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Article

Community-Based Eye Health Screening Report in Malaysia: Urban-Rural Referral Comparison

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Abstract: This study compared urban and rural referrals from a community-based eye health screening program named 'Jom Check Mata Malaysia (JCMM)'. The program was carried out in nine different states in Peninsular Malaysia—a total of 18 screening locations with a mix of urban and rural. Two mobile eye clinics were mobilised for community-based eye health screenings. This study involved 3,139 participants (1,158 and 1,981 participants from rural and urban, respectively). Visual complaints were collected via interviews using an ocular symptom checklist. The visual acuity was screened using a Snellen Chart. Ocular health screening, including anterior and posterior eye segments, was screened using slit-lamp bio-microscopy and fundus camera. Overall referrals were 2,139 (68%), 846 (27%) and 362 (12%) based on visual complaints, visual acuity and ocular health screening, respectively. Rural locations had significantly higher referral rates for visual complaint screening ($\chi2$ = 422.53, p<0.05), visual acuity screening ($\chi2$ = 20.20, p<0.05) as well as ocular health screening ($\chi2$ = 64.70, p<0.05) compared to the urban locations. There was a consistent pattern of higher rural referrals for all types of vision screening. Information from our three-category screening analysis could help to design a vision screening for our rural and urban populations.

Keywords: eye health; vision screening; visual complaint; visual acuity; ocular health; rural, urban

Introduction

In the past three decades, there has been a discernible decline in the prevalence of visual impairment and blindness on a global scale. Nevertheless, the task of eradicating preventable blindness has become increasingly formidable due to the expansion and ageing of populations (Ackland et al., 2017). Growing visual issues remain a global health concern (Burton et al., 2021). Most of the visual issues are: digital eye strain (DES) – the growing dependence on digital gadgets for professional, educational, and recreational purposes has resulted in a significant number of individuals encountering various symptoms such as ocular strain, dryness, and discomfort as a consequence of extended periods of screen usage (Chen et al., 2020; Jaiswal et al., 2019); myopia (near-sightedness) – frequency of myopia has been increasing worldwide, attributed to many factors such as increased screen usage and decreased engagement in outdoor activities (Foreman et al., 2021); and presbyopia – is a condition associated with ageing, characterised by the progressive decline in the lens of the eye's capacity to effectively focus on nearby objects. The phenomenon in question is an inherent aspect of the ageing process and often manifests itself subsequent to reaching the age of 40 (Pierścionek & Weale, 1995). Then, the most comment eye health problem such as: cataracts – refer to the opacification of the lens of the eye, leading to visual impairment, particularly prevalent among the elderly population; glaucoma – is a collection of ocular ailments that have the potential to induce impairment to the optic nerve and subsequent visual deterioration. It is frequently correlated with heightened intraocular pressure; diabetic retinopathy – is a vascular condition associated with diabetes that specifically impacts the blood vessels within the retina. Improper management of the condition might potentially result in ocular complications and eventual loss of vision; and age-related macular degeneration (AMD) – the problem pertains to the macula, which is a specific region of the retina that plays a crucial role in central vision and prevalence is higher among those in advanced age. All these problems are also significant correlation between national prevalence rates of visual impairment and ocular disabilities with depressive disorders, worldwide (Abdolalizadeh & Ghasemi Falavarjani, 2022).

Half the population is predicted to suffer a visual problem in 2050 (Holden et al., 2016). By 2050, it is anticipated that half of the people will experience visual impairment (Holden et al., 2016). World Health Organisation (WHO) has developed three essential methods, including a mechanism for disease management, the development of human resources, and the development of relevant technology, including infrastructure as the initiative to advocate the visual health issues (Pizzarello et al., 2004). In 1999, the WHO initiated the "Vision 2020: The Right to Sight" campaign, aiming to eradicate preventable blindness by the year 2020 (Ackland, 2012). Several significant actions and tactics have been implemented by the World Health Organisation (WHO) in pursuit of its Vision 2020 initiative, which are advocacy and awareness, capacity building, disease control, integration into health systems, partnerships, data collection and research, technology and innovation, policy and advocacy tools, and community engagement. Although the objective of achieving complete eradication of avoidable blindness by the year 2020 was not entirely realised, the Vision 2020 project has made substantial advancements in the global reduction of avoidable blindness and visual impairment (Abdulhussein & Abdul Hussein, 2023). The ongoing efforts of the programme extend beyond the year 2020, with a revitalised emphasis on attaining universal eye health and eradicating preventable blindness in the forthcoming years.

As a preventive action, the disease control approach can be initiated by doing a health screening (Wilson & Jungner, 1968). The WHO has emphasised the need for government investment in the Universal Eye Health Global Action Plan 2014-2019 to reduce avoidable visual impairment worldwide (WHO, 2013). A near- or distance vision impairment affects at least 2.2 billion individuals worldwide. Nearly half of these cases, or at least 1 billion, involved vision impairment that either might have been avoided or was not addressed (Burton et al., 2021; Fricke et al., 2018). The prevalence of blindness increased from 0.08% in children to 4.4% in people over 60 years, with an overall global blindness rate of 0.7% (WHO, 2007).

Eye health screening is a necessary part of a preventive healthcare ecosystem. Screening is pragmatic in a health care system based on the presumptive identification of unrecognised defects by the application of tests which can be applied rapidly to differentiate normal from abnormality (Wilson & Jungner, 1968). Eye health screenings can be conducted in selective, opportunistic or mass screenings, which can be varied according to age and target ocular conditions such as amblyopia, cataract, diabetic retinopathy, glaucoma, etc. (Speechley et al., 2017). Criteria used in screening program development include condition, test, treatment and program (Speechley et al., 2017). Various parameters are used in vision screening programs, such as visual acuity, refraction, ocular alignment, and ocular health. The parameter selection is usually related to the objective of the vision screening outcome (Hopkins et al., 2013). Community-based screening is a type of mass screening in which the visual acuity assessment is the preferred method in a community-based screening program worldwide (Langeslag-Smith et al., 2015). The screening methodology can be performed by the less highly trained personnel, whether by hand or by automatic equipment, which saves them time and achieves more for the unit expenditure of highly trained professional people (Wilson & Jungner, 1968). Vision screening is noticeably divided into three main categories; visual complaint, visual acuity and ocular health (Bakar, Chen, Rahim, et al., 2012; Dhungel & Shrestha, 2017; Jin et al., 2015; Marshall et al., 2010). Visual complaints refer to the signs and symptoms reported by the screening participants, which include tired eyes, sore/aching eyes, blurred vision, double vision, dry eye, burning eye and watering eye (Dhungel & Shrestha, 2017). Visual functions screening covers a range of tests such as the near and distance visual acuity, objective or subjective refractive error, and binocular vision status (Bakar, Chen, Rahim, et al., 2012; Jin et al., 2015;

Marshall et al., 2010). Ocular health connects to internal or external eye abnormalities such as corneal staining, diabetic retinopathy, cataracts, or age-related retinopathy (Jin et al., 2015; Marshall et al., 2010). Variation in methodology hinders a plausible comparison of vision screening studies between countries and within the same country.

Therefore, we empower the community with vision health issues by carrying out eye health screening programs in nine different states in Peninsular Malaysia—a total of 18 screening locations with a mix of urban and rural. We compared urban and rural referrals from a community-based eye health screening program named 'Jom Check Mata Malaysia (JCMM)'. By doing a comparative analysis of rural and urban areas, we can gain insights into the existing health disparities. This examination enables us to comprehend and subsequently tackle potential discrepancies in eye health outcomes that may arise between these distinct settings. In addition to this, it is possible to comprehend the distinct requirements of both rural and urban people that foster community involvement. This approach facilitates collaboration between healthcare practitioners and communities in order to devise culturally and contextually suitable solutions. The uniqueness of our study design is the uniformity of the screeners, equipment, and controlled environment in screening space and lighting. This approach allows a direct comparison of screening outcomes between urban and rural which is unable to derive from previous reports on vision screening in Malaysia due to variations (Aniza et al., 2012; Bakar, Chen, Noor, et al., 2012; Goh et al., 2005; Hashim & Tan, 2008; Ismail et al., 2012; Premsenthil et al., 2013; Zainal et al., 1998).

Methodology

The present study utilised retrospective methodology and relied on record review data obtained from a community-based eye health screening program 'Jom Check Mata Malaysia (JCMM)'. The target demographic consisted of individuals who participated in the JCMM programme in Peninsula Malaysia. The data pertaining to the participants, which spanned from October 2012 to March 2014, were reviewed and analysed. The record included a total of 18 locations, encompassing the states of Johor, Melaka, Negeri Sembilan, Selangor, Perak, Kedah, Kelantan, Terengganu, and Pahang (Figure 1).

Figure 1. Infographic of JCMM program for 18 locations in Peninsular Malaysia

Two mobile eye clinics were mobilised for community-based eye health screenings. Utilising a mobile eye bus for community-based eye health screenings presents several notable advantages. Firstly, it enhances the accessibility of eye screening services for populations residing in remote or underserved areas. This ensures that individuals in such regions can readily avail themselves of the necessary eye screenings. Secondly, it offers convenience to community members who would otherwise have to undertake long journeys to access these screenings. By bringing the service closer to their vicinity, the mobile eye bus eliminates the need for extensive travel. Moreover, employing a mobile eye bus proves to be cost-efficient as it can cater to multiple communities within a designated region. This approach optimises the utilisation of resources and reduces the overall cost per screening. Additionally, the mobile eye bus can provide comprehensive services by being equipped with a range of eye care facilities. These include vision testing, refraction for glasses, and screening for common eye conditions. By offering such comprehensive services, the mobile eye bus ensures that individuals receive a holistic eye care experience. Lastly, the mobile eye bus facilitates accessibility in data collection and analysis through the integration of data collection and analysis technology. This enables efficient and streamlined data management, enhancing the overall effectiveness of the eye health screening programme. This facilitates the monitoring of patterns, comprehension of the frequency of particular ocular diseases, and customization of forthcoming interventions. Each bus had a generator to overcome electricity supply issues in remote locations.

Each bus was divided into three screening corners: (1) the interview corner, to record visual complaints using the ocular symptom checklist; (2) the visual acuity screening corner; and (3) the ocular health screening corner of the anterior and posterior segments of the eye. The visual complaints corner pertains to the signs and symptoms that have been reported by participants during the screening process. These complaints encompass various issues such as eye fatigue, eye soreness or discomfort, blurred vision, double vision, dryness of the eyes, a burning sensation in the eyes, and excessive tearing. The second corner, assessment of visual acuity, encompasses a variety of examinations, including evaluations of near and distance visual acuity, objective or subjective determination of refractive error, and an assessment of binocular vision status. The ocular health corner is associated with both internal and exterior disorders of the eye, including corneal staining, diabetic retinopathy, cataracts, and age-related retinopathy. The information including the scope, target condition, technique, and equipment on the JCMM was summarised in Table 1.

Table 1. Information on the scope, target condition, technique and equipment used in the JCMM vision screening program

Scopes of Screening	Target Ocular Component	Technique / Instrument (Brand)
Visual complaints	Ocular symptoms	Interview with ocular symptom checklist
Visual acuity	Visual acuity	Snellen Chart
Ocular health	Anterior segment of the eye	Portable slit lamp bio-microscopy (Keeler)
	Posterior segment of the eye	Non-mydriatic fundus camera (VOLK Pictor Fundus and FundusVue)

This study involved 3,139 participants (1,158 and 1,981 participants from rural and urban, respectively). The screeners were optometry students under the supervision of qualified optometrists. At least five students were on each bus, with a minimum of two students at the visual complaint interview corner, one at the visual acuity screening corner, and two at the ocular health screening corner. A minimum of two certified optometrists (who held a bachelor's degree in optometry) were assigned to oversee the entire vision screening program.

All participants registered and filled up their demographic information before they proceeded to the visual complaint interview counter. Visual complaints were documented using the ocular symptom checklist that listed blurred vision, double vision, headache, haloes, and floaters. Additional visual symptoms were itemised and recorded manually. The visual complaint component was included in the JCMM program due to the close link between ocular complaints and the visual function (Hendricks et al., 2007). Blur vision could be linked to the quality of life. Double vision and headache could indicate binocular vision problems. Haloes and floaters could denote compromised ocular structures due to diseases. The next counter was the visual acuity screening counter. Distant visual acuity was screened using the Snellen chart. The smallest letters that participants could read were recorded. Referral criteria were 6/12 or worse. At the corner of ocular health screening, a fundus camera was used to screen for any abnormality at the posterior segment of the eye, not limited to diabetic retinopathy, macular degeneration, hypertensive retinopathy, and glaucoma. Fundus photos of both eyes were captured for each participant. A slip lamp biomicroscopy was used to screen any abnormality at the anterior segment of the eye in terms of structure and 'quiet eye status'. Referral criteria for ocular health were any abnormalities detected regardless of the severity, not limited to micro-aneurysms, retinal haemorrhages or exudates, cotton-wool spots, optic disk oedema, any irregular pigmentation or increase of optic cup-disc ratio (Clinical Practice Guidelines (CPG) Screening of Diabetic Retinopathy, 2011). All criteria used were precisely defined in verbal briefings, and screening was standardised at all locations. Participants who failed the vision screening were referred to an optometrist or ophthalmologist for further assessment. Figure 2 shows the layout of the bus, the position of the instruments, and the flow during vision screening.

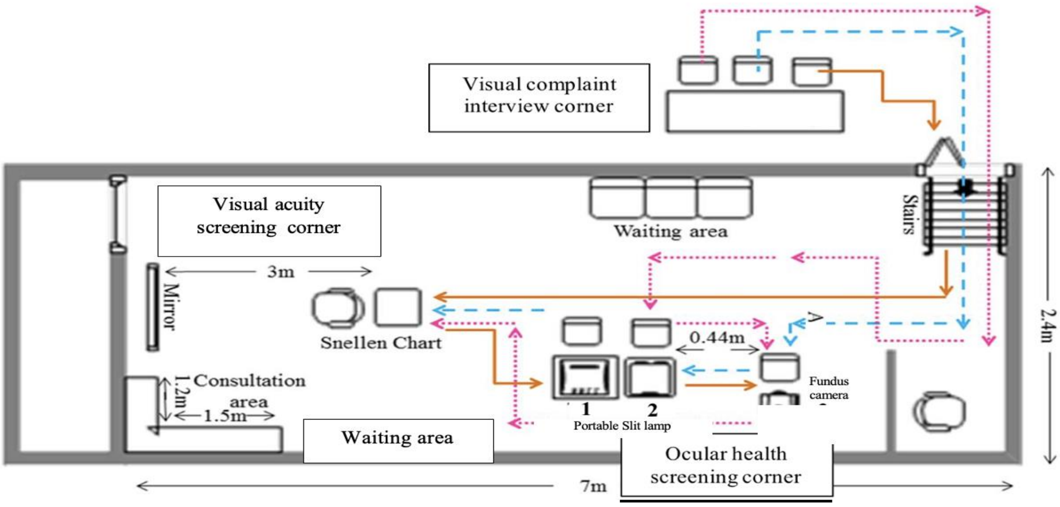

Figure 2. UiTM Mobile Optometry Clinic layout and locations of equipment
(3 different arrows indicated the flow of the three residents concurrently from outside to inside the bus)

For rural-urban comparison, nine locations were classified as urban with a total of 1,981 participants (Pasir Gudang, Bukit Katil, Port Dickson, Paroi, Selayang, Kajang, Bukit Malawati and Alor Setar), while ten locations were categorised as rural with a total of 1,158 participants (Pagoh, Sungai Besar, Bota, Bagan Dato, Jeli, Tanah Merah, Besut, Dungun, Pekan, and Bentong). Sorting refers to the location that has been gazetted as urban with a population of 10,000 or more in the Population Census 2000 (Masron et al., 2017). Rural was defined as locations with less than 10,000 people supported by agriculture and natural resources in which the population was either clustered, linear, or scattered.

Results

Participants included 1,656 females (53%) and 1,483 (47%) males. The overall referrals from total participants (rural and urban) were 2,139 (68%), 846 (27%) and 362 (12%) from the visual complaints, visual acuity screening and ocular health screening, respectively (Table 2). In the rural and urban comparison using a chi-square test for homogeneity, we found significantly higher referrals for visual complaints in rural (91%) compared to urban (55%), with a difference in the percentage of 36% ($\chi^2 = 422.53$, $p<0.05$). Rural locations had significantly higher referral rates for visual complaint screening ($\chi^2 = 422.53$, $p<0.05$), visual acuity screening ($\chi^2 = 20.20$, $p<0.05$) as well as ocular health screening ($\chi^2 = 64.70$, $p<0.05$) compared to the urban locations.

Table 2. Summary of the referral rate of vision screening outcomes of JCMM. The number represented the individuals that failed and were referred either based on visual complaints, visual acuity or ocular health screening

		Visual Complaint			**Visual Acuity**			**Ocular Health**		
	Locations (n)	**Referral cases by location**	**Referral Percentage by location**	**Rural versus Urban referral**	**Referral cases by location**	**Referral Percentage by location**	**Rural versus Urban referral**	**Referral cases by location**	**Referral Percentage by location**	**Rural versus Urban referral**
Rural (1158)	Bagan Dato, Perak (268)	244	91%	1,048 (91%)*	58	22%	366 (32%)*	36	13%	203 (18%)*
	Bentong, Pahang (84)	80	95%		53	63%		13	15%	
	Besut, Terengganu (44)	41	93%		23	52%		5	11%	
	Bota, Perak (154)	153	99%		132	86%		88	57%	
	Dungun, Terengganu (72)	64	89%		8	11%		13	18%	
	Jeli, Kelantan (84)	82	98%		0	0%		11	13%	
	Pagoh, Johor (248)	204	82%		11	4%		15	6%	
	Pekan, Pahang (93)	80	86%		18	19%		3	3%	
	Sungai Besar, Selangor (70)	59	84%		46	66%		12	17%	
	Tanah Merah, Kelantan (41)	41	100%		17	41%		7	17%	
Urban (1981)	Alor Setar, Kedah (82)	78	95%	1,091 (55%)*	23	28%	480 (24%)*	8	10%	159 (8%)*
	Bukit Katil, Melaka (198)	182	92%		43	22%		11	6%	
	Bukit Melawati, Selangor (378)	353	93%		236	62%		76	20%	
	Kajang, Selangor (39)	28	72%		4	10%		0	0%	
	Paroi, Negeri Sembilan (265)	68	26%		7	3%		0	0%	
	Pasir Gudang, Johor (91)	89	98%		14	15%		31	34%	
	Port Dickson, Negeri Sembilan (646)	31	5%		5	1%		5	1%	
	Selayang, Selangor (282)	262	93%		148	52%		28	10%	
	*****Total referred**	**2,139 (68%)**			**846 (27%)**			**362 (12%)**		

*Indicate statistically significant difference between rural and urban comparison using a chi-square test for homogeneity, $p<0.05$.

Discussion

Our study allowed direct comparison between rural and urban by minimising screeners, equipment, and controlled environment variations in screening space and lighting. Vision problem patterns were more apparent in rural populations (ranging from 18% to 91%) compared to urban (8% to 55%) in all vision screening categories. Three categories of vision screening (visual complaint, visual acuity, and ocular health) were discussed below to understand the impact of diverse vision problem patterns in rural and urban comparison.

Our visual complaint screening employed the interview approach coupled with a checklist. Visual complaints had been associated with various vision problems in binocular vision, dry eye and computer vision syndromes (Chen & Rosli, 2022; Edwards, 2010). Any signs and symptoms could indicate underlying vision problems (Gomes & Santo, 2019; Jaiswal et al., 2019). Ocular surface discomfort was associated with sore eyes, dryness, stinging, burning, itchiness and irritation, while visual discomfort could be linked to blurred vision, difficulty in refocusing between viewing distances, headache, eye strain and double vision (Jaiswal et al., 2019; Talens-Estarelles et al., 2023). Our referral rate based on visual complaint screening alone was relatively high, about 91% and 55% in rural and urban, respectively. Previous reports of visual complaints in rural areas were about 74% to 86%, compared to urban areas of 31% to 40% (Ebeigbe & Emedike, 2017; Portello et al., 2012). Our findings agreed with the previously reported 'rural higher than urban' trend but slightly higher than the previously reported range. Visual complaints might predict the vision-related quality of life or potential future vision problems (Ebeigbe & Emedike, 2017). Our close to twofold higher referral rate in rural areas prompted pressing concern for preventive eye health care education and promotion, like visual hygiene practices in rural locations. Visual hygiene aimed to reduce visual stress on our visual system during day-to-day activities (Talens-Estarelles et al., 2023).

Visual acuity screening involved direct measurements and did not rely solely on the memory recall of participants (Marsden et al., 2014). It might be more effective in screening children who were more likely to experience difficulties expressing their vision problems through visual complaints (Karande & Kulkarni, 2005). Our rural (32%) exhibited higher referral than urban (24%) in visual acuity screening. Our visual acuity finding was in agreement with the previously reported 'rural higher than urban' trend but slightly lower than the previously reported range of 36.5% to 61.5% in rural (Lam et al., 2012; Shah et al., 2008), and slightly higher than the previously reported range of 7.7% to 14.5% in urban (Alvi et al., 2015; Kvarnström et al., 2001). Our findings reflected the urbanisation effect of the industry revolution. The transformation of human mobility patterns since IR 3.0 influences micro-level human behaviours and well-being and macro-level social organization and change (Wu et al., 2016). The combined effects of urbanisation (air pollution, sedentary lifestyles and poor diet) contribute to the expanding worldwide epidemic of chronic diseases (Al-Nuaim et al., 2012; Chen et al., 2020). The lack of awareness of primary eye care might be the contributing factor (Alemayehu et al., 2018). Even though most of the eye screening was free, attendance for regular eye tests remained poor (Cheng et al., 2015). Visual acuity problems might affect the related visual quality of life issues caused by uncorrected refractive error (Dandona et al., 2002; Saw et al., 2006).

Ocular health screening aimed to detect any asymptomatic abnormalities in the eye. Late detection could be detrimental and lead to vision impairment (Michaud & Forcier, 2014). Our study reported higher rural (18%) referrals than urban (8%) in ocular health screening. A similar 'rural higher than urban' trend was seen in previous reports on ocular health screening (rural 63% and urban 26%), but our percentages were far below those previously reported range (Taylor, 2008; Thomas et al., 2005). The visual health risk had been related to more exposure to outdoor UV, low socioeconomic status and unhealthy lifestyle (Singh et al., 2019). Although the ocular health risk of our participants was not at the alarming stage, 1 to 2 out of 10 participants that we screened failed ocular health screening.

The limitation of study might be involved of inadequate screening for specific age groups and imperfect accessibility in remote rural areas. Certain age groups, such as children or the elderly, may not receive as much attention in terms of eye health screenings compared to other age groups in this study. Access to eye health services can be challenging in remote rural areas of Malaysia. These regions may have fewer healthcare facilities, including eye clinics and hospitals, and residents may need to travel long distances to access care, which is not in our coverage by the mobile busses.

Conclusion

There was a consistent pattern of higher rural referrals for all types of vision screening. Information from our three-category screening analysis could help to strategies a vision screening design for our rural and urban population. Designing an efficient vision screening program especially for the rural populations entails careful concern of the unique challenges and characteristics of these areas. Some recommended strategies for a vision screening program in rural settings were involves community engagement and education, utilizes of mobile clinics and outreach approach, collaborates with local healthcare providers, form a team of multidisciplinary approach, develops systematic referral system and follow-up care, and involves mechanism of evaluation and feedback to assess the program's effectiveness and make necessary enhancements. By incorporating these strategies, a vision screening program for rural populations can be more inclusive, accessible, and effective in identifying and addressing eye health issues in these underserved areas. Additionally, ongoing community engagement and education efforts can help sustain the program's impact over time.

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