



*UK National
Screening Committee*

Evidence map: screening for adolescent idiopathic scoliosis

A literature search to outline the volume and type of evidence related to screening for adolescent idiopathic scoliosis for the UK National Screening Committee

Version: Final

Author: Costello Medical

Date: March 2021

The UK National Screening Committee secretariat is hosted by Public Health England.

About the UK National Screening Committee (UK NSC)

The UK NSC advises ministers and the NHS in the 4 UK countries about all aspects of [population screening](#) and supports implementation of screening programmes.

Conditions are reviewed against [evidence review criteria](#) according to the UK NSC's [evidence review process](#).

Read a [complete list of UK NSC recommendations](#).

UK NSC, Floor 5, Wellington House, 133-155 Waterloo Road, London, SE1 8UG

www.gov.uk/uknsc

Twitter: [@PHE_Screening](#) Blog: phescreening.blog.gov.uk

For queries relating to this document, please contact:

phe.screeninghelpdesk@nhs.net

© Crown copyright 2016

You may re-use this information (excluding logos) free of charge in any format or medium, under the terms of the Open Government Licence v3.0. To view this licence, visit [OGL](#) or email psi@nationalarchives.gsi.gov.uk. Where we have identified any third party copyright information you will need to obtain permission from the copyright holders concerned.

Published May 2021

Contents

| | |
|--|----|
| About the UK National Screening Committee (UK NSC) | 2 |
| Contents | 3 |
| Summary | 4 |
| Introduction and approach | 5 |
| Background & objectives | 5 |
| Previous review | 7 |
| Aims of the evidence map | 7 |
| Outcomes | 8 |
| Evidence map | 9 |
| Search methodology | 9 |
| Summary of the evidence map findings | 9 |
| Conclusions | 13 |
| Recommendations | 13 |
| Appendix 1 — Search strategy for the evidence map | 14 |
| References | 17 |

Summary

This document discusses the findings of an evidence map on screening for adolescent idiopathic scoliosis (AIS).

Evidence maps are a way of scanning published literature to look at the volume, type and direction of the evidence base in relation to a specific topic. They inform whether there is sufficient evidence to commission an external review on the topic under consideration.

Based on the findings of the evidence map, an external review on screening for AIS should not be commissioned at the present time.

The UK National Screening Committee (UK NSC) will return to screening for AIS in 3-years' time.

Introduction and approach

Background & objectives

The UK National Screening Committee (UK NSC) external reviews (also known as evidence summaries or evidence reviews) are developed in keeping with the UK NSC evidence review process to ensure that each topic is addressed in the most appropriate and proportionate manner. Further information on the evidence review process can be accessed [online](#).

Adolescent idiopathic scoliosis (AIS) is a condition of unknown cause that affects 2 to 3% of children between the age of 10 and reaching skeletal maturity.^{1, 2} It is characterised by a lateral curve of the spine with a Cobb angle of at least 10°.³ Among other types of idiopathic scoliosis (infantile and juvenile), AIS comprises approximately 90% of all idiopathic scoliosis cases in children.⁴

AIS with severe spinal curvature can be associated with negative health outcomes, including pulmonary disorders, disability, back pain, psychological effects, cosmetic issues and reduced quality of life.⁵ Therefore, screening has been proposed to promote early detection and intervention in order to limit the severity of spinal curvature before skeletal maturity is reached and to minimise the impact of more severe cases of AIS.

The main tests used to screen for AIS are the (Adam) Forward Bend Test (FBT), which may include a scoliometer, and Moiré topography, while radiography is employed to confirm diagnosis in a suspected case. The FBT is the most commonly used test, wherein assessors search for abnormalities and asymmetries of the spine as a patient bends forward. A non-invasive, handheld device called a scoliometer can be used during the FBT to determine the angle of trunk rotation. Moiré topography is an alternative screening method that renders a 3D description of the back, highlighting any deformities present in the spine.⁶

At present, the UK National Institute of Health and Care Excellence (NICE) has no published clinical guidelines for AIS. In 2018, the US Preventative Services Task Force (USPSTF) published a recommendation not to screen for AIS in children and adolescents aged 10 to 18 years.⁵ This recommendation was based on the results of a systematic literature review (SLR), which concluded that there was insufficient evidence to assess the balance of benefits and harms of screening for AIS, specifically regarding the improvement in long-term outcomes from the correction of spine curvature.

Furthermore, the recommendation was based on the findings that the positive predictive value and sensitivity of available screening tests are variable, and that the majority of individuals identified through screening would never require treatment.³

The American Academy of Orthopaedic Surgeons, the Scoliosis Research Society, the Pediatric Orthopaedic Society of North America and the American Academy of Pediatrics recommend screening boys once at age 13 or 14 and girls twice at ages 10 and 12 using the FBT and a scoliometer, with a radiography follow-up to confirm suspected cases (individuals with an angle of trunk rotation of 5° to 7°).³ Recommendations on AIS screening vary amongst other countries, with some having discontinued school screening and some providing optional screening. School AIS screening is mandatory by law in Japan but may soon be incorporated into a broader school musculoskeletal screening programme.⁷ Table 1 summarises existing recommendations on screening for AIS from around the world.

Table 1: Existing international recommendations on AIS screening

| Country | Authority | Date of implementation | Recommendation | Reference |
|---------------------------------------|--|------------------------|---|--|
| USA | US Preventative Services Task Force | 2018 | Recommends not to screen for AIS in children and adolescents aged 10 to 18 years | Grossman <i>et al.</i> (2018) ⁵ |
| USA | The American Academy of Orthopaedic Surgeons; The Scoliosis Research Society; The Pediatric Orthopaedic Society of North America; The American Academy of Pediatrics | 2018 | Recommend screening girls twice at ages 10 and 12 and boys once at 13 or 14 | Dunn <i>et al.</i> (2018) ³ |
| Canada | Canadian Task Force on the Pediatric Health Examination | 2003 | Screening discontinued due to insufficient evidence to support continuation | Linker <i>et al.</i> (2012) ⁸ |
| Australia | Australian National Health and Medical Research Council | 1990s | Screening discontinued in favour of the National Self-Detection Program for Scoliosis | Plaszewski <i>et al.</i> (2012) ⁹ |
| Japan | Local educational authorities | 1979 | AIS screening mandated by law | Kuroki <i>et al.</i> (2017) ⁷ |
| Greece, Italy, Spain, Israel, Turkey, | Multiple | NA | AIS screening provided on a voluntary basis | Plaszewski <i>et al.</i> (2012) ⁹ |

| Country | Authority | Date of implementation | Recommendation | Reference |
|-----------------------|--|------------------------|---|--|
| Netherlands, Bulgaria | | | | |
| Poland | Polish Agency for Health Technology Assessment | NR | Does not recommend screening for AIS | Plaszewski <i>et al.</i> (2012) ⁹ |
| Norway | NR | 1976 | Discontinued screening in 1994 based on USPSTF recommendation | Adobor <i>et al.</i> 2012 ¹⁰ |
| Sweden | NR | 1977 | Ongoing AIS screening programme | Adobor <i>et al.</i> (2011) ¹¹ |

Adapted from Altaf *et al.* (2017)¹². Abbreviations: AIS: adolescent idiopathic scoliosis; NA: not applicable; NR: not reported

Previous review

The UK NSC currently does not recommend screening for AIS.¹³ This recommendation, published in July 2016, is based on the previous UK NSC review on screening for AIS, published in June 2015,¹⁴ which concluded that:

- the FBT has a high false positive rate; performing unnecessary X-ray procedures is wasteful of resources and exposes adolescents to potentially harmful radiation
- the FBT has a very low positive predictive value for identifying cases of AIS that are likely to progress and require treatment
- it is unclear whether the use of Moiré topography as a follow-up test following the FBT would improve the sensitivity of screening
- the optimal age for screening is unclear
- the optimal threshold (i.e. angle of trunk rotation) for referral to radiography is unclear
- it is unclear whether earlier intervention (i.e. following screen detection) results in better health outcomes than later intervention (i.e. following clinical detection)

Aims of the evidence map

Evidence maps are rapid evidence products that aim to gauge the volume and type of evidence relating to a specific topic. This document discusses the findings of an evidence map.

The evidence map aims to address the following question: does screening for AIS improve health outcomes?

This information is necessary for the UK NSC to consider whether another evidence review on screening for AIS should be commissioned.

Outcomes

On the basis of the evidence map, it is recommended that an evidence review on screening for AIS should not be commissioned at the present time.

Evidence map

Search methodology

A detailed search strategy, as well as the inclusion and exclusion criteria are presented in Appendix 1. One reviewer reviewed all titles and abstracts. All references were reviewed at the abstract level and in 3 cases full texts were reviewed to clarify uncertain pieces of information. Decisions regarding the eligibility of all included studies and 10% of excluded studies were verified by a second, independent reviewer. A formal quality assessment of the evidence was not required, given the remit of the evidence map.

The searches for the evidence map were conducted in the following electronic databases:

- MEDLINE, including MEDLINE In-Process, MEDLINE Daily and Epub Ahead of Print
- Embase
- The Cochrane Library, including:
 - Cochrane Database of Systematic Reviews (CDSR)
 - Cochrane Central Register of Controlled Trials (CENTRAL)

All database searches were performed on 30 April 2020.

MEDLINE and Embase were searched simultaneously via the Ovid SP platform and were date-limited to 1 January 2015 – 29 April 2020. The Cochrane Library databases were searched via the Wiley Online platform and were date-limited to 1 January 2015 – 30 April 2020.

Summary of the evidence map findings

The database searches returned a combined total of 667 references of potential relevance. After automatic and manual de-duplication, 622 unique references were reviewed for relevance, full texts were reviewed for 3 records and 1 record was ultimately included in the evidence map. A flow diagram summarising the number of studies included and excluded is presented in **Error! Reference source not found.** Figure 1.

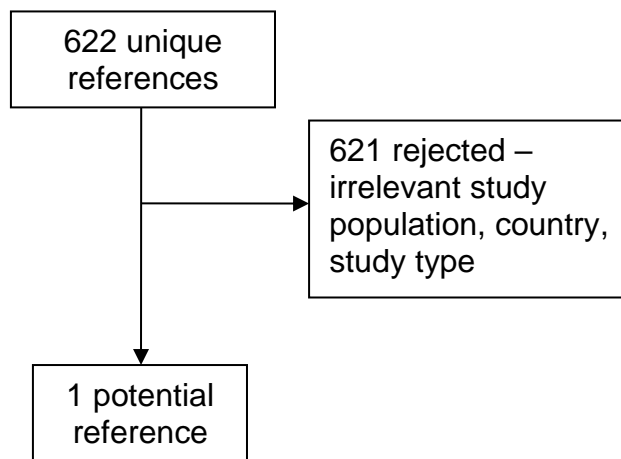


Figure 1: Summary of included and excluded publications

Does screening for adolescent idiopathic scoliosis improve health outcomes?

The majority of the identified studies failed to meet the eligibility criteria. The most common reasons for this were an irrelevant study population (i.e. study was conducted in patients with clinically diagnosed AIS only) or an irrelevant setting (i.e. study was not conducted in the UK or in a country where the population and healthcare settings are analogous to those in the UK).

For the 3 studies identified as being potentially relevant, full texts were sought to clarify their relevance. Of these, 1 was included. This was an SLR commissioned by the USPSTF, published in January 2018, that aimed to review evidence on the benefits and harms of AIS screening.³ The SLR sought to identify evidence on 6 Key Questions (KQs), including the long-term outcomes from AIS screening (harms and benefits), from AIS treatment in adolescence (also harms and benefits), or associated to spinal curvature at reaching skeletal maturity. As within the current review, the authors of the SLR found no evidence on the benefits or harms of AIS screening. They also reported insufficient evidence of the benefits of AIS treatment or association between spinal curvature and health outcomes. Based on these findings, the USPSTF published an updated recommendation not to screen for AIS in children and adolescents aged 10 to 18 years.⁵ This superseded the previous USPSTF recommendation from 2004, which also recommended against routine screening for idiopathic scoliosis in asymptomatic adolescents.⁵

The other 2 studies were deemed to be potentially relevant at the abstract review stage, but upon review of the full texts, proved to be irrelevant.

The first study was a review evaluating evidence on the efficacy of screening for AIS; inspection of the full text revealed this to be narrative review rather than an SLR.¹⁵ Moreover, the 2 potentially relevant studies cited in the review were published in 2008 and 1996, prior to the 2 previous UK NSC reviews (in 2012 and 2015) on screening for AIS.^{16, 17}

The second study was an SLR and meta-analysis on the effectiveness of school screening for AIS.¹² Crucially, none of the studies included in the SLR or meta-analysis were described as including a comparator arm of either clinical detection or no screening. The review does report that "a far greater number of patients who are screened are being offered treatment with a brace compared with surgery" and suggests that "the low surgical rates in the screened population are likely to be through the early detection and treatment of scoliosis curves, a proportion of which would have otherwise progressed to

surgery". However, the authors concede that this conclusion is purely speculative due to the absence of unscreened control groups.

In summary, at present there is an insufficient volume of evidence on health outcomes related to screening for AIS in the UK or analogous populations to justify commissioning an evidence review on screening for AIS.

Conclusions

The findings of the evidence map indicate that there is currently very little evidence on health outcomes related to screening for AIS in the UK or analogous populations.

Recommendations

The volume and type of evidence related to screening for AIS is currently insufficient to justify an evidence review at the current time and so should be re-considered in 3-years' time.

Appendix 1 — Search strategy for the evidence map

SOURCES SEARCHED: Ovid MEDLINE(R) Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily, Ovid MEDLINE and Versions(R) 1946 to 29 April 2020, Embase 1974 to 29 April 2020, and the Cochrane Library (Issue 4 of 12, April 2020)

DATES OF SEARCH: 1 January 2015 – 29 April 2020 for MEDLINE and Embase; 1 January 2015 – 30 April 2020 for the Cochrane Library (searches were run on 30 April 2020 for all databases)

SEARCH STRATEGIES:

MEDLINE and Embase (searched simultaneously via the Ovid SP platform)

1. exp idiopathic scoliosis/
2. *scoliosis/ and (idiopathic or ais).ti,ab,kf,kw.
3. (scolio* adj3 idiopathic).ti,ab,kf,kw.
4. or/1-3
5. exp child/ or (child* or juvenil* or kid? or minor* or p?ediatric* or preschool* or pre-school* or toddler? or underage? or under-age? or youth*).ti,ab,kf,kw.
6. exp adolescent/ or exp adolescence/ or (adolescen* or teenage* or puberty or pubescen*).ti,ab,kf,kw.
7. 5 or 6
8. (screen* or test*).ti,ab,kf,kw.
9. mandatory testing/ or mass screening/
10. (forward bend* test or fbt).ti,ab,kf,kw.
11. scoliomet*.ti,ab,kf,kw.
12. angle of trunk rotation.ti,ab,kf,kw.
13. *moire topography/ or (moire adj2 (topography or pattern)).ti,ab,kf,kw.
14. or/8-13
15. ("Conference Abstract" or "Conference Review" or comment or editorial or note or case reports or news or news release).pt.
16. (case stud* or case report*).ti,ab.
17. historical article/ or case study/
18. exp animals/ not exp humans/
19. or/15-18
20. 4 and 7 and 14
21. 20 not 19
22. limit 21 to yr="2015-current"
23. remove duplicates from 22

| Cochrane Library (searched via the Wiley Online platform) | |
|--|--|
| #1 | [mh scoliosis] and (idiopathic or AIS):ti,ab,kw |
| #2 | (Scolio* NEAR/3 idiopathic):ti,ab,kw |
| #3 | #1 or #2 |
| #4 | [mh child] or (child* or juvenil* or kid? or minor* or p?ediatric* or preschool* or "pre-school" or toddler? or underage? or "under-age" or "under-aged" or youth*):ti,ab,kw |
| #5 | [mh adolescent] or [mh adolescence] or (adolescen* or teenage* or puberty or pubescen*):ti,ab,kw |
| #6 | #4 or #5 |
| #7 | (screen* or test*):ti,ab,kw |
| #8 | [mh ^"mandatory testing"] or [mh ^"mass screening"] |
| #9 | (forward NEXT bend* NEXT test or fbt):ti,ab,kw |
| #10 | scolimet*:ti,ab,kw |
| #11 | "angle of trunk rotation":ti,ab,kw |
| #12 | [mh ^"moire topography"] or (moire NEAR/2 (topography or pattern)):ti,ab,kw |
| #13 | {OR #7-#12} |
| #14 | #3 and #6 and #13 with Publication Year from 2015 to 2020, with Cochrane Library publication date Between Jan 2015 and Apr 2020, in Trials |

Results by database

| | |
|---------------------------|------------|
| MEDLINE and Embase | 589 |
| Cochrane Library | 78 |
| Total | 667 |

Inclusions and exclusions

Studies were included based on the eligibility criteria listed in Table 2.

Table 2: Eligibility criteria

| PICOS domain | Inclusion Criteria | Exclusion Criteria |
|---------------------|---|--|
| Patient population | Asymptomatic children and adolescents aged 10 to 18 years* *Clinically diagnosed children and adolescents are eligible if included within the comparator arm | Children under 10 years of age or adults |
| Intervention | Screening for adolescent idiopathic scoliosis | Any other intervention |
| Comparator | <ul style="list-style-type: none"> • No screening • Clinical detection • None (only for studies of a case series design) | Any other comparators |

| PICOS domain | Inclusion Criteria | Exclusion Criteria |
|----------------------|---|--|
| Outcomes | <ul style="list-style-type: none"> • (Health-related) quality of life • Back pain • Degree of spinal curvature in childhood or adulthood (trunk rotation) • Surgery rates • Morbidity • Mortality • Functioning • Self-image • Mental health, including depression | Any other outcomes |
| Study design | <p><u>Tier 1:</u> RCTs, non-RCTs, prospective and retrospective cohort studies, before-after studies, systematic reviews/meta-analyses</p> <p><u>Tier 2:</u> case-control studies</p> <p><u>Tier 3:</u> case series</p> | Any other study design, including case reports, narrative reviews, editorials, commentaries, letters, conference abstracts or other publication types that have not been peer-reviewed |
| Setting | <p><u>Tier 1:</u> Studies conducted in the UK</p> <p><u>Tier 2:</u> Studies conducted in high-income countries where the population, screening methods and technology are expected to be similar to that of the UK (OECD and EEA countries excluding South Korea and Mexico)</p> | Studies in ineligible countries, or international studies where outcomes for eligible countries are not presented separately to outcomes from ineligible countries |
| Other considerations | Articles published in the English language and since 2015 | <ul style="list-style-type: none"> • Studies with full text not in the English language • Studies published pre-2015 |

Abbreviations: EEA: European Economic Area; OECD: Organisation for Economic Co-ordination and Development; RCT: randomised controlled trial

References

1. Thompson JY, Williamson EM, Williams MA, et al. Effectiveness of scoliosis-specific exercises for adolescent idiopathic scoliosis compared with other non-surgical interventions: a systematic review and meta-analysis. *Physiotherapy* 2019;105:214-234.
2. Weiss H-R, Negrini S, Rigo M, et al. Indications for conservative management of scoliosis (guidelines). *Scoliosis* 2006;1:5.
3. Dunn J, Henrikson NB, Morrison CC, et al. Screening for adolescent idiopathic scoliosis: evidence report and systematic review for the US preventive services task force. *Jama* 2018;319:173-187.
4. Konieczny MR, Senyurt H, Krauspe R. Epidemiology of adolescent idiopathic scoliosis. *Journal of children's orthopaedics* 2013;7:3-9.
5. Grossman DC, Curry SJ, Owens DK, et al. Screening for adolescent idiopathic scoliosis: US preventive services task force recommendation statement. *Jama* 2018;319:165-172.
6. Willner S. Moiré topography—a method for school screening of scoliosis. *Archives of orthopaedic and traumatic surgery* 1979;95:181-185.
7. Kuroki H. School Scoliosis Screening-World Trends and the Problems Encountered in Japan. *International Journal of Orthopaedics* 2017;4:814-818.
8. Linker B. A dangerous curve: the role of history in America's scoliosis screening programs. *American journal of public health* 2012;102:606-616.
9. Plaszewski M, Nowobilski R, Kowalski P, et al. Screening for scoliosis: different countries' perspectives and evidence-based health care. *International Journal of Rehabilitation Research* 2012;35:13-19.
10. Adobor RD, Riise RB, Sørensen R, et al. Scoliosis detection, patient characteristics, referral patterns and treatment in the absence of a screening program in Norway. *Scoliosis* 2012;7:18-18.
11. Adobor RD, Rimeslatten S, Steen H, et al. School screening and point prevalence of adolescent idiopathic scoliosis in 4000 Norwegian children aged 12 years. *Scoliosis* 2011;6:23.
12. Altaf F, Drinkwater J, Phan K, et al. Systematic Review of School Scoliosis Screening. *Spine deformity* 2017;5:303-309.
13. UK National Screening Committee. UK NSC recommendation on adolescent idiopathic scoliosis (AIS). In: England PH, ed, 2016.
14. UK National Screening Committee. Screening for Adolescent Idiopathic Scoliosis: External review against programme appraisal criteria for the UK National Screening Committee (UK NSC). In: England PH, ed, 2015.
15. Deurloo JA, Verkerk PH. To screen or not to screen for adolescent idiopathic scoliosis? A review of the literature. *Public Health* 2015;129:1267-72.
16. Bunge EM, Juttman RE, van Biezen FC, et al. Estimating the effectiveness of screening for scoliosis: a case-control study. *Pediatrics* 2008;121:9-14.

17. Pruijs JEH, Van der Meer R, Hageman M, et al. The benefits of school screening for scoliosis in the central part of The Netherlands. *European Spine Journal* 1996;5:374-379.