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SOCIAL INNOVATION TO IMPROVE VISION SCREENING FOR CHILDREN IN NEW ZEALAND

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INTRODUCTION

There are stories of children jumping up 12 reading levels within one school term when they start wearing glasses. Other stories tell of children who hate school for years and who then pick up confidence and start to read when they get their glasses (Russell, 2019). Children are a vulnerable population who depend on the adults in their lives to meet their needs for basic resources like spectacles. The availability of sufficient eye care services to children can be helped by simple referral pathways between education and health systems, including clear processes that aid follow-up, and the provision of spectacles (Burnett et al., 2018). In 2019, 1000 years after spectacles were invented, it is still possible for New Zealand children to go without spectacles throughout their school years without anyone noticing.

In September 2015, the UN General Assembly adopted the Sustainable Development Goals (SDGs) to stimulate action in areas of critical importance for humanity and the planet. The SDGs are built on the commitment to leave no one behind. These goals can also help to address the areas where countries like New Zealand might be falling behind, such as vision health for children. The SDG for Health (Goal 3: Good Health and Well-being) aims to "Ensure healthy lives and promote well-being for all at all ages" and in especially to "Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks" (Goal 3.D). This provides good linkages with the World Health Organisation Global Action Plan on Universal Eye Health, which calls for access to comprehensive and equitable eye care services for all, with an emphasis on vulnerable groups. Early detection and effective management of eye health conditions in children and youth would also contribute to achieve the SDG on Education (Goal 4), by reducing drop-out rates and improving academic excellence. Correction of refractive errors (that is, using spectacles) can an enormous difference to learning and general education.

At present, New Zealand provides two opportunities for vision screening for children. The first is the B4 School Check at the age of four when children are screened for amblyopia ('lazy eyes'), but not for other conditions that might affect their capacity to read such as refractive errors (long sightedness and short sightedness), or eye coordination. At the age of 10-11, children are again tested, but this time it is only for distance vision. In both of these situations, parents need to respond to the findings of the screening and to do something, if necessary. It is increasingly recognised that these screening opportunities are neither identifying all the children who have problems, nor providing ways of addressing the problems even if they are picked up (Davison & Russell, 2019).

Given the high prevalence of visual impairment due to uncorrected refractive errors in children, and the simplicity of treatment, the detection and correction of refractive errors is a significant public health issue. Refractive error (need for spectacles) is defined as the inability of an eye to bring parallel rays of light into focus on the retina resulting in a blurred image. There are three types of refractive error: myopia (short-sightedness, which compromises distance vision); hypermetropia (long-sightedness, compromising near vision); and stigmatism, caused by a non-spherical cornea, which impairs both distance and near vision (Evans, 2018).

Uncorrected refractive error is an important cause of visual impairment in children (Resnikoff, 2008). A meta-analysis of the prevalence of different conditions in children indicates that, the 11.7 percent have myopia, 4.6 percent have hyperopia, and 14.9 percent have astigmatism. The proportions vary across the world and we do not know what the percentages are in New Zealand. However, there is evidence that severe short sightedness (myopia) is becoming much more common (Hashemi et al., 2018). In terms of the time spent on visual-related academic tasks in school, 47 percent of activity involves near tasks, nine percent involves computer tasks, 15 percent involves distance-to-near tasks, and 29 percent involves distance tasks (Narayanasamy et al., 2016).

Children need to be able to see to make good use of educational opportunities at school, since 80 percent of the learning process is dependent on vision (AOA, 2017). Refractive errors and binocular vison conditions cause eyestrain, blurry vision, and diplopia putting these children at a disadvantage (Renner, 2017). Preschool children with uncorrected hyperopia score significantly worse on the Test of Preschool Early Literacy (TOPEL) when compared to children who had normal vision (Kulp, 2016). Even marginally reduced visual acuity is associated with a lower performance in mathematics (Cueto et al., 2017). In addition, children who just fail a basic vision screening test (i.e. not the full optometry test) are show to be disadvantaged in spelling grammar, reading and numeracy (White et al., 2017). It seems that reduced vision conditions cause poor focus, perseverance and class participation, affecting academic performance and leading to psychosocial stress (Dudovitz, 2016).

On the other hand, an improvement in learning has been demonstrated within six months of receiving spectacles in a lower socioeconomic area in the US (Renner, 2017). In an experimental study, Glewwe, Park and Zhao (2016), randomly assigned glasses to primary school students in China and found that providing the children with glasses increased achievement. In a qualitative study, participants described how receiving corrective lenses improved classroom attention, task persistence, and willingness to practice academic skills (Dudovitz, 2016).

There is wide variation in the vision screening protocols used worldwide (Burnett et al., 2018). We know that screening programs are expensive, and yet something needs to be done to improve the situation for children. In this project, we decided to trial a protocol where the children would be made responsible for screening the vision of their classmates. The hypothesis was that this method might allow significant numbers of children to be screened in a short period of time, while the children also learn about their eye sight. We wanted to examine whether such a screening process could be integrated into the school curriculum. The involvement of the children in this way could potentially build sustainability into the screening process. Ideally, it might be possible to arrive at a situation where vision screening could be a normal part of the school curriculum.

METHOD

We chose to use a screening toolkit called the Eyes Right Toolkit (ERT). This is a screening test that was originally developed for older adults (Jessa, 2009). It can be used to test both near and distance acuity, and also includes contrast sensitivity testing. It was found to be 80 percent sensitive for older adults and the question was whether it might also be sensitive to visual impairment in schoolchildren. The advantage of the ERT is that it comes as a standardised kit so that it can be used by lay people (Royal National Institute of Blind People [RNIB], 2017), and includes a booklet explaining how to do the test, a flipchart, a measuring tape, marking charts, and letters to be sent home with the results of the screening. A simple video demonstrating how to use the ERT is available on YouTube (Thomas Pocklington Trust, 2016).

The ERT was developed by an occupational therapist employed by the Pocklington Trust and has been used widely as a means of raising awareness about low vision in the UK. Each kit costs about $30 and the author was granted copyright permission to develop and publish the ERT for the New Zealand context. The first print run of 30 units

was done in collaboration with Retina NZ. An app was developed by third year information technology students and this can be found in the Google Play Store under: 'Otago Polytechnic – Eyes Right Toolkit.'

Ethics permission was obtained through the Otago Polytechnic Committee (Ethics B) in May 2018. We approached a decile one school and received permission to complete an interactive educational session for students aged 14 and 15 years in place of one of their physical education classes. Letters were sent to parents, offering an opt-out option (passive permission) and information was also sent out in a school newsletter.

The educational session was carried out by two occupational therapy students as part of their final year community project. This session was divided into three parts: (a) a presentation about common eye problems and ways of protecting the eyes against computer vision syndrome, myopia, and UV damage; (b) a vision simulation exercise, where students were given a series of tasks to complete with low vision goggles, including writing/texting, and playing table tennis; and (c) a demonstration of how to do the ERT screening, followed by an exercise where students screened each other. Each schoolchild received a letter at the end of the screening. This letter said either that they had passed the screening, or that they had not passed. Students who did not pass the screening test received a 50 percent discount voucher for a local optometrist. At the end of the session, students were invited to fill in a feedback form.

RESULTS

Seven classes completed the classroom session over two weeks in August /September 2018. In total, 122 year students from Years 9 and 10 (aged 14 and 15) were screened. There were no students who opted out of the classes, however one student who was non-literate was offered an alternative form of screening. One non-verbal student was able to complete the screening by typing the letters onto his assistive talk technology.

Of those who took the test, 17 percent (21) failed the screening and were given a referral letter to take home (with a discount voucher for a local optometrist). At the end of one month, none of the children who failed the vision screening (or their parents) had taken up the option of using the half price vouchers to visit the optometrist. At this point, a reminder was sent to all parents through the school newsletter and one family took up the opportunity to go to the optometrist.

Teachers indicated informally that they were pleased with how the class session had gone. They valued the exercise and suggested that they would like the vision screening to be repeated. They were surprised that so many children failed the test. Schoolchildren were asked for feedback about the teaching session overall and about the screening tool in particular. In general, it appeared that the students enjoyed the class and learned from the key messages (see Figure 1).

Feedback about the teaching session
"It was useful learning what some common eye problems are and what can cause them"
"It helped me understand what other people might live with"
"It let me know I could see well, and all about the harmful stuff that can happen to my eyes and how I can protect them"
"It was good fun"
"I really enjoyed this session"
"That eye health is important"
"The consequences of screen time"
"About different eye diseases and the effects also 20/20/20 thing when you use devices"
Feedback about the screening tool
"It was really good to use because the instructions were clear and easy to understand"
"It was good, but I feel it could've been bit more complex"
"It was simple but hard to find the right page"
"I found out that I need an eye test"
"I learned about eye diseases and another way to test eyesight"

Figure 1. Feedback from school children about the evaluation of the session

DISCUSSION

In 2017, a charity called the Essilor Vision Foundation screened 3000 primary school children in low decile areas in the North Island of New Zealand, and found that 30 percent of these school students required a full optometry assessment (Collins, 2017). In this project, it was found that just 17 percent of children at age failed the vision screening. Although this seems like a high percentage, it is not as high as that found by the Essilor Foundation. There are some differences between the ERT and usual vision screening for children. For example, near vision testing is not usually included in vision screening for children. In addition, the ERT includes a test of contrast sensitivity. This is potentially important because contrast sensitivity is the most comprehensive single means of evaluating the visual system's response to pattern information, and has a role in mobility, recognition of faces and the ability to undertake daily living tasks (Milling, Connor, & Newsham, 2014). However, contrast sensitivity is not usually included in vision screening for children either. It is not known whether the ERT is more or less sensitive than other screening assessments and this will require further research.

The fact that almost no parent took up the suggestion to have a full optometric assessment was one of the most interesting findings from this study. This was a decile one school, so it might be expected that cost was an issue for those families in a lower socioeconomic bracket. The 50 percent discount voucher was clearly not enough of an incentive to persuade parents to take their children to see an optometrist. A recent systematic review (Evans, 2018) indicated that provision of a prescription only leads to poor uptake of follow up with an optometrist. This means that even if children are screened, there needs to be more work done to ensure that there is adequate follow up. There is funding available including a 'spectacle subsidy' up to the age of 15 for children who come from families with a community services card. This entitles them to $287.50 per year, which pays for the optometry assessment, and includes $138.00 that can go towards frames. In 2018, 26,660 claims for the subsidy were approved. However, optometrists claim that this is just the tip of the iceberg and there are many more claims that could be

made (Russell, 2019). It seems clear that more research is needed to explore why parents find it difficult to access optometric services in the New Zealand context. If this is found to be a significant problem, then research is needed to help design cost effective solutions and to design a user journey that provides delivery of spectacles to those children who need them.

In previous research, it has been found that vision screening generally needs to be paired with provision of free/cheap spectacles in order to improve the number of children who have and who wear the spectacles they need. In the New Zealand Essilor project (Collins, 2017), each child was given two pairs of spectacles. One of these was kept at the school, and the other was sent home with the children. The Essilor project echoes similar projects in the US, such as 'Vision to Learn', which is a school-based programme that provides free corrective lenses to low-income students (Dudovitz, 2016). These projects demonstrate the power of providing vision care in schools, rather than in clinics. Two pairs of spectacles are necessary because one year after a similar project was conducted in the US, only 28.9 percent children in a lower socioeconomic area still had their glasses, and the rest were either lost or broken (Renner, 2017). The two pairs of spectacles method offers a useful reminder of the need to ensure that glasses are actually available to the child to assist with learning in school.

One of the findings is that there should be an alternative version of the ERT for those students who are non-literate. This could be done using the 'tumbling E' or 'tumbling C' variety of test. It is particularly important that children who are learning disabled receive the screening because of the high association between visual impairment and learning disability. Van Splunder (2006) demonstrated that 14 percent of the population with intellectual disability also have a visual impairment and 40 percent of these go undetected into adulthood.

One of the aims of this study was to demonstrate that vision screening can be successfully administered by school students and it was extremely effective in doing this. It has previously been found that using teachers to conduct vision screenings can be a cost cutting measure for programs (Burnett et al., 2018). This small research project goes a step further to suggest that children can conduct vision screening of each other in the context of the school curriculum. It was demonstrated that schoolchildren could be taught to administer the vision screening program efficiently and effectively. Feedback indicated that children enjoyed the process and learned from it. They did not need to lose time from their education, because the vision screening exercise was integrated into the curriculum. The use of the ERT, combined with messages about eye health, was seen as appropriate classroom material in the physical education/health program. It is likely that vision screening could also be fitted into other aspects of the curriculum. For example, if it were integrated into the science curriculum, children could be taught about the concept of fair testing. The important point is that 122 pupils were able to receive screening, with no additional resourcing from the school.

Social innovation is needed in order to meet SDG goals for health and education. An aspect of inequity that has received little attention is the impact on learning of even small variations in vision function for children. It is important to ensure a ready supply of free/cheap spectacles for children, and an awareness of the impact of visual impairment on learning. Children should not have to struggle through school, thinking that they are stupid, when there is a simple solution. Instead of needing to find funding for expensive public health specialists to screen children for their vision, we propose that children could take control of this element of their own well-being. New Zealand is a small country with limited resources and it is necessary to find smart solutions to the problems of primary health care including vision screening. In developing countries, there are models where teachers have integrated vision screening into their teaching process (Latorre-Arteaga et al., 2016). Similar processes could be adopted in NZ and what is learned here could be shared back into developing countries in order to meet SDG goals.

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