UK National Screening Committee (UK NSC)

Screening for adolescent idiopathic scoliosis in children

Date: 5 March 2021

Contents

Aim

1. To ask the UK National Screening Committee (UK NSC) to make a recommendation, based on the evidence presented in this document, whether or not screening for adolescent idiopathic scoliosis in children meets the UK NSC criteria for a systematic population screening programme.

Current Recommendation

2. The 2015 review of screening for adolescent idiopathic scoliosis in children concluded that systematic population screening is not recommended. This is because:

    a. the screening test (the Forward Bend Test) has a high false positive rate and a low positive predictive value for identifying cases that are likely to progress and require treatment, therefore the use of this screening test would lead to unnecessary and potentially harmful exposure to X-rays

    b. there was uncertainty around an optimum screening approach in terms of the optimal age and threshold for referral

    c. there was a lack of evidence that early treatment, as a result of screening, would improve outcomes compared with treatment following clinical detection.

Evidence Map

3. The 2020 evidence map was undertaken by Costello Medical in accordance to the triennial review process (https://www.gov.uk/government/publications/uk-nsc-evidence-review-process/uk-nsc-evidence-review-process).

4. The 2020 evidence map assessed the evidence on the effectiveness of screening for adolescent idiopathic scoliosis in children.

5. The conclusion of the 2020 evidence map is that no further work should be undertaken at this point. This is because there was limited evidence on the effectiveness of screening on health outcomes. **Criteria 11 and 13 not met**.

6. Refer to Table A below for criteria.

Consultation

7. A three month consultation (11 June to 3 September 2020) was hosted on the UK NSC website. Direct emails were sent to 14 stakeholders. (Annex A)

8. Comments were received from 1 stakeholder (see Annex B for comments):

    a. SWS Cymru Support with Scoliosis.

9. Stakeholders disagreed with the recommendation of the evidence map. This is because they were concerned that this evidence map missed evidence on the effectiveness of screening on health outcomes; and also brought to the UK NSC's attention the evidence on new screening tests.

Evidence on the effectiveness of screening on health outcomes

Stakeholders indicated that the previous US Preventative Services Task Force (USPSTF) 2012 review had missed two systematic reviews published in 2009 by Sabirin et al[1] and in 2010 by Fong et al[2] that supported school-based screening.

Response: The conclusion of this evidence map was mainly based on the findings of the USPSTF review published in 2018 which found no evidence on the effectiveness of school-based screening for adolescent idiopathic scoliosis on health outcomes. In this evidence map systematic reviews by Sabirin et al 2009 and Fong et al 2010 were not included because they were published before the search date. However, these reviews were examined in more detail to understand whether any important evidence has been missed. The Sabirin et al (2009) review was not included in either 2011 or 2015 UK NSC reviews. However, it concluded that there were no randomised controlled trials assessing the effectiveness of the school scoliosis screening programme and only limited evidence suggested that a screening programme contributed to earlier detection and less surgery in screen-detected

patients. The Fong et al (2010) review was included in the 2011 UK NSC review but the usefulness of an outcome selected to represent clinical effectiveness was questionable as it focused on treatment prevalence and positive predictive value for treatment. In addition, stakeholders noted that a new study published in 2020 by Anthony et al[3] was not included in the UK NSC evidence map. This study was published after the search date. The study was examined by the reviewers and they concluded that it would not meet inclusion criteria of this evidence map as the population in this study included only referrals. Similarly, a study by Fazal et al (2006)[4] conducted in the Scoliosis Clinic at University College Hospital also included only those who were referred to this clinic. For this reason, the UK NSC agreed that an additional search with extended search dates is not required.

References

[1] Sabirin J, Buang SN (2009) School scoliosis screening programme. Health Technology Assessment Report, Health Technology Assessment Section, Ministry of Health Malaysia, MOH/P/PAK/186.09 (TR).
[2] Fong DY, Lee CF, Cheung KM, Cheng JC, Ng BK, Lam TP, Mak KH, Yip PS, Luk KD (2010) A meta-analysis of the clinical effectiveness of school scoliosis screening. Spine 35:1061–1071
[3] A. Anthony, R. Zeller, C. Evans and J. Dermott, "Adolescent idiopathic scoliosis detection and referral trends: impact treatment options" 2020. [Online]. Available: https://link.springer.com/article/10.1007/s43390-020-00182-6.
[4] Fazal, Muhammad & Edgar, Michael. (2006). Re: Detection of adolescent idiopathic scoliosis [2]. Acta orthopaedica Belgica. 72. 184-6.

Evidence on screening tests

Although this UK NSC evidence map did not focus on screening tests, 3 studies on tests were mentioned in the consultation response. Two studies considered a test called Scolioscan and the remaining study considered Digital Moire topography.

Response: Scolioscan, radiation-free scoliosis assessment system using 3D ultrasound imaging, appears to be a diagnostic test rather than a screening test. The Digital Moire topography is a screening test but the identified study focused on predicting adolescents with a Cobb angle of >10 degrees in patients already diagnosed with adolescent idiopathic scoliosis therefore more studies looking at unselected populations are needed. Currently, the available evidence base was considered to be limited and therefore the UK NSC agreed that an evidence map on screening tests may be commissioned in 3 years' time.

Recommendation

10. The Committee is asked to approve the following recommendation:

A systematic population screening for adolescent idiopathic scoliosis in children is not recommended in the UK.

Table A: Criteria for appraising the viability, effectiveness and appropriateness of a screening programme

Criteria	Met/Not Met
The Screening Programme	
There should be evidence from high quality randomised controlled trials that the screening programme is effective in reducing mortality or morbidity. Where screening is aimed solely at providing information to allow the person being screened to make an "informed choice" (eg. Down's syndrome, cystic fibrosis carrier screening), there must be evidence from high quality trials that the test accurately measures risk. The information that is provided about the test and its outcome must be of value and readily understood by the individual being screened. (NSC criterion 11) The benefit gained by individuals from the screening programme should outweigh any harms, for example from overdiagnosis, overtreatment, false positives, false reassurance, uncertain findings and complications. (NSC criterion 13)	**Not met**

Annex A: List of organisations and individuals contacted

1. British Orthopaedic Association
2. British Scoliosis Research Foundation
3. British Scoliosis Society
4. Faculty of Public Health
5. Institute of Child Health
6. Royal College of General Practitioners
7. Royal College of Physicians
8. Royal College of Physicians and Surgeons of Glasgow
9. Royal College of Physicians of Edinburgh
10. Royal College of Surgeons
11. Scoliosis Association UK
12. Scoliosis Awareness Ireland
13. Scoliosis Ireland
14. Support with Scoliosis Cymru

UK National Screening Committee

Annex B: Consultation comments

1. SWS Cymru Support With Scoliosis

Name:	Lynda Williams	**Email address:**	xxxx xxxx
Organisation (if appropriate):	SWS Cymru Support With Scoliosis		
Role:	**Chair**		

Do you consent to your name being published on the UK NSC website alongside your response?

Yes

Section and / or page number	Text or issue to which comments relate	Comment *Please use a new row for each comment and add extra rows as required.*
Introduction and approach. Background and objectives.	The use of 2018 Recommendation by US Preventative Services Task Force (USPSTF)	This review found that there was insufficient evidence of harm or benefit The review also used evidence from a previous recommendation in 2012. This report was based on the low quality and outdated review from 2004. The 2012 review omitted the evidence from 2 more recent reviews

Page 5 paragraph 5 & Page 6 paragraph 1		(2009 and 2010), both supporting the continuation of school screening programmes. [1]
Introduction and approach. Background and objectives. Page 6 Paragraph 2	Text indicates that school screening is being discontinued in many countries.	Within the 2018 Recommendation by USPSTF it is reported that 'More than half of US states either mandate or recommend school-based screening for scoliosis'. [2] Furthermore a recent 2020 study carried out by the Spine Clinic Hospital for Sick Children in Ontario found that since discontinuing school screening the majority of AIS patients present too late for effective management with bracing. It highlights that surgical waiting lists are inflated by late AIS referrals and that some of these patients may have avoided surgery with earlier detection and/or timelier referral. The study found that the majority of AIS patients are referred too late for effective treatment with spinal bracing. Given the Level 1 evidence supporting brace efficacy in minimising the risk of curve progression to surgical range, this is concerning. [3]
Previous Review Page 7	Responses relating to UKNSC recommendations for AIS • the FBT has a high false positive rate; performing unnecessary X-ray proce-	It is common to find false positive results in all screening. The second test carried out should clearly identify if there is a scoliosis that should be treated or not. The problem with exposure to radiation from X-rays is one that all health trusts are aware of and therefore operate strict policies on exposure to radiation to minimise the risk.

Page 6 Paragraph 2	dures is wasteful of resources and exposes adolescents to potentially harmful radiation • the optimal age for screening is unclear	There is more evidence supporting the use of equipment such as EOS System, which some hospitals are now using. Plus new equipment such as the Scolioscan, a no radiation system and is proven to be effective in the monitoring and measurement of curves. [4] [5] [6] It is acknowledged by the NSC that scoliosis can develop in puberty, although typically it is in early puberty that the child has the best possible chance of success in any non-surgical treatment. The Evidence Map highlights the optimal ages for screening stating that '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.' Puberty is a difficult time for many children as their bodies change and in most cases it is common to find that whilst a pre-adolescent child was happy to be in public wearing little or no clothes, as an adolescent, they now want to cover their bodies from everyone and become very body conscience.

		Early diagnosis in any condition is always preferable to offer the patient the best possible outcome in their choice of treatment. With scoliosis, an early diagnosis can mean the child will have a choice of treatment, based on the severity of the curve and whether it is progressive. Growth in an adolescent progresses at a rapid rate and if there is a curve present, no matter if that curve appears mild, it can progress at an alarming rate. The only way to measure what stage a child is at in their maturity is to see at what stage on the Risser scale they are. [7] To allow the child the best possible treatment options it is important that they are at Risser 0, 1 or 2 so that the rapid growth may be harnessed in any non-surgical treatment choice. A growth spurt in boys occurs sometime between ages 12 and 17, with the peak typically between ages 13 and 15; a gain of > 10 cm can be expected in the year of peak velocity. A growth spurt in girls occurs sometime between ages 9½ and 14½, with the peak typically between ages 11 and 13½; gain may reach 9 cm in the year of peak velocity. [8] If a child was fortunate to present at their first appointment with a mild to moderate curve and a good amount of growth

	• it is unclear whether earlier intervention (i.e. following screen detection) results in better health outcomes than later intervention (i.e. following clinical detection)	still available, they would be presented with a choice of treatments. Support from charities such as Scoliosis Association UK or SWS Cymru, Support With Scoliosis can provide encouragement and put the child and their family in touch with others who have scoliosis. This enables that child to make a more informed decision about their choice of treatment. One of the SWS Trustees has scoliosis and xxxx xxxx xxxx xxxx was diagnosed with scoliosis early because of xxxx xxxx awareness of the condition. From a parental perspective, xxxx xxxx agrees with the concerns about unnecessary X-rays and appreciates the risks. However, under the guidance of a consultant, this was a vital part of xxxx xxxx xxxx xxxx treatment and without it xxxx xxxx would not have had the opportunity to wear a brace. Coupled with the support and determination to comply, the Trustee's xxxx xxxx succeeded in avoiding to have surgery. Currently, there is no population screening for scoliosis, therefore children are only seeking help once symptoms are discovered. This is often after the summer months when a child may be seen with fewer clothes on, or by a vigilant sports coach who may notice some changes in a child's body, or at a dress fitting or being measured for a bra. As with many conditions, once the symptoms are noticeably visible on the outside of the body, the reality

		of what is happening on the inside may come as a shock to the individual and their immediate family. The majority of children are presenting at their first appointment with curves measuring 35 degrees plus and a Risser stage of at least 3. It is unlikely at this stage in growth development that a brace will improve the curve and with a progressive curve, the consultant, the child and their family are faced with a difficult decision: whether to undergo this major surgery as soon as possible, or to wait and possibly face more complex surgery at a later stage. All health professionals want to do the best for their patients and be in a position to offer a variety of treatment choices, but sadly this is not possible here.
Does screening for adolescent idiopathic scoliosis improve health outcomes? Page 11	The author does identify that in a screened group there were more children being treated with bracing and low surgical rates are likely to be through early detection but that this is a speculative conclusion as there was an absence of unscreened groups.	If we use the UK as an example of an unscreened group, it is clear from hospital cases that the majority of children are presenting too late to be treated with bracing.
Conclusions Page 13	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.	A study conducted in London Scoliosis Clinic at the University College Hospital shows the changing patterns in presentation and detection of adolescent idiopathic scoliosis over the last thirty years at our institution. The majority of the cases are now detected by family and friends often at a later stage with larger Cobb angles in excess of 40°. With Cobb angles of this magnitude, non-

		operative measures are ineffective, highlighting the importance of having some means of early detection of scoliosis. Knowing the advantages and dis-advantages of scoliosis screening, this study concluded that there should be an early means of detection of scoliosis, preferably screening, but criteria for screening and referral to specialist clinic have to be redefined by multicentre studies. Another challenge is to produce a greater awareness of the condition in the adolescent population and those who come in contact with them and to put greater emphasis on health education programmes. [] Recommendations made by the USPSTF are independent of the U.S. Government. Hence why more than half the states in US continue to carry out routine screening. The UK National Screening Committee (UK NSC) advises ministers and the NHS in the 4 UK countries about all aspects of population screening and supports implementation of screening programmes. UKNSC work together with Public Health England who help to protect the nations health and wellbeing, and reduce health inequalities. They are an executive agency of the

		Department of Health and Social Care, having a direct influence on patients. [2] [9] [10] Probably the primary difference is that the NHS is a public service for all, whilst in the US they operate a private system. This may also explain why in US they have more procedures offered. NHS England have made a commitment to become much better at involving patients. The NHS is based on Patient Centred Care with patients having the right to make informed choices. As we look to continuously improve patient care, should we not make ALL options available where possible? Especially as more participation from patients is seen to lead to better adherence to advice and treatment and, thus, to better health outcomes. [11] [16]
Recommendations Page 13	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.	Whilst reviewing the recommendations of NSC from 2016 and current research in scoliosis, screening and advancements in radiology we believe that we have demonstrated in our full written response to consult on UK Screening for Scoliosis that there is a good amount of evidence to support screening. With 18 papers all within a10 year period, we believe this is worth further discussion.
	COVID 19 Pandemic	Waiting times have been difficult to manage for some time now. Since going into lockdown for COVID 19 the

		NHS has seen a huge increase in the delay for services including surgery. With this in mind, if scoliosis screening was introduced in some form, children would be diagnosed earlier and allow them to have the option of non-surgical treatment to slow, stop or even decrease the progression of a curve. Early treatment would also result in less challenging surgery and reduced costs. [12] [13] [14]

References

[1] M. Płaszewski and J. Saltikov, "Are current scoliosis school screening recommendations evidence-based and up to date? A best evidence synthesis umbrella review," 2014. [Online]. Available: https://link.springer.com/article/10.1007%2Fs00586-014-3307-x.

[2] US Preventive Services Task Force, "Final Recommendation Statement," 2018. [Online]. Available: https://www.uspreventiveservicestaskforce.org/uspstf/document/RecommendationStatementFinal/adolescent-idiopathic-scoliosis-screening.

[3] A. Anthony, R. Zeller, C. Evans and J. Dermott, “Adolescent idiopathic scoliosis detection and referral trends: impact treatment options” 2020. [Online]. Available: https://link.springer.com/article/10.1007/s43390-020-00182-6.

[4] Y.-P. Zheng, T. Lee, K. Lai, B. Yip, G. Zhou, W. Jiang, J. Cheung, M. Wong, B. Ng, J. Cheng and T. Lam, "A reliability and validity study for Scolioscan: a radiation-free scoliosis assessment system using 3D ultrasound imaging," 2016. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4900244/.

[5] The Hong Kong Polytechnic University, ""Scolioscan Air” – the first-of-its-kind palm-sized 3D ultrasound imaging system brings accurate, safe and cost-efficient mass screening to schools and anywhere in the community," 2019. [Online]. Available: https://www.polyu.edu.hk/bme/news-and-events/news/2019/scolioscan-air---3d-ultrasound-imaging-system/.

[6] T. Sato, I. Yonezawa, T. Akimoto, T. Nobuyuki, Y. Shimamura, O. Muto, T. Suzuki, R. Momomura, K. Uno, K. Yamazaki, K. Fujiwara, A. Misawa and K. Kaneko, "Novel Hump Measurement System With a 3D Camera for Early Diagnosis of Patients With Adolescent Idiopathic Scoliosis: A Study of Accuracy and Reliability," 2020. [Online]. Available: https://www.cureus.com/articles/30928-novel-hump-measurement-system-with-a-3d-camera-for-early-diagnosis-of-patients-with-adolescent-idiopathic-scoliosis-a-study-of-accuracy-and-reliability.

[7] J. M. Hacquebord and S. M. Leopold, "In Brief: The Risser Classification: A Classic Tool for the Clinician Treating Adolescent Idiopathic Scoliosis," 2012. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3392381/.

[8] E. Graber, "Physical Growth and Sexual Maturation of Adolescents," 2019. [Online]. Available: https://www.msdmanuals.com/en-gb/professional/pediatrics/growth-and-development/physical-growth-and-sexual-maturation-of-adolescents.

[9] Gov.UK, "UK National Screening Committee," [Online]. Available: https://www.gov.uk/government/groups/uk-national-screening-committee-uk-nsc.

[10] Gov.UK, "Public Health England," [Online]. Available: https://www.gov.uk/government/organisations/public-health-england/about.

[11] Healthcare Administration, "Brief Comparison - UK Healthcare System Vs. US Healthcare System," 2020. [Online]. Available: http://www.healthcareadministration.com/brief-comparison-uk-healthcare-system-vs-u-s-healthcare-system/#:~:text=The%20healthcare%20system%20of%20the%20United%20States%20and,England%20is%20in%20the%20bottom%20among%20industrial%20countries..

[12] T. Grivas, T. Kotwicki, T. Maruyama, J. OBrien, H. Labelle and T. Hresko, "The BrAIST study and the implications for scoliosis screening: our duty for raising awareness and advocacy," 2014. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4290449/.

[13] T. Maruyama and K. Takeshita, "Surgical treatment of scoliosis: a review of techniques currently applied," 2008. [Online]. Available: https://scoliosisjournal.biomedcentral.com/articles/10.1186/1748-7161-3-6#:~:text=Surgical%20treatment%20for%20scoliosis%20is%20indicated%2C%20in%20general%2C,function%2C%20and%20much%20larger%20curves%20cause%20respiratory%20failure..

[14] S. M. Weinstein and L. P. J. M. M. M. M. Dolan, "Effects of Bracing in Adolescents with Idiopathic Scoliosis," 2013. [Online]. Available: https://www.nejm.org/doi/full/10.1056/NEJMoa1307337#:~:text=Methods%201%20Study%20Design.%20We%20conducted%20BRAIST%20in,Data-Collection%20and%20Follow-up%20Periods.%20...%205%20Outcomes.%20.