

# Vision Screening for Children 1 to 5 Years of Age: US Preventive Services Task Force Recommendation Statement



**WHAT'S KNOWN ON THIS SUBJECT:** In 2004, the US Preventive Services Task Force (USPSTF) provided a statement about screening for visual impairment among children <5 years of age.



**WHAT THIS STUDY ADDS:** The 2004 USPSTF recommendation statement is updated here.

## abstract

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**OBJECTIVE:** The goal was to provide an update of the 2004 US Preventive Services Task Force (USPSTF) statement about screening for visual impairment in children <5 years of age.

**METHODS:** The USPSTF examined evidence on the association of screening for visual impairment in children 1 to 5 years of age with improved health outcomes, the accuracy of risk factor assessment and screening tests, the effectiveness of early detection and treatment, and the harms of screening and treatment.

**RECOMMENDATION:** The USPSTF recommends vision screening for all children at least once between the ages of 3 and 5 years, to detect the presence of amblyopia or its risk factors (grade B recommendation). The USPSTF concludes that the current evidence is insufficient to assess the balance of benefits and harms of vision screening for children <3 years of age (I statement). *Pediatrics* 2011;127:340–346

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### KEY WORDS

vision screening, preventive services, children

### ABBREVIATION

USPSTF—US Preventive Services Task Force

The USPSTF makes recommendations about preventive care services for patients without recognized signs or symptoms of the target condition. It bases its recommendations on a systematic review of the evidence of the benefits and harms and an assessment of the net benefit of the service.

The USPSTF recognizes that clinical or policy decisions involve more considerations than this body of evidence alone. Clinicians and policy makers should understand the evidence but individualize decision-making to the specific patient or situation.

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## VISION SCREENING IN CHILDREN AGES 1 TO 5 YEARS: CLINICAL SUMMARY OF U.S. PREVENTIVE SERVICES TASK FORCE RECOMMENDATION

Population	Children ages 3 to 5 years	Children younger than 3 years of age
Recommendation	<b>Provide vision screening</b>  <b>Grade: B</b>	<b>No recommendation</b>  <b>Grade: I (Insufficient Evidence)</b>
Screening tests	Various screening tests are used in primary care to identify visual impairment in children, including: <ul style="list-style-type: none"> <li>• Visual acuity test</li> <li>• Stereoacuity test</li> <li>• Cover-uncover test</li> <li>• Hirschberg light reflex test</li> <li>• Autorefraction</li> <li>• Photoscreening</li> </ul>	
Timing of screening	No evidence was found regarding appropriate screening intervals.	
Interventions	Primary treatment for amblyopia includes the use of corrective lenses, patching, or atropine therapy of the non-affected eye. Treatment may also consist of a combination of interventions.	
Balance of harms and benefits	There is adequate evidence that early treatment of amblyopia in children ages 3 to 5 years leads to improved visual outcomes. There is limited evidence on harms of screening, including psychosocial effects, in children ages 3 years and older.  There is inadequate evidence that early treatment of amblyopia in children younger than 3 years of age leads to improved visual outcomes.	
Suggestions for Practice Regarding the I Statement	In deciding whether to refer children younger than 3 years of age for screening, clinicians should consider: <ul style="list-style-type: none"> <li>• <i>Potential preventable burden:</i> screening later in the preschool years seems to be as effective as screening earlier</li> <li>• <i>Costs:</i> initial high costs associated with autorefractors and photoscreeners</li> <li>• <i>Current practice:</i> typical vision screening includes assessment of visual acuity, strabismus, and stereoacuity; children with positive findings should be referred for a comprehensive ophthalmologist exam</li> </ul>	

For a summary of the evidence systematically reviewed in making these recommendations, the full recommendation statement, and supporting documents please go to [www.uspreventiveservicestaskforce.org](http://www.uspreventiveservicestaskforce.org).

### FIGURE 1

Clinical summary of USPSTF recommendation for vision screening in children 1 to 5 years of age. For a summary of the evidence systematically reviewed in making these recommendations, the full recommendation statement, and supporting documents please go to [www.uspreventiveservicestaskforce.org](http://www.uspreventiveservicestaskforce.org).

### SUMMARY OF RECOMMENDATIONS AND EVIDENCE

The USPSTF recommends vision screening for all children at least once between the ages of 3 and 5 years, to detect the presence of amblyopia or its risk factors. This recommendation is a grade B recommendation.

The USPSTF concludes that the current evidence is insufficient to assess the balance of benefits and harms of vision screening for children <3 years of age. This statement is an I statement.

See Figure 1 for a summary of the recommendations and suggestions for clinical practice, Table 1 for a descrip-

tion of the USPSTF grades, and Table 2 for a description of the USPSTF classification of levels of certainty about net benefit.

### RATIONALE

#### Importance

Approximately 2% to 4% of preschool-aged children have amblyopia, an alteration in the visual neural pathway in the developing brain that can lead to permanent vision loss in the affected eye. Amblyopia usually occurs unilaterally but can occur bilaterally. Identification of vision impairment before school entry could help identify chil-

dren who may benefit from early interventions to correct or to improve vision.

#### Detection

The USPSTF found adequate evidence that vision screening tools have reasonable accuracy in detecting visual impairment, including refractive errors, strabismus, and amblyopia.

#### Benefits of Detection and Early Intervention

The USPSTF found adequate evidence that early treatment for amblyopia, including the use of cycloplegic agents, patching, and eyeglasses, for children

**TABLE 1** USPSTF Grade Definitions and Suggestions for Practice

Grade	Grade Definition	Suggestions for Practice
A	The USPSTF recommends the service. There is high certainty that the net benefit is substantial.	Offer/provide this service.
B	The USPSTF recommends the service. There is high certainty that the net benefit is moderate or there is moderate certainty that the net benefit is moderate to substantial.	Offer/provide this service.
C	The USPSTF recommends against routinely providing the service. There may be considerations that support providing the service for an individual patient. There is moderate or high certainty that the net benefit is small.	Offer/provide this service only if there are other considerations in support of offering/providing the service for an individual patient.
D	The USPSTF recommends against the service. There is moderate or high certainty that the service has no net benefit or that the harms outweigh the benefits.	Discourage use of this service.
I	The USPSTF concludes that the current evidence is insufficient to assess the balance of benefits and harms of the service. Evidence is lacking, of poor quality, or conflicting, and the balance of benefits and harms cannot be determined.	See the clinical considerations in the USPSTF recommendation statement. If the service is offered, patients should understand the uncertainty about the balance of benefits and harms.

**TABLE 2** USPSTF Levels of Certainty Regarding Net Benefit

Level of Certainty	Description
High	The available evidence usually includes consistent results from well-designed, well-conducted studies with representative primary care populations. These studies assess the effects of the preventive service on health outcomes. This conclusion is unlikely to be strongly affected by the results of future studies.
Moderate	The available evidence is sufficient to determine the effects of the preventive service on health outcomes, but confidence in the estimate is constrained by factors such as (1) the number, size, or quality of individual studies; (2) inconsistency of findings across individual studies; (3) limited generalizability of findings to routine primary care practice; or (4) lack of coherence in the chain of evidence. As more information becomes available, the magnitude or direction of the observed effect might change, and this change might be large enough to alter the conclusion.
Low	The available evidence is insufficient to assess the effects on health outcomes. Evidence is insufficient because of (1) limited number or size of studies; (2) important flaws in the study design or methods; (3) inconsistency of findings across individual studies; (4) gaps in the chain of evidence; (5) lack of generalizability of findings to routine primary care practice; or (5) lack of information on important health outcomes. More information may allow estimation of effects on health outcomes.

The USPSTF defines certainty as the “likelihood that the USPSTF assessment of the net benefit of a preventive service is correct.” The net benefit is defined as benefits minus harms of the preventive service, as implemented for a general, primary care population. The USPSTF assigns a certainty level on the basis of the nature of the overall evidence available for assessment of the net benefit of a preventive service.

3 to 5 years of age leads to improved visual outcomes. The USPSTF found inadequate evidence that early treatment of amblyopia for children <3 years of age leads to improved visual outcomes.

### Harms of Detection and Early Intervention

The USPSTF found limited evidence regarding harms of screening, including psychosocial effects, for children ≥3 years of age. False-positive

screening results may lead to the overprescribing of corrective lenses. Adequate evidence suggests that the harms of treatment of amblyopia for children ≥3 years of age are limited to reversible loss of visual acuity resulting from patching of the nonaffected eye. The USPSTF found inadequate evidence of the harms of screening and treatment for children <3 years of age.

### USPSTF Assessment

The USPSTF concludes with moderate certainty that vision screening for children 3 to 5 years of age has a moderate net benefit. The USPSTF concludes that the benefits of vision screening for children <3 years of age are uncertain and that the balance of benefits and harms cannot be determined for this age group.

## CLINICAL CONSIDERATIONS

### Patient Population Under Consideration

This recommendation applies to all children 1 to 5 years of age.

### Screening Tests

Various screening tests that are feasible in primary care are used to identify visual impairment among children. These tests include visual acuity tests, stereoacuity tests, the cover-uncover test, and the Hirschberg light reflex test (for ocular alignment/strabismus), as well as the use of autorefractors (automated optical instruments that detect refractive errors) and photostereometers (instruments that detect amblyogenic risk factors and refractive errors).

### Treatment

Primary treatment for amblyopia includes the use of corrective lenses, patching, or atropine treatment of the nonaffected eye. Treatment

may consist of a combination of interventions.

### Suggestions for Practice Regarding I Statement

In deciding whether to refer children <3 years of age for screening, clinicians should consider the following.

#### Potential Preventable Burden

Most studies show that screening and treatment later in the preschool years seem to be as effective at preventing amblyopia as screening and treatment earlier in life.

#### Costs

Potential disadvantages of using photoscreeners and autorefractors are the initial high costs associated with the instruments and the need for external interpretation of screening results with some photoscreeners.

#### Current Practice

Typical components of vision screening include assessments of visual acuity, strabismus, and stereoacuity. Younger children often are unable to cooperate with some of the screening tests performed in clinical practice, such as visual acuity testing. Stereoacuity testing often is omitted and may be performed incorrectly when attempted. Screening of younger children may be difficult and often yields false-positive results because of the child's inability to cooperate with testing. Children with positive findings should be referred for a full ophthalmologic examination, to confirm the presence of vision problems, and further treatment.

#### Screening Intervals

The USPSTF did not find adequate evidence to determine the optimal screening interval.

## OTHER CONSIDERATIONS

### Research Needs and Gaps

Several gaps in the evidence were identified. All treatment trials in the literature review enrolled children  $\geq 3$  years of age. Well-designed studies are needed to identify the optimal age for initiation of screening, optimal screening methods, and optimal screening frequency. Longitudinal studies that link optimal screening tests to the identification of children with visual impairments are needed. Additional studies are needed to determine the most-favorable combinations of screening tests, as well as the optimal treatment for amblyopia and the optimal treatment duration. There also is a need for studies that examine the long-term benefits and harms of preschool vision screening, such as quality of life, school performance, and labeling or anxiety.

## DISCUSSION

### Burden of Disease

The most common causes of vision impairment in children are amblyopia and associated risk factors (strabismus, anisometropia, astigmatism, and hyperopia) and refractive errors not associated with amblyopia (Table 3). Amblyopia is a disorder characterized by abnormal processing of visual images by the brain during a critical period of vision development, which results in a permanent reduction in visual acuity. It is associated with conditions that interfere with normal binocular vision, such as strabismus (oc-

ular misalignment), anisometropia (a large difference in refractive power between the 2 eyes), cataracts (lens opacity), ptosis (eyelid drooping), and other structural impairments. Amblyopia is regarded as a disease of childhood; however, its effects are irreversible if left untreated, and it is the most common cause of monocular vision loss among adults 20 to 70 years of age. An important risk of amblyopia is that an unrelated, severe vision impairment or blindness might occur in the nonaffected eye, resulting in severe vision loss or even legal blindness.

### Scope of Review

The review on which this recommendation is based examined evidence regarding the following topics: the association of screening for visual impairment among children 1 to 5 years of age with improved health outcomes, the accuracy of risk factor assessment, the accuracy of screening tests, the effectiveness of early detection, the effectiveness of treatment, and the harms of screening and treatment.

### Accuracy of Screening Tests

No studies evaluated the accuracy or reliability of risk factor assessment in preschool vision screening. There also was no evidence on the outcomes of targeted versus universal preschool vision screening.

Twenty-six studies, including 3 of poor quality and 23 of fair quality, evaluated

**TABLE 3** Risk Factors for Amblyopia

Condition	Description
Amblyopia	Functional reduction in visual acuity characterized by abnormal processing of visual images, which is established by the brain during a critical period of vision development
Strabismus	Ocular misalignment; most common cause of amblyopia
Anisometropia	Asymmetric refractive error between the 2 eyes, which causes image suppression in the eye with the larger error.
Astigmatism	Blurred vision at any distance because of abnormal curvature of the cornea or lens
Hyperopia	Farsightedness; visual images come to focus behind the retina

the diagnostic accuracy of various preschool vision screening tests.<sup>1,2</sup> However, none of the tests was associated consistently with both high sensitivity and high specificity (ie, >90%) for specific amblyogenic risk factors. Cycloplegic refraction testing was included in the reference standard examination in 21 studies. Vision screening tests included tests of visual acuity, stereoacuity, and ocular alignment, as well as tests using autorefractors and photoscreeners. The largest study comparing screening tests was the Vision in Preschoolers study,<sup>3,4</sup> which compared 10 different screening tests. In the Vision in Preschoolers study, the Random Dot E stereoacuity test (StereoOptical Co, Chicago, IL), the Randot Stereo Smile Test II (StereoOptical Co, Chicago, IL), and the iScreen (iScreen, Inc, Memphis, TN) and Medical Technologies, Inc photoscreeners (Riviera Beach, FL) were associated with lower sensitivity (at a similar specificity), compared with the Lea symbols test (Precision Vision, Inc, LaSalle, IL), the HOTV visual acuity test (Precision Vision, Inc, LaSalle, IL), and the Retinomax (Nikon, Inc, Melville, NY) and Power Refractor II (Plusoptix, Nuremberg, Germany) autorefractors; however, differences in likelihood ratio estimates were relatively small. The cover-uncover test was associated with lower sensitivity and higher specificity, compared with the other tests. The available studies on vision screening that evaluated various tests in various combinations found that combinations of tests were generally associated with greater diagnostic accuracy, compared with single tests of visual acuity, stereoacuity, or ocular alignment, although there is insufficient evidence to recommend a specific combination of tests.<sup>1</sup>

Vision screening requires a cooperative child, and this factor is influenced by the age of the child. Nine fair-quality

studies evaluated screening tests for vision impairment in stratified age groups.<sup>1</sup> Most of the evidence was limited and inconsistent. Four studies found no definitive differences according to age, because testability generally exceeded 80% to 90% for children 3 years of age, with small increases through 5 years of age. Four studies found that testability rates were lower for most screening tests (Random Dot E test, Lea symbols test, and SureSight autorefractor [Welch Allyn, Inc, Skaneateles Falls, NY]) for children 1 to 3 years of age, compared with children 3 to 5 years of age. One large, statewide screening study of the Medical Technologies photoscreener found 94% testability by 1 year of age.<sup>1</sup>

### **Effectiveness of Early Detection and Treatment**

There were no randomized controlled trials that compared preschool vision screening with no screening. All studies evaluated reported on vision outcomes for children  $\geq 3$  years of age. There were no studies available that evaluated school performance or other functional outcomes in screened versus unscreened populations.

One fair-quality, nested, randomized trial found that periodic screening from the ages of 8 months to 37 months was associated with a 1% decrease in the prevalence of amblyopia at age 7.5 years, compared with one-time screening at 37 months of age.<sup>5</sup> However, the difference was statistically significant for only 1 definition of amblyopia. A limitation of the study was that it was not possible to separate effects of earlier screening from those of repeated screening.

Three fair- or good-quality trials with older preschool-aged children (3–5 years of age) with mild/moderate amblyopia or unilateral refractive errors (with or without amblyopia) reported

that treatment (patching and/or eyeglasses) resulted in a statistically significant but small (<1 line on the Snellen eye chart) average improvement in visual acuity in the affected eye, compared with no treatment, after follow-up periods of 5 weeks to 1 year.<sup>6–8</sup> Benefits were greater for children with more-severe visual impairment at baseline. One trial found that, in a subgroup of children with more-severe visual impairment at baseline, patching was associated with visual acuity improvement of 1 to 2 lines on the Snellen eye chart, compared with no treatment.<sup>6</sup> Five fair- or good-quality trials found no differences in visual acuity improvement in the affected eye between shorter and longer daily patching regimens,<sup>9,10</sup> among different atropine treatment regimens,<sup>11,12</sup> or between patching and atropine treatment.<sup>13</sup>

### **Potential Harms of Screening and Treatment**

Potential harms of preschool vision screening include psychosocial effects such as labeling and anxiety, unnecessary referrals because of false-positive screening results, and unnecessary use of corrective lenses or treatments to prevent amblyopia, which can have potential effects on long-term vision or function. The USPSTF found limited evidence regarding the harms of vision screening for children <5 years of age. However, the data that are available suggest that harms do exist. Six of 7 studies reported false-positive rates of >70% in low-prevalence populations.<sup>1</sup> One large study of a statewide, preschool photoscreening program found that 20% of children who did not meet criteria for amblyogenic risk factors were prescribed eyeglasses; however, there is no evidence available on the long-term effects of unnecessary corrective lenses or treatment for amblyopia.<sup>14</sup>

Five fair-quality trials with children  $\geq 3$  years of age demonstrated that some amblyopia treatments are associated with an increased risk of reversible, short-term loss of visual acuity in the nonaffected eye.<sup>1</sup> Although 1 short-term (5-week) trial found no increased risk of visual acuity loss in the nonaffected eye associated with patching versus no patching, another trial found that patching of the nonaffected eye was associated with an increased risk of visual acuity loss of  $\geq 2$  lines on the Snellen eye chart, compared with atropine treatment (9% vs 1.4%;  $P < .001$ ). One trial found that atropine treatment plus a plano lens was associated with an increased risk of visual acuity loss of  $\geq 1$  line, compared with atropine treatment alone (17% vs 4%;  $P = .005$ ). In both trials that found deficits, visual acuity in the nonaffected eye returned to baseline levels for most children. Two other trials found no difference in the risk of visual acuity loss in the nonaffected eye in direct comparisons of different patching or atropine treatment regimens.<sup>1</sup>

Evidence on adverse psychosocial effects of amblyopia treatments is limited. Two randomized controlled trials examined adverse psychosocial effects and found that children were more likely to be upset about patching and eyeglasses, compared with eyeglasses alone, and that patching was associated with worse emotional well-being than atropine treatment.<sup>1</sup> In a cohort study, screening and treatment did not increase the incidence of bullying but unexpectedly decreased the odds of bullying by  $\sim 50\%$  for children offered screening, compared with those not offered screening, perhaps because the screened children completed patching regimens at an earlier age.<sup>2</sup>

### Estimate of Magnitude of Net Benefit

The USPSTF found adequate evidence that treatment for amblyopia or unilateral refractive errors is associated with moderate improvements in visual acuity for children 3 to 5 years of age and, in theory, permanent improvements throughout life. Although the average improvement in visual acuity resulting from treatment for amblyopia was  $\sim 1$  line on a Snellen eye chart, the USPSTF concluded that the benefits are moderate because untreated amblyopia results in permanent, uncorrectable vision loss and the potential benefits are experienced over the individual's life span. Harms from treatment seem to be minimal. Therefore, the USPSTF concluded with moderate certainty that the overall net benefit is moderate.

### How Does Evidence Fit With Biological Understanding?

Amblyopia is a functional reduction in visual acuity characterized by abnormal processing of visual images by the brain. The loss in visual acuity is not immediately reversible with simple refractive correction, and it is unlikely to resolve spontaneously if left untreated. Amblyopia typically becomes irreversible if the child is not treated by 6 to 10 years of age. Therefore, preschool screening seems to be consistent with the current biological understanding of amblyopia and the importance of detecting it during a critical period in development.

### Response to Public Comments

A draft version of this recommendation statement was posted for public comment on the USPSTF Web site from October 5 through October 23, 2009. A small number of comments were received from individuals or organizations. All comments were reviewed in the creation of this final recommendation.

### UPDATE OF PREVIOUS USPSTF RECOMMENDATION

This recommendation updates the 2004 recommendation, in which the USPSTF recommended vision screening for all children  $< 5$  years of age.<sup>15</sup> The USPSTF now recommends vision screening for the presence of amblyopia and its risk factors for all children 3 to 5 years of age (B recommendation). For children  $< 3$  years of age, the USPSTF concludes that the current evidence is insufficient to assess the balance of benefits and harms of vision screening (I statement).

### RECOMMENDATIONS OF OTHERS

Preschool vision screening is recommended by several other organizations; however, the specific age for initiation of screening and the particular screening tests that are recommended vary. The American Academy of Family Physicians is updating its recommendation, which is similar to that of the USPSTF.<sup>16</sup> The American Academy of Pediatrics recommends screening for distance visual acuity, ocular alignment, and ocular media clarity for children 3 to 6 years of age and older.<sup>17</sup> The American Academy of Ophthalmology and the American Association for Pediatric Ophthalmology and Strabismus recommend vision screening during the preschool years.<sup>18</sup> The American Optometric Association recommends a comprehensive eye examination at 3 years of age.<sup>19</sup>

### MEMBERS OF THE USPSTF

Members of the USPSTF at the time this recommendation was voted on were as follows: Ned Calonge, MD, MPH, chair (Colorado Trust, Denver, CO); Diana B. Petitti, MD, MPH, vice-chair (Arizona State University, Phoenix, AZ); Susan Curry, PhD (University of Iowa, Iowa City, IA); Thomas G. DeWitt, MD (Children's Hospital Medical Center,

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