Hearing screening in newborns: systematic review of accuracy, effectiveness, and effects of interventions after screening

CRD summary
The authors concluded that there was a lack of high-quality evidence for all aspects of newborn hearing screening; early identification and treatment of children with hearing impairment may improve language development. There were limitations in reporting of individual studies, but overall the authors' conclusions reflected the evidence from generally poor-quality studies and are likely to be reliable.

Authors' objectives
To evaluate the benefits and harms of universal hearing screening in newborns. This is an update of a previous review (see Other Publications of Related Interest).

Searching
MEDLINE, EMBASE, CINAHL, PsycINFO, PSYNDEX, ERIC, The Cochrane Library, DARE, NHS EED and HTA database were searched for studies in any language up to October 2007. Search terms were reported. Reference lists of included studies and identified reviews were screened. Hospitals and manufacturers of screening equipment, hearing aids and cochlear implants were contacted.

Study selection
The review evaluated screening tests, compared screening with no screening and compared the effect of early with later treatment. Children at high risk were excluded in all parts of this review.

Screening tests: Application studies of unselected populations of children aged up to 12 months old were eligible if they compared hearing screening using otoacoustic emissions and/or auditory brainstem response with other procedures and reported adequate results for an evaluation of test accuracy.

Screening versus no screening: Randomised controlled trials (RCTs), non-randomised screening studies and controlled cohort studies of children aged up to 12 months were eligible if they compared hearing screening using otoacoustic emissions and/or auditory brainstem response with no screening or different screening strategies. Studies needed to report any of: hearing ability; language, psychosocial, emotional or cognitive and educational development; and adverse effects of treatment or adverse effects of screening caused by false positive or false negative results.

Early versus later treatment: Controlled studies, uncontrolled studies and cohort studies of children aged up to 10 years of age were eligible if they compared early versus later treatment. Uncontrolled studies had to adequately consider at least three confounding factors.

Two reviewers independently selected studies and resolved disagreements by discussion and consensus.

Assessment of study quality
Two reviewers independently assessed the validity of controlled and uncontrolled studies using modified CRD criteria. Criteria included sample size calculation, blinding, baseline comparability of treatment groups, accounting for confounders and clarity of patient flow. The quality of diagnostic studies was assessed using QUADAS criteria. Disagreements were resolved by discussion and consensus.

Data extraction
Sensitivity and specificity values with 95% confidence intervals (CI) were reported for diagnostic studies. Means, standard deviations and group differences were presented for studies that compared screening with no screening.

Two reviewers independently extracted data and resolved disagreements by discussion and consensus. Authors were contacted for additional information about the included studies.
Methods of synthesis
The studies were combined in a narrative synthesis. The diagnostic studies were heterogeneous and results were plotted on a receiver operating characteristic (ROC) space.

Results of the review
The quality of diagnostic studies was not reported. The quality of other types of study was generally poor. Methodological limitations included lack of: sample size planning; blinded outcome assessment; adjustment for confounding factors; and reporting of uninterpretable tests and tests not performed. One treatment study showed minor deficiencies; all other studies had major deficiencies.

Diagnostic accuracy: nine studies
Eight studies (n=1,801 patients, range 64 to 444) compared otoacoustic emissions with automated auditory brainstem response. Studies were heterogeneous. Sensitivity ranged from 0.50 (95% CI 0.35 to 0.65) to 1.00 (95% CI 0.03 to 1.00). Specificity ranged from 0.49 (95% CI 0.36 to 0.63) to 0.97 (95% CI 0.94 to 0.99). One study (n not reported) compared two-stage screening using otoacoustic emissions plus auditory brainstem response and reported a sensitivity of 0.92 (95% CI 0.74 to 0.98) and specificity of 0.99 (95% CI 0.98 to 0.99). Children who screened negative were not followed up.

Screening versus no screening: two studies (n=101 and 50)
Studies compared hearing-impaired children from hospitals, time periods or regions with and without screening. Test procedures were specified. Screening was associated with improvements in receptive language development (two studies reported significant effects), expressive language development (one study reported a significant effect of screening and the other reported a non-significant trend), total language development (one study reported a significant effect of screening) and communicative abilities and spontaneous speech (one study reported a significant effect of screening).

Early versus later treatment: six studies (n not reported)
Five studies were retrospective analyses and one was a population-based cohort study. Treatments varied and included cochlear implants, hearing aids, early intervention sessions and a parent/infant programme. One study reported a significant benefit in language intelligibility in the early screening group. Four of five studies reported improvements or significant improvements in receptive language development in early screening groups. One study reported no significant difference.

Authors’ conclusions
There was a lack of high-quality evidence for all aspects of newborn hearing screening. Early identification and treatment of children with hearing impairment may be associated with advantages in language development; other aspects such as quality of life had not been adequately evaluated.

CRD commentary
The review question was clearly stated and inclusion criteria appropriately defined for the three parts of the review. Several relevant sources were searched and attempts were made to minimise publication and language bias. Validity was assessed using specified criteria, but results for diagnostic studies were not completely reported. Adequate methods were used to minimise reviewer error and bias during the review process. Some information was provided about the included studies, but information such as the number of participants was not consistently reported. A narrative synthesis was appropriate in view of the differences between studies.

There were limitations in reporting of individual studies, but overall the authors’ conclusions reflected the evidence from generally poor-quality studies and are likely to be reliable.

Implications of the review for practice and research
Practice: The authors did not state any implications for practice.

Research: The authors stated that there was a lack of high-quality evidence about all aspects of screening newborns for hearing impairment.

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