they detect any form of diabetic retinopathy. In this way it would be possible to minimize missing of severe degrees of retinopathy. This method will ensure that most if not all diabetics will get their eyes screened for diabetic retinopathy while enabling patients with mild, moderate and severe degrees of diabetic retinopathy to get specialist care. This will also enable ophthalmologists to render their services to the patients who really need it.

There are several limitations that must be considered in interpreting the results of this study. Firstly the training provided for the non-specialist doctors was very brief and their feedback was not obtained. Secondly the number of patients with advanced degrees of diabetic retinopathy was low.

Conclusion

Currently, many diabetic patients do not get screened adequately for retinopathy due to two main reasons; the lack of competent specialists especially in the rural areas of the developing countries and routine examination of the fundus by primary care physicians without dilating the pupil. Our study suggests that this can be easily performed in the primary care setting with reasonable accuracy and efficiency and a non-specialist doctor can identify many patients with diabetes who are likely to have some form of retinopathy. While this technique cannot replace the attempts to provide specialist retinopathy screening for all diabetic patients, screening for diabetic retinopathy by non-specialist doctors can be considered complementary and should be regularly advocated especially in situations where the services of specialist ophthalmologists are not available. In addition non-specialist doctors need to be given an additional period of training in retinopathy screening to improve their ability to diagnose different degrees of diabetic retinopathy with higher sensitivity and specificity. It should also be recommended that all patients showing some form of diabetic retinopathy or visual defect should be referred for specialized evaluation.

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References

1. IDF (International Diabetes Federation). Diabetes Atlas 2012. URL http://www.idf.org/diabetes atlas//5e/ update2012 (Accessed July 2013).
2. World Health Organization: Diabetes Mellitus: Report of a WHO Study Group, technical report 727. Geneva, World Health Organization, 1985.
3. Yau JW et al. Global prevalence and major risk factors of diabetic retinopathy. *Diabetes Care* 2012; **35**(3): 556-64.
4. Wijewardena K et al. Prevalence of hypertension, diabetes and obesity: baseline findings of a population based survey in four provinces in Sri Lanka. *CMJ* 2005; **50**(2): 62-70.
5. Ramachandran A, Snehalatha C, Vijay V, King H. Impact of poverty on the prevalence of diabetes and its complications in urban South India. *Diab Med* 2002; **19**: 130-5.
6. The effect of intensive treatment of diabetes on the progression of long-term complications in insulin-dependant diabetes mellitus. Diabetes Control and Complications Trial Research Group. *N Eng J Med* 1993; **329**: 977-86.
7. UK Prospective Diabetes Study (UKPDS) Group. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). *Lancet* 1998; **352**: 837-53.
8. Centers for Disease Control and Prevention (CDC). Blindness caused by diabetes – Massachusetts, 1987-1994. *MMWR Morb Mortal Wkly Rep* 1996; **45**: 937-41.
9. Javitt JC, Aiello LP, Bassi LJ. Detecting and treating retinopathy in patients with type I diabetes mellitus: Savings associated with improved implementation of current guidelines. *Ophthalmology* 1991; **98**: 1565.
10. Javitt JC, Aiello LP, Chang YP: Preventive eye care in people with diabetes is cost saving to the federal government: Implications for health care reform. *Diabetes Care* 1994; **17**: 909.
11. Early treatment of Diabetic Retinopathy Study (ETDRS) Report No 22. *Arch Ophthalmol* 1996; **114**: 1079-84.
12. Photocoagulation Treatment of proliferative diabetic retinopathy: clinical application of Diabetic Retinopathy Study (DRS) findings. DRS Report 8. *Ophthalmology* 1981; **88**: 583-600.
13. Lloyd MA. Perspectives on Diabetic Retinopathy. *Am J Ophthlmol* 2003; **136**: 122-32.
14. Fernando DJ, Siribaddana S, De Silva, Subasinghe Z. Prevalence of retinopathy in a Sri Lankan diabetes clinic. *Ceylon Med J* 1993; **38**(3): 120-3.