

School Vision Screening Data Informing a County-Based Community Health Needs Assessment

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Abstract

Purpose: The objective of this study was to (I) analyze Arkansas school nurse vision screening data, (II) provide a county-based pediatric vision care need assessment, and (III) evaluate eye care provider workforce in both rural and urban settings to overcome the vision screening follow-up care gap.

Methods: Descriptive statistics and paired t-Tests ($p < 0.05$) were calculated for the number of students receiving vision screening, number of students referred to an eyecare provider, number of students receiving follow-up vision care, the vision screening referral rate, and follow-up rate for all public and charter schools in the state of Arkansas.

Findings: The mean number of students screened in rural counties (mean \pm SD; 1530.5 \pm 1170.9) was statistically significantly (t-Test 2-tail, $p = 0.003$) lower than the mean number of students screened in urban counties (7301.10 \pm 7663.45). The referral rate was comparable in rural counties (9.41% \pm 4.95%), compared to urban counties (9.29% \pm 5.16%). Nearly two-thirds of the children who failed their vision screening did not receive a follow-up comprehensive eye exam (rural: 68.26% \pm 17.48%; urban: 66.30% \pm 11.91%). Rural counties had just 1.03 \pm 0.86 eye care providers per 10,000 people, compared to urban counties which had 1.30 \pm 1.11 eye care providers per 10,000 people.

Conclusions: The purpose of school nurses screening children for vision abnormalities is to recognize and treat ailments early to ensure students have the best opportunity to learn. This study unveiled that rural and urban Arkansas school children alike go without follow-up eye care after failing their school vision screening two-thirds of the time. Rural areas have less eye care providers per capita and have a greater burden placed on each eye care provider, however, the follow-up care rate is comparable in rural and urban areas.

Keywords: Rural Eye Care, Amblyopia; Nurse Vision Screening

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Background and Significance

The leading cause of pediatric vision impairment – lazy eye (amblyopia) – is often fully reversible if detected and treated prior to age 5 (Donahue et al., 2013). However, if this condition is not treated the brain develops without learning how to properly utilize both eyes. After age 7, some lazy eye vision impairment can be permanent (Holmes et al., 2011).

The pooled prevalence of amblyopia is 1.44% (95% CI 1.17% to 1.78%) (Fu et al., 2020). Prior studies have shown that children in medically underserved areas are at the highest risk for underdiagnosis of amblyopia (Simmons, 2005). Amblyopia once detected in young children is affordably and effectively treated using an eye patch or atropine eye drops (Jefferis et al., 2015). By decreasing stimuli to the stronger eye, the brain is trained to reconnect with the malfunctioning eye and it progressively regains its strength and neural pathways. The outcomes are poor for older children and adults – surgical realignment of ocular muscles may be performed with only partial improvement (Koo et al., 2017).

In 2006, the Arkansas legislature established Code §6-18-1501 specifying a pediatric vision screening procedure to be completed by all public and charter school nurses for children in pre-kindergarten, kindergarten, Grade 1, Grade 2, Grade 4, Grade 6, Grade 8, and all transfer students. Prior to this landmark improvement there was no unified policy preventing Arkansas children from going through all of primary education without proper vision care. Amblyopia, cataracts, and uncorrected refractive error would not be detected early enough to preserve vision and the opportunity for educational achievement.

The school nurse vision screening procedure is regulated to include the assessment of gross eye appearance, visual acuity, visual acuity with a +2.00 lens, color perception, binocular stability, and various instrument tests. Students with abnormal eye alignment, frequent head tilt, visual acuity of 20/40 or worse, improvement of 2 eye chart lines with a +2.00 lens, incomplete color perception, unequal eye muscle stability, or failure of an instrument test are registered with the Department of Education screening registry as having a failing vision screening.

Fast forward 15 years, Arkansas nurses screened a total of 206,338 students for vision abnormalities in the 2020-2021 academic year alone. Although only 11.7% (24,107) of students failed their vision screening, 68.0% (16,402) of those students failing their screening went without follow-up care from an ophthalmologist or optometrist.

When two-thirds of those at risk do not receive the follow-up eye care they need, the purpose of screening has been squandered. This unfortunate reality has been consistently documented in Arkansas Annual School Vision Screening Reports for years (Follow-Up Rate 2017: 61.7%, 2018: 64.9%, 2019: 65.0%, 2020: 68.7%, 2021: 68.0%) Lindsey, n.d.-a, n.d.-b, n.d.-c; McDonald, n.d.-a, n.d.-b).

Prior studies have also noted differences in vision care outcomes for rural school children when compared to those living in urban areas. Rural areas generally have fewer eye doctors and thus families may have greater difficulty obtaining care. However, numerous studies have unveiled rural school children have comparatively lower rates of myopia, hypermetropia and astigmatism (He et al., 2007; Padhye et al., 2009). Grzybowski et al. (2020) posited that high population density might be a surrogate for less time spent outdoors and more hours performing near work tasks (Grzybowski et al., 2020).

The U.S. Census Bureau had defined urban clusters as having between 2,500 to 49,999 residents and urbanized areas have 50,000 residents or more, comparatively rural is all that is outside of urban clusters and urban areas (as cited in the Rural Health Information Hub, n.d.). More specifically, for the purposes of this study rural counties are those that the Federal Office of Management and Budget defines as not containing a core urban area of 50,000+ people or an adjacent county that has a high degree of social and economic integration with the urban core (i.e. commuting to work).

The purpose of this manuscript is multipronged. The purpose includes:

- (I) analyze school nurse vision screening data,
- (II) provide a county-based pediatric vision care need assessment, and
- (III) evaluate eye care provider workforce in both rural and urban settings to overcome the Arkansas school vision screening follow-up gap.

Methods

The University of Arkansas for Medical Sciences Institutional Review Board determined that this study was exempt and not considered human subjects research. Deidentified school vision

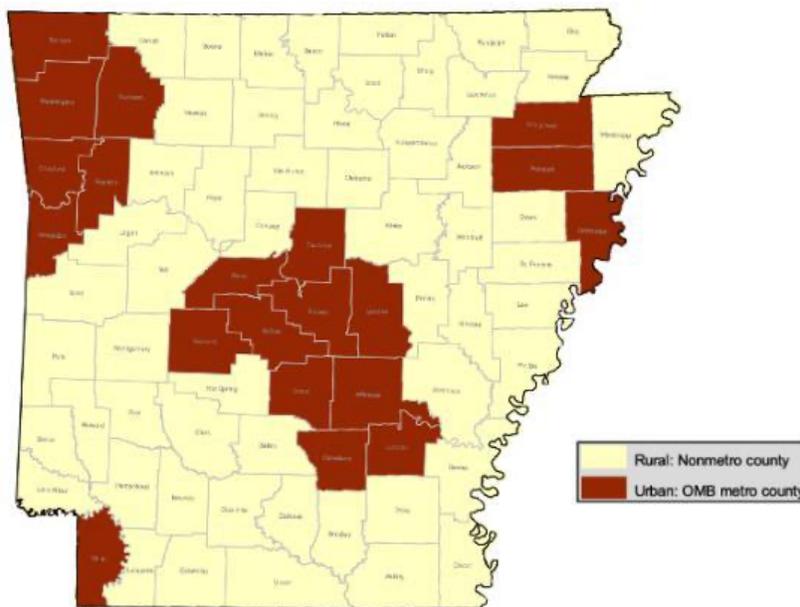
screening data from the 2020-2021 academic year was acquired from the Arkansas Department of Education on 3/11/2022.

Descriptive statistics (average, standard deviation) were calculated for the number of students receiving vision screening, number of students referred to an eyecare provider, number of students receiving follow-up vision care, the vision screening referral rate, and follow-up rate using Microsoft® Excel (version 16.56, Redmond, WA) for all public and charter schools in the state of Arkansas.

The Local Education Agency (LEA) code look-up tool on the Arkansas Department of Education data repository was utilized to determine the county in which each school resided. Data were combined for all schools within each respective county and subsequently counties were categorized as rural or urban per the OMB classification as pictured in Figure 1.

Figure 1

Rural vs. Urban County Classification Federal Office of Management and Budget



The ophthalmology and optometry workforce was quantified via the 2020 US Federal Health Resources and Services Administration records and the 2020 Arkansas Manpower Report.

Statistical significance was set at $\leq .05$. Paired t-tests were performed comparing the number of students screened, school nurse referral rate, and student follow-up rate with an eyecare professional in rural compared to urban counties.

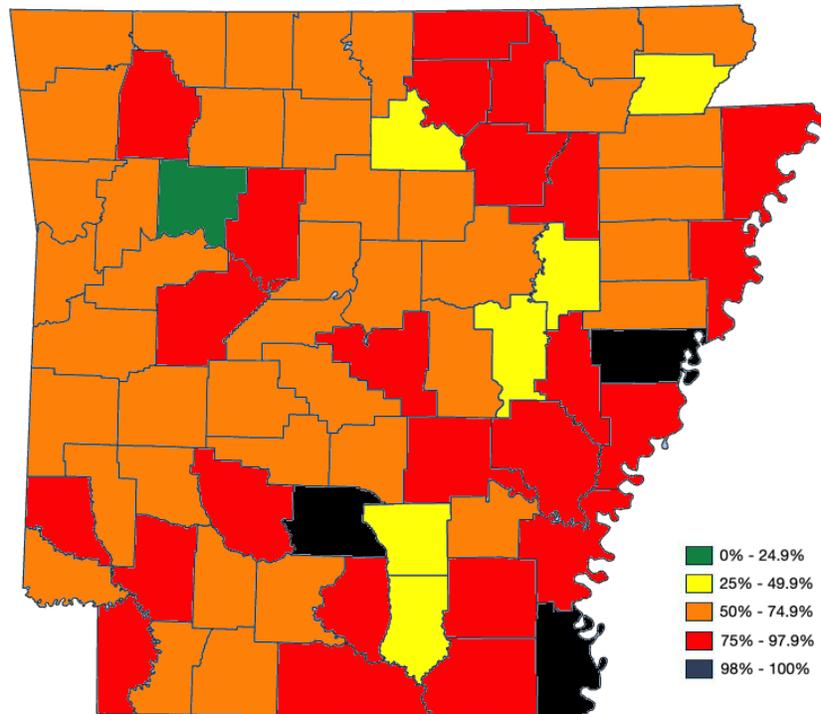
Results

Of the 1,050 Arkansas public and charter schools analyzed, 1019 (97.0%) reported screening at least one student. For the 31 schools without reported vision screening data, 22 (71.0%) were high schools, 3 (9.7%) were preschools, 2 (6.5%) were elementary schools, 1 (3.2%) was a middle school, 1 (3.2%) was a K-12 integrated program, 1 (3.2%) was a civilian training program, and 1 (3.2%) was an online independent learning platform.

A total of 230,578 students were screened and 24,116 were referred to an eye care provider. There were 7,793 (32.3%) students who received follow-up care, whereas 16,323 (67.7%) students did not receive follow-up care. The mean number of students screened in rural counties (mean \pm SD; 1530.5 \pm 1170.9) was statistically significantly (t-Test 2-tail, $p = 0.003$) lower than the mean number of students screened in urban counties (7301.10 \pm 7663.45). The referral rate was comparable in rural counties (9.41% \pm 4.95%) compared to urban counties (9.29% \pm 5.16%). The follow-up rate was similar between rural (31.74% \pm 17.48%) and urban (33.70% \pm 11.91%) counties (t-Test 2-tail, $p = 0.645$). Figure 2 graphically depicts each counties vision screening follow-up rate.

Figure 2

Percentage of Students Without Follow-Up Care



Both rural and urban county public and charter schools had nearly two-thirds of the children who failed their vision screening go without follow-up care (rural: 68.26% +/- 17.48%; urban: 66.30% +/- 11.91%). Rural and urban county vision care data analysis outcomes and capacity are summarized in Table 1 below.

Table 1

Comparing Rural vs. Urban County School Vision Screening Outcomes & Eye Care Capacity

School Nurse Screening Vision Care Outcomes & Care Capacity			
	Rural (55 Counties)	Urban (20 Counties)	t-Test (2-Tailed)
Total Number of Students			
Receiving vision screening	84,175	146,022	
Referred to an eyecare provider	8,428	15,663	
Receiving follow-up vision care	2,651	5,094	
Not receiving follow-up vision care	5,777	10,569	

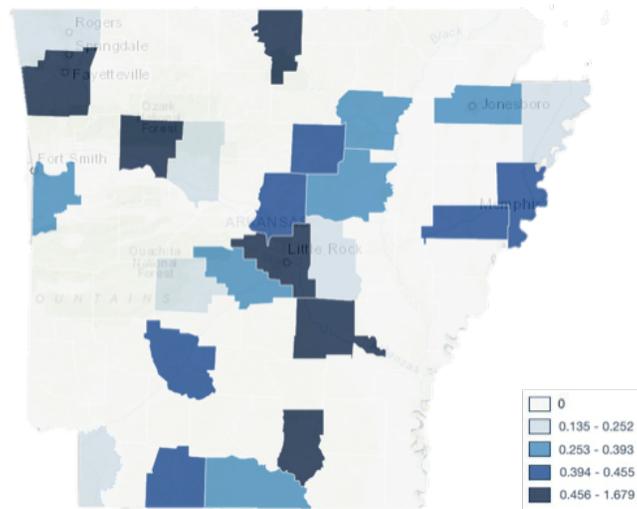
Average Number of Students +/- SD			
Receiving vision screening	1530.45 +/- 1170.86	7301.10 +/- 7663.45	p = 0.0033
Referred to an eyecare provider	153.24 +/- 151.21	783.15 +/- 984.84	p = 0.0103
Receiving follow-up vision care	48.20 +/- 54.08	254.70 +/- 349.44	p = 0.0164
Not receiving follow-up vision care	105.04 +/- 104.05	528.45 +/- 660.99	p = 0.0102
Average Percentage of Students +/- SD			
Vision screening referral rate	9.41% +/- 4.95%	9.29% +/- 5.16%	p = 0.9290
Vision screening follow-up rate	31.74% +/- 17.48%	33.70% +/- 11.91%	p = 0.6445
Vision screening no follow-up rate	68.26% +/- 17.48%	66.30% +/- 11.91%	p = 0.6445
Total Number of Providers			
Ophthalmologists	20	109	
Optometrists	114	308	
Combined Eye Care Providers	134	417	
Combined Eye Care Providers per 10,000 People	1.03 +/- 0.86	1.30 +/- 1.11	
Average Number of Providers +/- SD			
Ophthalmologists	0.36 +/- 1.04	5.45 +/- 14.55	p = 0.1348
Optometrists	2.07 +/- 2.33	15.40 +/- 19.64	p = 0.0069
Combined Eye Care Providers	2.44 +/- 2.91	20.85 +/- 31.62	p = 0.01759
Relative Care Capacity Ratio			
Number Referred / Number of Eye Care Providers	62.90	37.56	
Relative Care Gap Ratio			
Number Without Follow-up Care / Number of Eye Care Providers	43.11	25.35	

The US Federal Health Resources and Services Administration reported 129 practicing Arkansas ophthalmologists in 2020. The 2020 Arkansas Manpower Report reported that there were 422 practicing optometrists. The total number of eye care providers in Arkansas was 551. There were 20 counties found to not have a practicing ophthalmologist or optometrist. Of these counties, 15 were rural and 5 were urban. Rural counties averaged 0.36 +/- 1.04 ophthalmologists and 2.07 +/- 2.33 optometrists, whereas urban counties had greater care capacity averaging 5.45 +/- 14.55 ophthalmologists and 15.40 +/- 19.64 optometrists. Moreover, rural counties had just 1.03 +/- 0.86 eye care providers per 10,000 people, compared to urban counties which had 1.30 +/- 1.11 eye care providers per 10,000 people. An assessment of relative need shows that rural providers areas

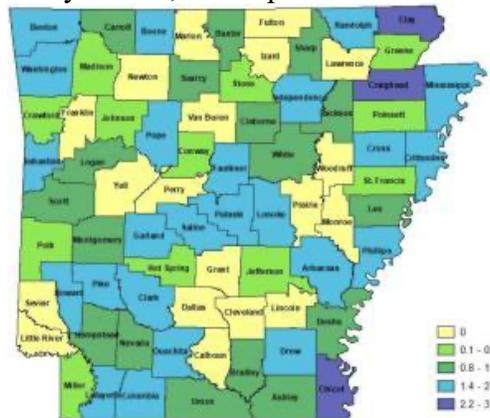
have an average demand for service of 62.90 school nurse screening follow-up referrals per provider, which is 67.5% greater than urban eye care providers who have an average of 37.56 vision screening follow-up referrals. Figure 3 provides a breakdown of the ophthalmologist and optometrist availability by county.

Figure 3

Eye Care Professional Workforce Map



Note. Ophthalmologists by County Per 10,000 Population



Note. Optometrists by County Per 10,000 Population

Conclusion

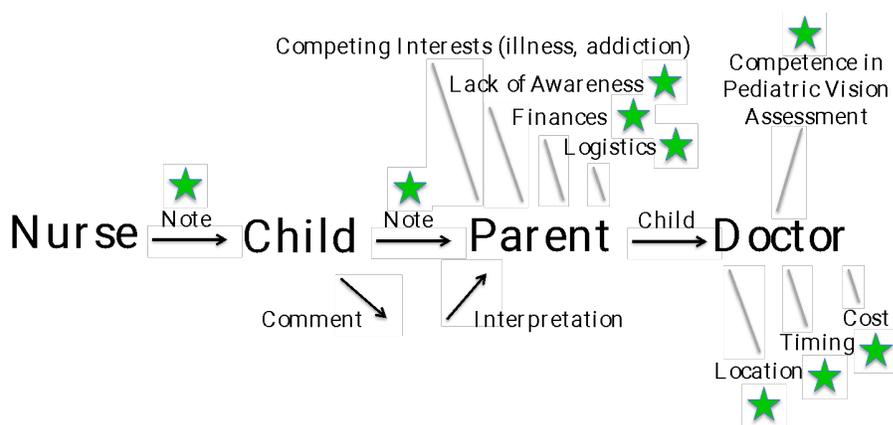
This study unveiled that rural and urban Arkansas school children alike go without follow-up eye care after failing their school vision screening two-thirds of the time. The purpose of school

nurses screening children for vision abnormalities is to recognize and treat ailments early, ultimately ensure students have the best opportunity to learn. Rural areas have less eye care providers per capita and have a greater burden placed on each eye care provider, however the follow-up rate is comparable between rural and urban areas. Further efforts are needed to foster community partnership between school nurses who perform the screenings and eye doctors who conduct the follow-up evaluation and treatment. Ultimately educating family members, school administrators, and teachers in a more holistic approach may hold the key to improving follow-up care conversion from screening to treatment.

Researchers have previously identified barriers to eyecare including transportation, logistics, timing, cost, family awareness, health literacy, and access to an eyecare provider (Balasubramaniam et al., 2013; Elam & Lee, 2014; Kimel, 2006). A Fish Bone diagram graphically depicting the layered factors undermining poor nurse vision screening follow-up rates is shown in Figure 4.

Figure 4

Barriers to Vision Care Fish Bone Diagram



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