

Executive Summary: Health Impact Review of HB 1865

Concerning Visual Screening in Schools

Evidence indicates that HB 1865 has potential to increase the number of students who have near vision problems detected and treated, which in turn has potential to improve educational, income, and health outcomes for these students. Although evidence suggests that this bill could decrease disparities in undiagnosed near vision problems by race/ethnicity and income, it is unclear how the bill would impact treatment and long-term outcomes across student subpopulations.

BILL INFORMATION

Sponsors: Representatives Magendanz, Ortiz-Self, McCaslin, Hayes, Pollet

Summary of Bill: Requires every board of school directors to provide for screening for near vision acuity in addition to screening already required for distance vision acuity.

HEALTH IMPACT REVIEW

Summary of Findings:

This Health Impact Review found the following evidence regarding the provisions in HB 1865:

- Strong evidence that school-based near vision screening would likely increase detection, diagnosis, and treatment of near vision problems in at least some students.
- Very strong evidence that detecting and treating near vision problems would lead to improved academic outcomes for these students.
- Very strong evidence that improving academic outcomes would likely increase educational attainment for these students.
- Very strong evidence that increasing educational attainment would likely improve health outcomes for these students.
- Very strong evidence that increasing educational attainment would likely increase earning potential for these students.
- Very strong evidence that increasing earning potential would likely improve health outcomes for these students.
- Unclear evidence for the bill's impact on health disparities. Evidence suggests that this bill could decrease disparities in undiagnosed near vision problems by race/ethnicity and income, however it is unclear how the bill would impact treatment and long-term outcomes across student subpopulations. See the full Health Impact Review for a detailed analysis of the potential impacts of HB 1865 on health disparities.

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Health Impact Review of HB 1865

Concerning Visual Screening in Schools

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Introduction and Methods

A Health Impact Review is an analysis of how a proposed legislative or budgetary change will likely impact health and health disparities in Washington State ([RCW 43.20.285](#)). For the purpose of this review ‘health disparities’ have been defined as the differences in disease, death, and other adverse health conditions that exist between populations ([RCW 43.20.270](#)). This document provides summaries of the evidence analyzed by State Board of Health staff during the Health Impact Review of House Bill 1865 ([HB 1865](#)).

Staff analyzed the content of HB 1865 and created a logic model depicting possible pathways leading from the provisions of the bill to health outcomes. We consulted with experts in school-based health and vision screening. State Board of Health staff can be contacted for more information on which stakeholders were consulted on this review. We conducted objective reviews of the literature for each pathway using databases including PubMed and Google Scholar.

The following pages provide a detailed analysis of the bill including the logic model, summaries of evidence, and annotated references. The logic model is presented both in text and through a flowchart (Figure 1). The logic model includes information on the strength of the evidence for each relationship. The strength-of-evidence has been defined using the following criteria:

- **Not well researched:** the literature review yielded few if any studies or only yielded studies that were poorly designed or executed or had high risk of bias.
- **A fair amount of evidence:** the literature review yielded several studies supporting the association, but a large body of evidence was not established; or the review yielded a large body of evidence but findings were inconsistent with only a slightly larger percent of the studies supporting the association; or the research did not incorporate the most robust study designs or execution or had a higher than average risk of bias.
- **Strong evidence:** the literature review yielded a large body of evidence on the relationship (a vast majority of which supported the association) but the body of evidence did contain some contradictory findings or studies that did not incorporate the most robust study designs or execution or had a higher than average risk of bias; or there were too few studies to reach the rigor of ‘very strong evidence’; or some combination of these.
- **Very strong evidence:** the literature review yielded a very large body of robust evidence supporting the association with few if any contradictory findings. The evidence indicates that the scientific community largely accepts the existence of the association.

Staff made modifications to these criteria at the start of the 2015 legislative session beginning January 12, 2015. Therefore strength-of-evidence rankings may not be comparable between reviews completed before and those completed after this date.

This review was subject to time constraints, which influenced the scope of work for this review. The annotated references are only a representation of the evidence and provide examples of current research. In some cases only a few review articles or meta-analyses are referenced. One article may cite or provide analysis of dozens of other articles. Therefore the number of references included in the bibliography does not necessarily reflect the strength-of-evidence. In addition, some articles provide evidence for more than one research question so they are referenced multiple times.

Analysis of HB 1865 and the Scientific Evidence

Summary of HB 1865

Requires every board of school directors to provide for screening for near vision acuity in addition to screening already required for distance vision acuity.

Health impact of HB 1865

Evidence indicates that HB 1865 has potential to increase the number of students who have near vision problems detected and treated, which in turn has potential to improve educational, income, and health outcomes for these students. Although evidence suggests that this bill could decrease disparities in undiagnosed near vision problems by race/ethnicity and income, it is unclear how the bill would impact treatment and long-term outcomes across student subpopulations.

Pathways to health impacts

The potential pathways leading from the provisions of HB 1865 to improved health are depicted in Figure 1. There is strong evidence that vision screening leads to increased detection, diagnosis, and treatment of vision problems in at least some students.¹⁻⁶ There is very strong evidence that near vision problems are associated with adverse academic outcomes and that treating vision problems is associated with improvements in these outcomes. For example, near vision problems have been linked to lower reading level, lower reading scores, and slower reading speed. Treating vision problems has been linked to improved grades and standardized test scores.⁷⁻⁹ In addition the literature indicates that there is very strong evidence that improved educational outcomes are associated with higher educational attainment,¹⁰⁻¹³ that higher educational attainment is associated with better health,¹⁴⁻²³ and that higher educational attainment is associated with higher earning potential.^{19,24} There is also very strong evidence that improved earning potential is associated with improved health outcomes.^{19,20,23,25-28}

The likely impact of near vision screening on health disparities is less clear. Overall the evidence suggests that universal school near vision screening could help decrease health disparities in undiagnosed near vision problems as low-income and students of color are more likely to have their vision problems undiagnosed.⁸ However, if those students do not receive follow-up care, an abnormal screen will not result in improved vision, and at least one study has found that low-income students may be less likely to receive follow-up eye exams.⁴ A majority of the evidence, though, does suggest that once treatment (e.g. eye-glasses) are prescribed, that there is similar eye-glass use across student populations,⁶ and that vision problems in students were being adequately corrected regardless of child race/ethnicity or parental income or education attainment.³ Low-income students and students of color are also more likely to be falling into the educational opportunity gap, so detection and treatment of near vision problems (even if not distributed similarly across all student populations) may have a greater positive impact on these students because they are facing greater academic repercussions as a result of untreated vision problems.

In addition, experts in school-based health in Washington have indicated that school nurses already have a workload that exceeds their capacity, a problem that is worse in schools with fewer resources. These experts have expressed that without additional funding for more screening, some schools may not have the capacity to meet this new mandate. This could lead to the additional risk that low-income schools would be less likely than schools with greater resources to implement effective screening programs.

Due to time limitations we only researched the most direct connections between the provisions of the bill and decreased health disparities and did not explore the evidence for all possible pathways. For example, potential pathways that were not researched include:

- Evidence for how near vision problems impact quality of life outside of the classroom.
- Evidence for how near vision problems impact behavior and involvement in the justice system.
- Evidence for the potential benefits of diagnosing near vision problems even if they go untreated (e.g. decreased risk of misdiagnosed learning disabilities, student and parent understanding, support from school personnel).

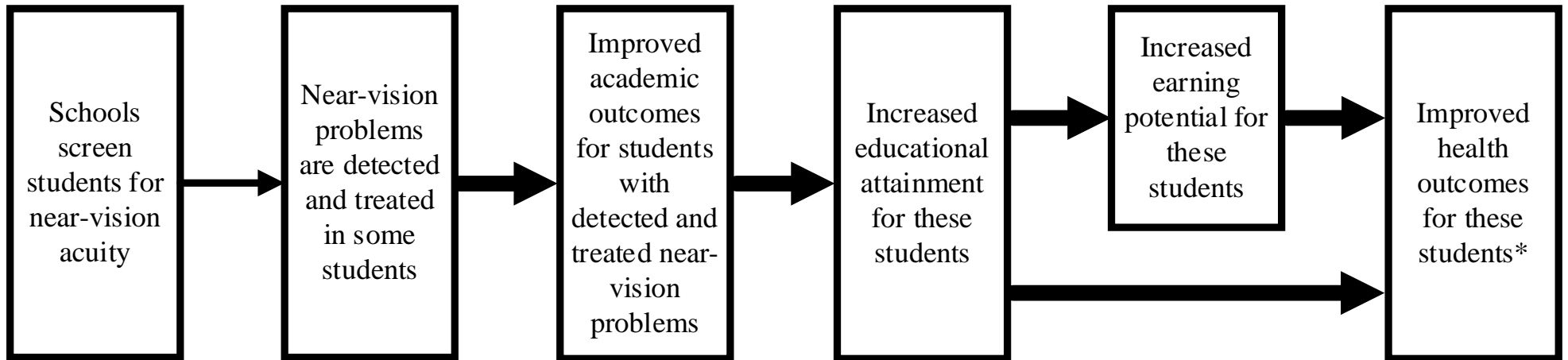
Magnitude of impact

The fiscal note for HB 1865 estimates that school nurses annually screen about 490,652 students for far vision acuity. While schools may voluntarily screen for near vision acuity, experts in school-based health and vision screening in Washington have indicated that they don’t know of any schools that are currently screening for near vision problems, so we have assumed that this same number of students would begin to be screened for near vision acuity as a result of HB 1865.

We do not have good data on the number of near vision problems among students in Washington State because this is not currently routinely screened for. Therefore the following estimates of the number of students with near vision problems who would be detected are very rough estimates that often depend on findings from one study which may not be fully generalizable to Washington. Research has found that somewhere between 4% and 12.8% of students screened had abnormal results for near vision acuity.^{1,8} This indicates that, in Washington, somewhere between 19,626 and 62,803 students may be referred for a follow-up eye exam. Studies have found varying results on how many parents will take their child for a follow-up eye exam after receiving a letter indicating that their child had an abnormal vision screening. These rates range from 32% to 70%.^{1,2,4} This indicates that between 6,280 and 43,962 students may actually attend a follow-up appointment. One study found that 80% of students who received a follow-up exam after being referred from a screening program had visual abnormalities⁴— indicating that between 5,024 and 35,170 referred students who seek follow-up may be diagnosed. Research suggests that the percent of students who wear their glasses once prescribed and obtained ranges from about 13% to 82%,⁶ which indicates that between 653 and 28,839 Washington students may actually see an improvement in their near vision as a result of school-based screening. These estimates are also provided in Table 1.

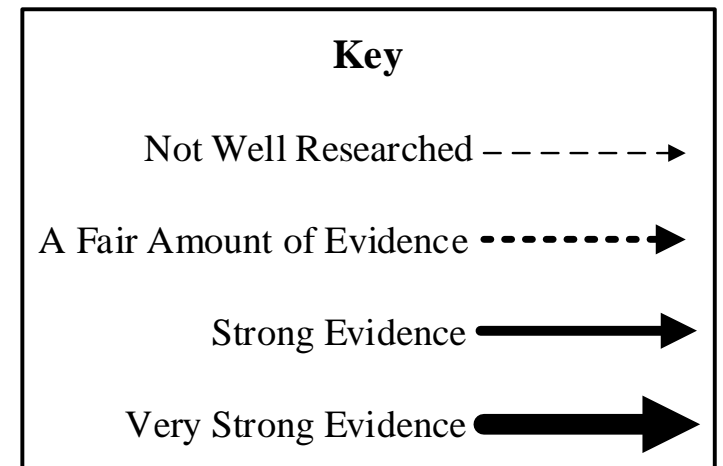
Table 1. Estimated Magnitude of Impact of School-Based Near Vision Screening in Washington	
Estimated number of students to be screened	490,652
Estimated number of students to be referred for follow-up exam	19,626 to 62,803
Estimated number of students to attend follow-up exam	6,280 to 43,962
Estimated number or students to be diagnosed with a visual abnormality	5,024 to 35,170
Estimated number of students to see an improvement in their near vision	653 to 28,839

Logic Model



*See the full Health Impact Review for a detailed analysis of the potential impacts of HB 1865 on health disparities

Figure 1
Concerning Visual Screening in Schools
HB 1865



Summaries of Findings

Will screening for near vision acuity lead to near vision problems being detected and treated?

There is strong evidence that vision screening leads to increased detection, diagnosis, and treatment of vision problems in students. The evidence does not suggest that **all** students with screened-for vision problems will be detected through school-based screening, that all parents who receive a letter from the school recommending that their child receives a follow-up eye exam will take their child to a follow-up exam, or that students prescribed glasses will wear them when needed. However, at least some students who would have otherwise gone undetected with near vision problems will likely be detected and treated leading to an improvement in their vision.¹⁻⁶ Studies have found varying results on how many parents will take their child for a follow-up eye exam after receiving a letter indicating that their child had an abnormal vision screening. These rates range from 32% to 70%.^{1,2,4} Parents have cited several barriers to attending a follow-up eye exam including cost, lack of time, lack of transportation, difficulty making an appointment, having all adults in the household working, and not seeing vision care as a priority.²

In order for vision screening to actually lead to improved vision, students need to receive both a follow-up eye exam with diagnosis and treatment, and to wear their glasses. Research suggests that the percent of students who wear their glasses once prescribed and obtained ranges from about 13% to 82%.⁶ One study found that 28% of vision problems had been adequately corrected at follow-up (meaning that the child had been prescribed and was wearing appropriate corrective lenses).³ Parents and students have cited several barriers to wearing glasses such as youth losing or breaking them.⁶ So, while the evidence suggests that the rates of follow-up and compliance with treatment (e.g. wearing glasses) following vision screening is not universal, and in some cases can be quite low, it does indicate that some youth who would have otherwise gone with undetected and untreated vision problems will receive and wear glasses and see an improvement in their vision.

Will near vision problems being detected and treated lead to improved academic outcomes for those students?

There is very strong evidence that near vision problems are associated with adverse academic outcomes and that treating vision problems is associated with improvements in these outcomes. For example, near vision problems have been linked to lower reading level, lower reading scores, and slower reading speed. Treating vision problems has been linked to improved grades and standardized test scores.⁷⁻⁹ For example, one study found that near vision problems were associated with lower levels of reading, but that when 25 students were given vision correction 84% of them gained over 20 percentage points in their achievement test percentile rank.⁷ Evidence also indicates that undetected or untreated vision problems can also be a risk factor for social or emotional problems, but we did not fully explore these potential links.⁸

Will improving academic outcomes for these students lead to increased educational attainment?

There is very strong evidence that improved educational outcomes are associated with higher educational attainment.¹⁰⁻¹³ For example, one study found that low grades during primary school were predictive of not having completed a secondary education by age 20 or 21.¹³ These links are well documented and because this connection is widely accepted, less time was dedicated to researching this relationship. In addition several measures of educational outcomes are innately indicative of education attainment (e.g. specific grades are required as a prerequisite for high school graduation—one measure of educational attainment) further supporting the strength-of-evidence for this relationship.

Will increased educational attainment for these students improve health outcomes?

There is very strong evidence that higher educational attainment is associated with better health. Data collected nationally and in Washington State indicate a correlation between higher educational attainment and positive health outcomes such as decreased rates of diabetes, oral health problems, tobacco use, inactivity, obesity, depression, and coronary heart disease. The correlation between health and education is observed even after controlling for income, which can also serve as a mediating factor.¹⁴⁻²³

Will increased educational attainment for these students improve earning potential?

There is very strong evidence for the connections between increasing educational attainment and increasing income as well as decreasing rates of unemployment. These links are well documented globally, and data indicate that these trends do exist in Washington State as well.^{19,24} Because this connection is widely accepted, less time was dedicated to researching this relationship.

Will improved earning potential for these students improve health outcomes?

There is very strong evidence that economic instability, low-income, and low socioeconomic status (SES) are associated with adverse health outcomes, such as, depression, acute and recurring infections, poor health-status, higher body mass index (BMI), and poor oral health.^{19,20,23,25-28} Data indicate that the correlation between low-income and poor health is also found in Washington State.^{19,20,23}

Will improved health outcomes for these students lead to decreased health disparities?

The impacts of universal school near vision screening on health disparities are unclear. There are several mechanisms through which universal school screening could impact gaps in educational opportunity and health outcomes. The following questions must be considered:

- Will screening detect more vision problems among some populations than others?
- Will some populations be more likely to receive treatment if a near vision problem is detected?
- Will some populations be more likely to comply with treatment (e.g. wear glasses) if prescribed?

Evidence indicates that low-income and youth of color are more likely to have vision problems in general and to have **undiagnosed** vision problems.⁸ This indicates that universal school-screening would have a greater positive impact on these student populations in regards to detecting near vision problems. However, the evidence is unclear concerning which students will receive a follow-up eye examination once a parent or guardian has received a letter from the school indicating that their child received an abnormal vision screen and recommending that their child receive an eye examination because they had an abnormal vision screen. One study found that there was no difference in follow-up exams by insurance status (a proxy for income), but that students receiving free/reduced lunch (another proxy for income) were less likely than their counterparts to receive a follow-up exam following an abnormal screen.⁴ Evidence is also not fully consistent with regard to compliance in eye-glass use among different student populations. While some evidence has found that White students were more likely than their counterparts to wear their glasses once prescribed,⁸ a majority of the studies have found **no** significant difference in compliance by parental education or socioeconomic status or student race/ethnicity.⁶

Overall this evidence suggests that universal school near vision screening could help decrease health disparities in undiagnosed near vision problems as low-income and students of color are more likely to have their vision problems undiagnosed in the absence of school screening.⁸ However, if those students do not receive follow-up care, an abnormal screen will not result in improved vision. A majority of the evidence, though, does suggest that once treatment (e.g. eye-glasses) is prescribed, that there is similar compliance across student populations.⁶ In addition, another study found that vision problems in students were being adequately corrected regardless of child race/ethnicity or parental income or education attainment.³ Another important point to consider is that low-income students and students of color are more likely to be falling into the educational opportunity gap, so detection and treatment of near-vision problems (even if not distributed similarly across all student populations) may have a greater positive impact on these students because they are facing greater academic repercussions as a result of untreated vision problems.

This discussion assumes that near vision screening would be implemented in all Washington schools. However, experts in school-based health in Washington have indicated that school nurses already have a workload that exceeds their capacity, a problem that is worse in less resourced schools. These experts have expressed that without additional funding for more screening, some schools may not have the capacity to meet this new mandate. This could lead to the additional risk that low-income schools would be less likely than more resourced schools to implement effective screening programs.

Annotated References

1. Kemper AR, Helfrich A, Talbot J, Patel N. Outcomes of an elementary school-based vision screening program in North Carolina. *The Journal of School Nursing*. 2012;28(1):24-30.

Kemper et al. indicate that North Carolina has a unique electronic database which can be used to track vision care following school vision screening. Data from the North Carolina Department of Health and Human Services indicate that in the 2009-2010 school year over 70% of students referred for follow-up exams as a result of the school-based vision screening received follow-up exams. These data show that the schools conducted nearly 500,000 vision screenings leading to more than 25,000 eye exams. Vision screening occurs in most North Carolina schools in kindergarten through fifth grades—but schools can opt out of the screening. Distance visual acuity and stereopsis (depth perception) screening are recommended. The state also recommends that schools send a letter with the screening results home to parents and that the school make three additional attempts to contact the parents to ensure that follow-up was completed. Washington State does not require follow-up with parents in addition to the original letter, and therefore the compliance rates in North Carolina may not be fully generalizable to Washington. Kemper et al. analyzed 2009-2010 data for first, third, and fifth grade students from ten elementary schools in four counties in North Carolina that complied with the screening recommendations and where the screening program was administered by school nurses. Two-hundred nine (7.7%) of the 2,729 children screened had an abnormal screening result. Eighty-nine percent of the 209 students were entered into the database. The school nurse was able to collect subsequent eye examination results from nearly 57% of those who were in the database, with an additional 14% of parents reporting that they had taken their child for a follow-up exam—indicating that at least 71% of those students in the database who were referred for follow-up actually received a follow-up exam. Of those who provided eye exam results, 54.7% had far-vision problems and 22.6% had near vision problems. It is important to note that the schools did not screen for near vision acuity, so this figure represents the near-vision problems among students who had abnormal results for other vision screenings. Almost 89% of students referred received new corrective lenses. The authors note that even with incomplete follow-up, many children received treatment.

2. Kimel LS. Lack of follow-up exams after failed school vision screenings: An investigation of contributing factors. *Journal of School Nursing*. 2006;22(3):156-162.

Kimel provided an overview of past studies on the rates of follow-up exams for children who have had abnormal vision screenings. Rates have varied widely between studies. For example, they note that Parrott et al., 1999 found 32-37% of children who had an abnormal vision screening in day care centers received follow-up exams. In order to identify barriers to care, Kimel interviewed parents (n=55; 82% response rate) of students who had abnormal school vision screenings but who did not receive follow-up eye care. The author found that only 9% of participants were not aware of their child's abnormal screening and the need for follow-up care. The participants identified a number of barriers including cost, logistical barriers (e.g. no car, no phone, problems making an appointment), social barrier (e.g. all adults in household working), and perception barriers (e.g. did not see vision care as a priority).

3. Manny RE, Sinnott LT, Jones-Jordan LA, et al. Predictors of adequate correction following vision screening failure. *Optometry and Vision Science : Official Publication of the American Academy of Optometry*. 2012;89(6):892.

Manny et al. analyzed data from a subset of children enrolled in the Collaborative Longitudinal Evaluation of Ethnicity and Refractive Error (CLEERE) Study (n=798) who failed the vision screening portion of the CLEERE protocol and returned for follow-up the following year. This longitudinal study tracked youth in first through eighth grade from 1989 to 2009 in California, Alabama, Texas, and Arizona. Fifty-six percent of the 798 participants also had complete parental income, education, and vision acuity data and could be included in the analysis controlling for these factors. Four hundred ninety-two of the 798 children received a vision screening with a letter sent home to their parents if a complete eye examination was recommended based on the screening results. The remaining children received a vision screening, a free eye examination if indicated by the screening, and a free pair of eye glasses (complete care model). One year later all participants were seen and 28% of those whose parents were notified by letter only (those who did not receive the complete care model) had their vision problem adequately corrected (compliance). This rate was similar for the children receiving the complete care model. The authors found no association between race/ethnicity and odds of vision problems being adequately corrected. With each one year increase in age the odds of compliance at the follow-up visit increased by 12%. Parental factors (income, educational attainment, and vision acuity) were not significantly associated with the odds of compliance at follow-up.

4. Mark H, Mark T. Parental reasons for non- response following a referral in school vision screening. *Journal of School Health*. 1999;69(1):35-38.

A school nurse attempted to contact the parents of all 301 students who had abnormal results in the school vision screening in Durham County, North Carolina between 1996-1997 to administer a questionnaire (n=232 parents; response rate 77%). Ninety percent of the parents recalled receiving a referral letter from the school nurse, 65% of whom reported taking their child for a follow-up eye exam. The authors note that the school vision screening did not lead to high rates of over-referral (80% of the students who received a follow-up exam had visual abnormalities). The authors found no significant association between insurance status and if a parent had secured a follow-up exam, though they did find differences in why the parents did not seek care based on insurance status (e.g. parents with no insurance were more likely to cite financial barriers than parents with private insurance or Medicaid). Children who were eligible for free or reduced lunch (a proxy for family income) were significantly less likely (29%) than their counterparts to have received a follow-up exam (66%).

5. Mathers M, Keyes M, Wright M. A review of the evidence on the effectiveness of children's vision screening. Vol 36. Oxford, UK 2010:756-780.

Mathers et al. conducted a review of the literature published from 1990 to 2008 to determine the effectiveness of universal vision screening for children from birth to 16 years of age. The authors rated the quality of both primary evidence and review articles. They included 40 articles (2 randomized control trials, 33 non-randomized control trials, and 8 systematic reviews). The included studies were not only on school-based vision screening programs, though studies in these settings were included. Mathers et al. conclude that evidence indicates that early vision screening, and early treatment, lead to improved vision outcomes, while vision screening in the later grades detected few new cases of vision abnormalities. The authors also note that a majority

of the studies indicate that orthoptists were the preferred screener but that screening could be performed by nurses. One systematic review found that nurses were highly accurate in vision screening for school age children, but that they would benefit from more training.

6. Messer DH, Mitchell GL, Twelker JD, Crescioni M. Spectacle wear in children given spectacles through a school- based program. *Optometry and Vision Science : Official Publication of the American Academy of Optometry*. 2012;89(1):19.

Messer et al. analyzed data for 8 to 14 years olds participating in the CLEERE study in Southern Arizona. These youth were predominantly Native American students. From 2004 to 2005 six hundred children had their vision screened, and 307 were prescribed and dispensed glasses. Eighth graders (n=20) were not available for follow-up at one year, so the study population included 287 potential participants. Ten to 14 months after the initial exam students were brought from class for a follow-up exam and asked to wear their glasses. Students knew that a follow-up would occur, but they did not know the exact date of the exam. Researchers noted if the student was wearing their glasses for the exam. During the follow-up students filled out a questionnaire. The authors had complete follow-up data for 86% of the students (n=247). At the follow-up only 33% of students had their glasses with them. Over 80% of students without their glasses reported that they were lost or broken. Using univariate logistic regression the authors found that male students and Native-American students were less likely than their counterparts to be wearing their glasses. Multivariate logistic regression, though, did not identify race/ethnicity or sex as significant factors. The authors found no significant association between parental educational attainment or income and likelihood that their child was wearing their glasses. Almost all of these students (whether they were wearing their glasses or not) reported that their glasses helped them see more clearly and made their eyes feel better. As visual acuity decreased, likelihood of wearing their glasses increased. In their discussion, the authors cite six studies which have found a range of compliance with wearing glasses at follow up. The rates of compliance in five of these studies included: 13.4% (with an additional 34% of students having glasses with them but not wearing them), 19%, 50%, 71.6% and 82%. They also note that their finding that parental education and socioeconomic status were not significantly associated with compliance with wearing glasses is consistent with what other studies have found (four studies cited).

7. Allen Thurston P, Mhairi Thurston MAM. A literature review of refractive error and its potential effect on reading attainment in the early years of school. *Optometry & Visual Performance*. 2013;1(1):25-31.

Thurston et al. conducted a review of the literature published between 1970 and 2011 on the relationship between vision problems (including near vision problems) and reading development. Forty articles met their inclusion criteria. They note that the literature shows a correlation between near vision problems and reading problems in school age children—though only a few studies have explored the possibility of causation. Twelve primary studies looked specifically at the link between vision acuity and reading outcomes (e.g. reading speed, reading scores, reading level), all of which found a link between vision problems and worse reading outcomes. For example, a study conducted by Krumholtz (2000) found that hyperopia (near vision problems) was associated with lower levels of reading, but that when 25 students were given vision correction 84% of them gained over 20 percentage points in their achievement test percentile

rank. An additional study found the provision of reading glasses and vision therapy was associated with improved grades and standardized test scores in reading and mathematics.

8. Basch CE. Vision and the achievement gap among urban minority youth. *Journal of School Health*. 2011;81(10):599-605.

Basch provides a review of the literature relating to the connection between vision problems and the educational opportunity gap. The author cites data from a National US sample which show that rates of vision problems were significantly higher for Black and Hispanic 12 to 19 year olds than their White counterparts, and that the rates were almost three times higher for individuals below the poverty level than for those with incomes twice the poverty level. One study found that Black and Hispanic 12-18 year olds were less likely to have their glasses with them at the time of the study. A study conducted in the United States found that 12.8% of screened 5-17 year olds had near vision problems. The author also cites evidence that low-income children and those experiencing problems in school are disproportionately impacted by poor vision. Research also indicates that low-income youth and youth of color are more likely than their counterparts to have undiagnosed and undertreated vision problems. Youth with academic or behavioral risk factors (such as intellectual disabilities or dyslexia) may also be more likely to have unidentified or untreated vision problems. The author cites evidence that hyperopia is associated with adverse impacts on literacy, reading test scores, as well as letter and word recognition among 4-7 year olds. The authors also indicate that undetected or untreated vision problems can also be a risk factor for social or emotional problems. Basch cites evidence indicating that school-based screening paired with a note home to a child's guardian about a failed screening test may not be sufficient to lead to treatment for low-income students. The author concludes that school-based vision screening is a logical approach to identify disparities in vision problems, but that without adequate follow-up and treatment the full "educational benefits of vision screening cannot be realized."

9. Narayanasamy S, Vincent SJ, Sampson GP, Wood JM. Impact of simulated hyperopia on academic- related performance in children. *Optometry and Vision Science : Official Publication of the American Academy of Optometry*. 2015;92(2):227.

Narayanasamy et al. measured academic performance among fifteen youth with normal vision both before and after simulating hyperopia. The authors found that simulated near vision problems led to significantly worse performance on a standardized reading test, visual information processing tests, and eye movement tests. When simulated hyperopia was combined with 20 minutes of sustained near-work the authors observed performance reductions between 5 and 24%.

10. Melby JN, Conger RD, Fang SA, Wickrama KA, Conger KJ. Adolescent family experiences and educational attainment during early adulthood. *Developmental Psychology*. 2008;44(6):1519-1536.

Melby et al. analyzed data from a longitudinal study of two-biological-parent intact families in Iowa. They had a sample size of 451 families. The researchers conducted modeling to determine what factors impact educational attainment and found level of academic engagement was strongly correlated with later educational attainment.

11. Lucio R, Hunt E, Bornovalova M. Identifying the necessary and sufficient number of risk factors for predicting academic failure. *Developmental Psychology*. 2012;48(2):422-428.

Lucio et al. analyzed data from the Educational Longitudinal Study: 2002 which includes a national sample of 14,796 students. The authors used a 5-step process to identify which factors contribute to academic ‘failure’—a grade point average (GPA) of less than 2.0 which is the minimum GPA needed to graduate from high school. They found that a number of academic outcomes impact a student’s GPA and therefore their ability to attain a high school diploma. These factors include academic engagement, grade retention, and behavior. The authors also found that the odds of passing decreased with each additional risk factor: “For each risk factor that is added, there is a 47% increased likelihood of failing.”

12. Ou S-R, Reynolds AJ. Predictors of educational attainment in the Chicago Longitudinal Study. *School Psychology Quarterly*. 2008;23(2):199-229.

Ou and Reynolds analyzed data from the Chicago Longitudinal Study, using a sample size of 1,286 youth in order to investigate predictors of high school completion and total educational attainment. They found that, among other factors, school absences, grade retention, and youth’s educational expectations all influenced educational attainment.

13. Winding TN, Nohr EA, Labriola M, Biering K, Andersen JH. Personal predictors of educational attainment after compulsory school: Influence of measures of vulnerability, health, and school performance. *Scandinavian Journal of Public Health*. 2013;41(1):92-101.

Winding et al. analyzed data from a 2004 questionnaire completed by a cohort of adolescents born in 1989 (n=3053) in Denmark (83% response rate) and linked 2010 educational attainment data from Statistics Denmark. This allowed for a follow-up of 6.5 years. The authors found that low grades during primary school was predictive of not having completed a secondary education by age 20/21 (odds ratios between 1.7 and 2.5). For students with low math grades this association was even stronger. The authors cite two additional studies which have also found an association between school performance and later educational attainment.

14. Kandel DB, Griesler PC, Schaffran C. Educational attainment and smoking among women: Risk factors and consequences for offspring. *Drug and Alcohol Dependence*. 2009;104:24-33.

Researchers examined United States data from four national data sets and found that, among women, lower levels of education are associated with greater risk of being a current smoker, smoking daily, smoking heavily, being nicotine dependent, starting to smoke at an early age, having higher levels of circulating cotinine (a metabolite of nicotine) per cigarettes smoked, and continuing to smoke in pregnancy. In addition, lower levels of maternal education were linked to increased risk of antisocial behavior among offspring.

15. McCarty CA, Mason WA, Kosterman R, Hawkins JD, Lengua LJ, McCauley E. Adolescent school failure predicts later depression among girls. *The Journal of Adolescent Health : Official Publication of the Society for Adolescent Medicine*. 2008;43(2):180-187.

McCarty et al. conducted a prospective longitudinal cohort study with a sample of 808 youth followed from ages 10 to 21. The researchers discovered that adolescent school ‘failure’

(meaning being suspended, expelled, or dropping out of high school early) predisposed girls to depression in early adulthood.

16. McLaren L. Socioeconomic status and obesity. *Epidemiologic Reviews*. 2007;29(1):29-48.

McLaren et al. conducted a meta-analysis exploring the relationship between obesity and SES among adults. A total of 333 studies published internationally met the inclusion criteria. In highly developed countries, the majority of the studies found higher body weights among women with lower education attainment. Nearly 50% of the studies in highly developed countries found the same relationship for men.

17. Mersky JP, Reynolds AJ. Educational success and adult health: Findings from the Chicago Longitudinal Study. *Prevention Science*. 2009;10(2):175-195. Mersky and Reynolds analyzed data from a Chicago prospective cohort study that followed 1,539 individuals. Results indicate that high school completion was significantly and inversely associated with tobacco smoking, frequent substance use, depression, and no health insurance coverage. In addition, middle school reading performance was inversely related to depression and student's expectation to attend college was negatively associated with frequent drug use.

18. Mezuk B, Eaton WW, Golden SH, Ding Y. The influence of educational attainment on depression and risk of type 2 diabetes. *American Journal of Public Health*. 2008;98(8):1480.

Researchers analyzed adult survey data collected in the Baltimore Epidemiological Catchment Area and then conducted follow-up interviews with the survey cohort. Mezuk et al. found a statistically significant association between type 2 diabetes and lower educational attainment. In addition, the data indicate that depression was associated with type 2 diabetes, but each year of education attained decreased the risk of type 2 diabetes for those experiencing depression.

19. Centers for Disease Control and Prevention. Behavioral risk Factor Surveillance System Prevalence and Trends Data: Washington. 2012; <http://apps.nccd.cdc.gov/brfss/page.asp?cat=XX&yr=2012&state=WA#XX>. Accessed December 2, 2013.

Recent Behavioral Risk Factor Surveillance System (BRFSS) data from Washington State indicate that as educational attainment increases income level also increases. These data also find correlations between higher income and improved health for a number of indicators including: oral health, tobacco use, women's health indicators, health screening rates, and physical activity. These data also show correlations between higher educational attainment and positive health outcomes for these same indicators.

20. Reed P KD, Cheng E, Kinne S. Washington State Department of Health. *Health of Washington State Report: Mortality and Life Expectancy*. 2013. The authors present Washington State data on mortality and life expectancy. The data show that age-adjusted death rates were higher in Washington census tracts with higher poverty rates. The state data also show that self-reported health status decreases as income decreases.

21. Skodova Z, Nagyova I, Dijk J, et al. Socioeconomic differences in psychosocial factors contributing to coronary heart disease: A review. *Journal of Clinical Psychology in Medical Settings*. 2008;15(3):204-213.

Skodova et al. conducted a meta-analysis of the literature addressing the relationships between SES, coronary heart disease (CHD), and psychosocial factors contributing to coronary heart disease. Researchers identified 12 studies that met their inclusion criteria. They found that higher levels of education are associated with lower rates of CHD, and that decreasing education is associated with factors that are linked to CHD such as depression, anxiety, hostility, and a lack of social supports.

22. Steptoe A, Hamer M, Butcher L, et al. Educational attainment but not measures of current socioeconomic circumstances are associated with leukocyte telomere length in healthy older men and women. *Brain Behavior and Immunity*. 2011;25(7):1292-1298.

Steptoe et al. analyzed data collected from 543 male and female London-based civil servants of white European origin. All participants were between the ages of 53 and 76 and healthy. Researchers looked at blood samples to determine telomere length and telomerase activity. Telomere shortening is associated with aging. Short telomeres are also associated with increased risk of premature heart attack and mortality. Researchers found that lower educational attainment was associated with shorter telomere length after controlling for biological and behavioral covariates. This association remained significant even after adjusting for current SES. Researchers speculated that low educational attainment may be an indicator of long-term lower SES, and may be associated with accumulated stress resulting in telomere shortening. They also postulate that education may promote problem-solving skills leading to reduced responses to stress, thereby impacting aging.

23. VanEenwyk J BG, Bezruchka S, Pobutky, A. Washington State Department of Health. 2013. *Health of Washington State Report: Social and Economic Determinants of Health*. 2013.

VanEenwyk et al. conducted a review of the literature on the complex relationships between the social factors that impact health. The authors found that the literature provides extensive evidence of the association between lower income and poor health outcomes.

24. Bureau of Labor Statistics website. Employment projections: Earnings and Unemployment Rates by Educational Attainment. Last updated May 22, 2013; http://www.bls.gov/emp/ep_chart_001.htm. Accessed December 10, 2013.

National data from 2012 indicate that as educational attainment increases median weekly earnings also increase and unemployment rates decrease.

25. Paul KI, Moser K. Unemployment impairs mental health: Meta-analyses. *Journal of Vocational Behavior*. 2009;74(3):264-282.

Paul et al. conducted a meta-analysis of 237 cross-sectional and 87 longitudinal studies that examined the relationship between mental health and unemployment. The meta-analysis of cross-sectional data revealed that unemployed persons showed significantly more symptoms of distress and impaired well-being than did employed persons. The meta-analyses of longitudinal studies and natural experiments supported the concept that unemployment is not only correlated to distress but also causes it.

26. Prause J, Dooley D, Huh J. Income volatility and psychological depression. *American Journal of Community Psychology*. 2009;43(1-2):1-2.

Prause et al. analyzed a sample (n = 4,493) from the National Longitudinal Survey of Youth. Researchers found that income volatility was significantly associated with depression; and downward volatility (frequent losses in income) was significantly associated with depression even after controlling for baseline depression. High income appeared to act as a buffer, so those with lower incomes were more vulnerable to the adverse effects of downward volatility.

27. Spencer N, Thanh TM, Louise S. Low income/socio-economic status in early childhood and physical health in later childhood/adolescence: A systematic review. *Maternal and Child Health Journal*. 2013;17(3):424-431.

Spencer et al. conducted a meta-analysis of studies examining the relationship between low socioeconomic status in the first five years of life and physical health outcomes in later childhood and adolescence. Nine studies met the researchers' strict inclusion criteria. The studies indicated significant associations between early childhood low-income status and a number of adverse health outcomes including: activity-limiting illness, parent-reported poor health status, acute and recurrent infections, increasing body mass index (BMI), dental caries, and higher rates of hospitalization.

28. Subramanyam M, Kawachi I, Berkman L, Subramanian SV. Relative deprivation in income and self-rated health in the united states. *Social Science & Medicine*. 2009;69(3):327-334.

Subramanyam et al. analyzed data from the Current Population Surveys conducted by the United States Census Bureau. Researchers found that individuals from the lowest income category were over five times more likely to report being in poor health than participants from the highest income category. In addition, they found that relative deprivation (the differences in incomes between an individual and others who have higher incomes than that individual [one measure of income inequality]) appeared to explain a large part of this association.