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REVIEW ARTICLE

Impact of rurality on optical health: review of the literature and relevant Australian Bureau of Statistics data

AJ Saliba

Charles Sturt University, Wagga Wagga, New South Wales, Australia

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Saliba AJ

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ABSTRACT

Context: Rurality is associated with a number of direct and indirect causes of eye disease. The direct causes are best described as lifestyle factors, such as exposure to UV light and occupational risks. Indirect factors are those where the occurrence of a predisposition is magnified due to rural population distributions, for example gender and age.

Issue: Research into rurality and optical health is limited, so definitive increases in the prevalence of vision disease are difficult to ascertain. Furthermore, establishing the need for additional optometrists in rural areas has been mixed in the literature. The current review addresses the relationship between rurality and optical health and suggests an increase in available optometrists in rural areas.

Lessons learned: Age is the single largest correlate of vision disease, with an increase in age over 40 years correlating significantly with a range of vision diseases. Rural New South Wales (NSW) Australian areas contain a higher proportion of 'older' residents than urban equivalents. Gender is also a correlate of vision disease, although the phenomenon is more complex than for age. Rural NSW populations contain a higher ratio of men to women than do urban areas, which is significant. Rural residents are exposed to higher levels of UV radiation than their urban counterparts, increasing the prevalence of pterygium. Rural residents experience higher levels of occupational eye injury and may have less stringent eye safety standards. The interaction between vision and hearing loss can accentuate occupational safety vulnerability and general living difficulties. Rural communities experience higher levels of noise-induced hearing loss. Rural communities experience higher levels of certain eye disease and may be exposed to an increased risk from indirect factors such as age, gender and private health insurance ownership. Rural

communities may have lower access to optometrists and this review suggests increasing the number of optometrists in rural Australia. The amount of research conducted on factors associated with rurality and optical health should be increased.

Key words: age, Australia, gender, noise-induced hearing loss, optical health, rural lifestyle, rural occupational risk, rurality, UV light, optometrist.

Context

Recent policy history on optical health

Key work undertaken to develop policy on optical health in Australia falls outside the scientific literature and is therefore not found in academic databases. The 2001 National Health Survey revealed that 9.7 million Australians or 51% of the population had at least one sight problem[1]. Quality of life gains from improving vision in such a large proportion of the population are potentially large. The cost of such an undertaking is significant and full financial modelling was undertaken as a response to this finding.

Eye Research Australia commissioned two reports. The first estimated the economic impact and cost of vision loss in Australia[2]. Taking into account the direct costs of vision loss as well as indirect factors, such as loss of earnings and carer costs, the report estimated that the real financial cost of vision impairment was greater than $5 billion in Australia in 2004. The report also estimated that the cost of human suffering and premature death was a further $4.8 billion in 2004. A second report outlined strategies to prevent vision loss in Australia[3]. The report showed that programs to reduce vision loss could produce significant cost savings in the long term. The framework of the program included:

- regular vision testing, particularly for high-risk groups
- reducing risk factors
- preventing eye injuries
- enhancing access to low vision services.

Optometrists provide the bulk of services required to address these issues and are therefore a major component of the framework. It is likely that these reports will garner substantial government spending on addressing optical health due to the potential to save government spending on health interventions, as well as increasing quality of life.

Specific eye disease and treatment pathways

Optometrists play a role in managing almost all eye-related injuries, disease and checkups, even if it is only to refer patients to specialty healthcare providers. It is difficult to determine the exclusive role of an optometrist because their role intersects with several medical specialty areas. The role of optometrists will be considered separately to that of medical doctors, ophthalmologists and other professionals where possible.

There are five eye conditions that account for 75% of vision loss. They are (in order of prevalence)[3]:

- refractive error (62%)
- cataract (14%)
- macular degeneration (10%)
- glaucoma (3%)
- diabetic eye disease (2%).

Taylor[4] stated that approximately 50% of blindness and 70% of vision impairment in Australia is a result of preventable or treatable conditions. A significant proportion of vision loss is caused by uncorrected refractive error, a condition most often treated solely by optometrists. Optometrists also play a role in treating the other prevalent eye diseases.

A cataract is a cloudy area in the eye's lens that causes blurred vision and photophobia. Due to the nature of the symptoms, optometrists are often first to examine patients with cataract. On diagnosis, these patients are referred to an ophthalmologist who will perform surgery to remove the cataract. Because of the high success rate of the surgery (only 1–2% experience complications) and the highly procedural nature of the treatment, it has been suggested that optometrists could be trained to perform cataract surgery[5]. Optometrists may diagnose macular degeneration; the disease is incurable although several drugs offer some relief[6]. Optometrists may be the first to treat patients with glaucoma and diabetic eye disease. Because the occurrence of symptoms is usually associated with advanced stages of these diseases, early detection through regular examinations is preferable.

The optometrist is the major 'front of house' for most eye-related disorders. Refractive corrections are generally solely performed by the optometrist, whereas other disorders may include co-treatment with other professionals. This report will consider the range of disorders that optometrists treat, including those managed with the input of other professionals. The demand for medical practitioners and ophthalmologists will not be reviewed; ophthalmology is a *medical* specialisation and not a continuation of the four-year degree course in optometry. However an increase in the demand for ophthalmological services may be indirectly influenced by increases in the number of optometrists trained and generating referrals.

Issue: Rurality and eye disease

Refractive error

Refractive error, as the most prevalent cause of vision impairment in Australia, is reviewed specifically. Refractive corrections are made almost exclusively by optometrists. Only one study was found on the rate of refractive error in both urban *and* rural populations in Australia. That study reported no difference in prevalence of undercorrected refractive error between the two populations in a Victorian sample of those 40 years and older[7]. No significant differences were found in visual acuity improvement between urban and rural participants of the study after required corrections had been applied. This suggests that the rural sample received equivalent treatment prior to the study. The authors acknowledge that the results are not generalisable to other states, particularly to more remote, sparsely populated zones. The inclusion of participants of less than 40 years of age may have influenced the results because recent studies have shown that up to 10% of 12 year-old children in Australia have uncorrected visual impairment in at least one eye[8].

Further study is required to ascertain whether rates of undercorrected refractory error in rural areas are equivalent to that in urban areas. However, no evidence for significant differences between the areas has been established, although this is based on only one study.

Availability of services

One study reports that the supply of optometrists is sufficient to meet the needs of the Australian population as a whole, but calls for further investigation of needs at local levels[9]. The Australian Institute of Health and Welfare produced a report on the optometric labour force in 1999 (reported in[10]) which showed substantial variation in the distribution of the optometric workforce. The number of optometrists (by population number) in large rural centres was equivalent to that found in urban areas. However, the number of optometrists dropped by 2% from large rural centres to small rural centres, and by a further 5% in remote centres. The largest disparity was reported for 'other rural areas' (12% less than large rural centres) and 'other remote areas' (greater than 17% disparity). These data also support the call for investigation at a more local level to determine whether other remote areas have sufficient access to eye care professionals.

Utilisation of services

There are large differences in the utilisation of healthcare services between urban and rural populations, even where the overall prevalence of eye disease is similar[11,12]. One study hypothesises that the difference is related to the availability of healthcare professionals[13]. The data strongly support that assertion for ophthalmologists, but the situation is more complex for optometrists. Rural residents are less likely to have ever seen an eye-health professional, although this finding is influenced by the fact that ophthalmology services were utilised at significantly lower rates in rural areas.

The same study reported that urban residents (based on 4744 Victorians) were 17% more likely to have private health insurance, and that having private health insurance increased the likelihood of seeing an eye-care professional by almost 50%. Studies in other countries have also found that health insurance ownership correlates positively with visits to health professionals[14]. This is an intuitive finding because health insurance ownership requires payment, and therefore the owner would intend to utilise the product. The assertion that rural residents have less private health insurance in Australia is more tenable. The Australian study is based on a Victorian sample and results may not be generalisable to the rest of Australia. Further investigation of private health insurance ownership and locality of residence should be undertaken because no information on this topic was identified.

Rural and Indigenous populations

Rural populations tend to experience higher levels of disease and lower access to health services than their metropolitan counterparts. Multiple explanations have been reported, including greater travel distances, cost[15] and attitudes[16].

Australia's Indigenous population continues to experience much poorer health than other Australians[17]; rural populations comprise 3% Indigenous Australians while in metropolitan populations this is only 1%. This proportional difference is not high enough to impact on differences in health status between people living in metropolitan and rural zones. There may, however, be differences between metropolitan and remote zones. For people living in non-remote areas, similar proportions of Indigenous (49%) and non-Indigenous people (51%) reported having an eye disorder[18]. Therefore, for the purposes of this report, Indigenous Australians will not be considered separately.

Age factors

Vision impairment is highly age-correlated. It is well known that the need for refractive correction increases with age due to a loss of flexibility in the lens, as well as other factors[19]. One study[6] found that age was the strongest predictor of undercorrected refractive error in a Victorian population. Eye Research Australia[3] used Australian Bureau of Statistics (ABS) data to demonstrate a strong positive correlation between age and the prevalence of cataract, glaucoma, age-related macular degeneration, diabetic retinopathy and refractive error. Significant increases in refractive error can be seen for every decade of life after 40 years of age.

Keeffe and colleagues[11] found that utilisation of eye care services increased with age. As with many diseases, age may have the greatest influence on visual impairment. It is therefore important to consider the age distribution of rural compared with urban populations.

Figure 1 illustrates the age disparity between urban and rural populations in New South Wales (NSW). Rural populations include substantially more 45–54 and 55–64 year olds, while urban populations contain more of those aged 75–84 and 85 years and older. Further modelling of ABS data is required to enable specific claims to be made, but Figure 1 suggests that rural populations in NSW contain a greater proportion of older residents than urban populations. This may translate to a higher incidence of vision impairment in rural areas compared with urban locations and, therefore, suggest an increased need for eye care.

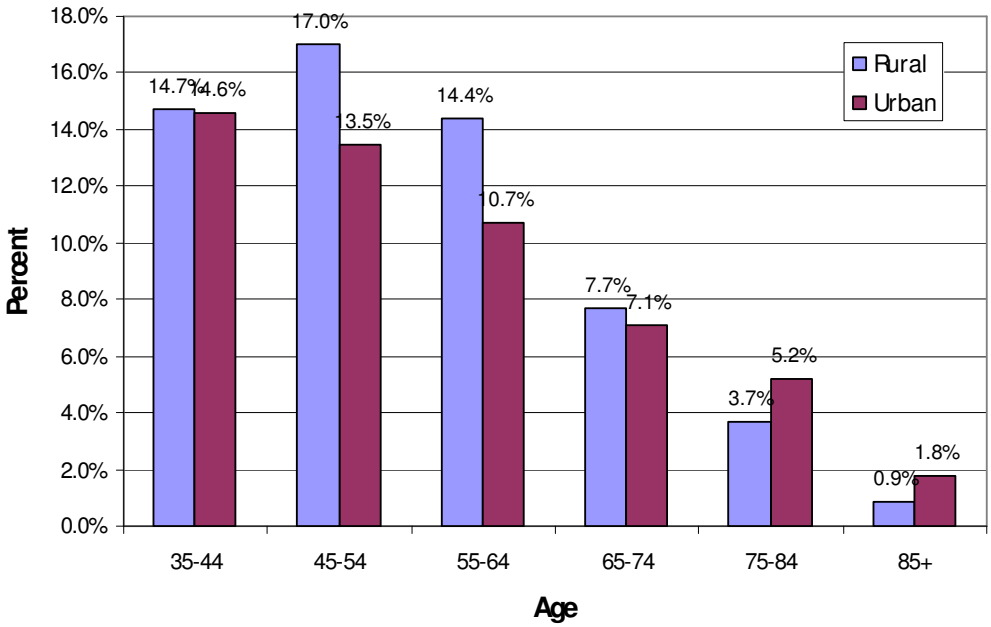

Figure 1: Percentage of population by age for rural and urban areas in New South Wales. Generated using Australian Bureau of Statistics data[20] and ABS definitions of urban and rural.

Influence of gender

Men utilise health services much less frequently than women[21]. Men are less likely to arrange regular check-ups[12] and are also less likely to have symptoms checked for fear of wasting the health professional's time[22]. Keeffe and colleagues[11] reported that men are more likely to never see an eye-care professional (at a ratio of one woman to 0.77 men). One study has shown that the effect for rural men may be even greater[23].

Strodl found that rural men tended to deny symptoms even of a chronic nature, only seeking help when symptoms were regarded as life threatening[23]. This phenomenon has also been demonstrated in a rural NSW sample[24]. Buckley and Lower[25] have tentatively suggested that work related factors, such as shift times, may restrict males living in rural areas from utilising health services. Males who did not have restrictive work requirements were 1.62 times more likely to utilise health services. The authors recognised that their study of the Midwest region of Western Australia was limited in size (71 rural males) and that generalisability to the rest of Australia was questionable.

Because men do not utilise health care to the same extent as women, it is not surprising that men in the USA are less likely to have private health insurance[12]. No Australian study could be found on gender and private health insurance ownership.

Urban men are three times more likely to experience ocular trauma than women; for rural men the rate increases four-fold[26]. It has been hypothesised that the higher rate of ocular trauma for rural men is due to comparatively higher rates of eye injury being reported in mining and agricultural industries[8].

Men are also approximately twice as likely to experience pterygium[27], a condition that is treated by an optometrist, except in serious cases where the patient is referred to an eye

surgeon. The major cause of pterygium is thought to be UV radiation[28]. The prevalence of pterygium increases sharply in rural populations at approximately equal rates for males and females[24]. A possible explanation is that rural residents are exposed to greater amounts of UV radiation as a general lifestyle factor, which will be discussed later.

In summary, men are more likely to experience ocular trauma, and the risk increases for rural men. Men are more likely to experience pterygium. Men are less likely to utilise health services and less likely to have symptoms checked, and this effect may be more pronounced in rural men. These combined findings suggest that men are at greater risk of experiencing vision disease. Men, and particularly rural men, may benefit from targeted campaigns to promote health checks and other safety-related behaviours. Rural optometrists should participate in such a campaign.

Table 1 shows the ratio of males to females in rural and urban NSW populations (ABS data [20]). It is noteworthy that NSW rural populations have a higher ratio of men to women (1.07:1) than urban populations (0.96:1). This could, in part, explain why rural populations experience greater levels of vision disease.

Lifestyle factors

There is a clear gender effect for ocular trauma, with men being more likely to experience injury than women. The effect of rurality on ocular trauma is less clear. One study has shown that metropolitan women are significantly less likely to experience ocular trauma than their rural counterparts, but that the magnitude of difference is only 0.3%[24]. It is questionable whether this difference relates to a differing lifestyle between areas of residence. The prevalence rate for men, however, increases from 30.5% to 42.1% for rural residents, a significant change likely to be related to inherent lifestyle factors. A study in the La Trobe Valley, a rural region of Victoria, Australia found that eye injuries accounted for 12% of all presenting injuries at the local hospital, whereas the rate reported at state capital Melbourne-based hospitals was 5%. Occupational activities accounted for over one-third of eye injuries; 40% of the non-occupational eye injuries occurred while performing maintenance-related activities[29].

It is likely that rural residents are exposed to more UV radiation than their urban counterparts. UV radiation is a major cause of cataract and pterygium. The prevalence of pterygium in rural adults is more than five times that reported for urban adults[24], increasing from 1.2% to 6.7% for rural residents. McCarthy and colleagues demonstrated that sunlight is the largest attributable risk, further supporting the hypothesis that the rural lifestyle introduces greater levels of UV exposure[24].

The interplay between UV exposure, occupational risk and attitudes toward safety is complex, but a specific eye condition known as Albury-Wodonga syndrome provides evidence of their combined importance[30,31]. Also known as harvester's eye or Christmas eye, the condition occurs in summer and is caused by 4–5 days of severe corneal sunburn. The prevalence of this condition is unknown and further research is required to understand the ideal treatment regime. No research has followed Howsam's 1995 pilot study[28] on the use of drops which called for further research. The existence of a rural-based research group in the area of eye health may provide resources to conduct such research. One study claims that the cost of treating preventable vision loss is less than what would be required to deal with the consequences of the vision impairment[32]. Further, a strong case exists for research into vision loss that can be neither prevented nor treated.

Madden and colleagues[8] claimed that rural lifestyle factors such as diet, smoking, exposure to UV radiation, occupational hazards and attitudes to work safety may all play a role in increasing the prevalence of vision impairment. No supporting evidence was provided, and a full review of Australian population data available on these known risk factors and their prevalence in rural areas needs to be undertaken before definitive claims can be made. This relational approach is necessary because there is a paucity of causal data on rural lifestyle and the risk of vision disease.

Table 1: Distribution of males and females in rural and urban locations in New South Wales, using the Australian Bureau of Statistics defined rural/urban localities[20]

Group	Total population	Total male or female	Overall %
Rural			
Male	571 255	295 445	51.72
Female	571 255	275 810	48.28
Urban			
Male	5 967 593	2 926 920	49.05
Female	5 967 593	3 040 673	50.95

Interaction with hearing loss

There is evidence that rural NSW populations experience higher levels of noise-induced hearing loss than their urban counterparts[33]. Safety equipment is available to help prevent hearing loss from the use of loud and very loud machinery[34], but it is likely that poor attitudes towards safety hinder the protective benefits that such equipment can offer. Research has shown that approximately two-thirds of farmers have a measurable hearing loss or hearing levels 10–15 years worse than the rest of the population[35].

Research has demonstrated the important role that visual cues play in human sound localisation[36] and speech intelligibility[37]. In populations with a high prevalence of hearing loss, it becomes even more important to identify vision deficits and to treat or educate clients on the interaction between their vision and hearing loss. Poor sound localisation ability can increase the likelihood of accidents, while poorer speech intelligibility can lead to a range of difficulties. The higher prevalence of hearing loss reported in rural communities increases the importance of delivering vision health services to this community.

Lessons learned

The current report has reviewed major policy research and all scientific research that could be found on rurality and optical health. There is a general paucity of research in this area and further scientific research should be encouraged. Six recommendations follow.

Recommendation 1: Refractive error in rural areas

The current review found only one study on the prevalence of refractive error in rural compared with urban populations. That study[6] showed no difference in uncorrected refractive error but was based on a Victorian sample. Further work should examine other sources of information (eg ABS, Medicare) to provide a current and comprehensive picture for all of Australia.

Recommendation 2: Up-skilling optometrists

The management of some eye diseases has become so procedural and routine that they could be treated by an optometrist, rather than a medical specialist. The identification of suitable diseases is beyond the scope of this review, but the Optometrists Association Australia and universities teaching optometry form key components of any long-term strategy to treat a greater range of eye disease through optometric services.

Recommendation 3: Number of optometrists in rural areas

Rural residents appear to utilise health services at lower rates than their urban counterparts, and some hypothesise that this may be due to inequity of access[11]. There is evidence that the availability of optometrists in rural areas (by some definitions) may be below that in urban areas; if this is so, the number of optometrists practising in rural areas should be increased.

Recommendation 4: Private health insurance and rurality

Private health insurance ownership promotes good health practices, such as seeking regular health checks. A Victorian study has shown that rural residents are less likely to have private health insurance[11]. Further investigations should be made as to the prevalence of private health insurance ownership in rural Australia and, potentially, rural Australians should be encouraged to take up private health insurance.

Recommendation 5: Age distribution in rural and urban areas

It has been established that age is a strong correlate of vision disease, and ABS data has shown that there are more 'older' residents in rural NSW than in urban areas[20]. The age disparity between rural and urban areas may be one of the most important factors associated with rurality and optical health. The age disparity should be considered when developing solutions to rural optical health issues, as well as generic health phenomena related to rurality.

Recommendation 6: Gender distribution in rural and urban areas

It has been established that males may be at greater risk of vision disease than females, and a higher proportion of males were reported living in rural NSW areas. Specific campaigns should target rural men because this segment of the population is predisposed to a higher incidence of vision disease and are also less likely to seek treatment.

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