Is pre-school child health surveillance an effective means of detecting key physical abnormalities?

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SUMMARY

Background. *The effectiveness of child health surveillance (CHS) screening is still being questioned. There has been little work on the quality of CHS provided in primary care following the shift in provision encouraged by the 1990 Contract.*

Aim. *To determine the effectiveness of primary care CHS screening for five physical conditions: undescended testes, congenital heart disease, squints, developmental dysplasia of the hip, and congenital hearing loss.*

Method. *A prospective study of a one-year cohort of children born to mothers registered with one-quarter of general practices in a single health authority. At age 15 to 18 months, all referrals for the five physical conditions were traced through hospital record systems and copies of CHS reviews from the children's personal child health records.*

Results. *From an initial cohort of 2308 babies, 1972 (85%) were followed up. Four hundred and thirteen (21%) children had been referred for one of the five physical conditions. Of the children referred, 395 (91%) were referred directly from CHS reviews. Forty-nine (12%) children were found to have an abnormality requiring treatment or follow-up and, of these, 41 (84%) were referred from CHS. The sensitivities of CHS screening for the five conditions were generally high, but the false–positive rates were also high, especially for developmental dysplasia of the hip and hearing loss.*

Conclusion. *The majority of children with undescended testes, congenital heart disease, squints, developmental dysplasia of the hip, and congenital hearing loss presenting during the first 18 months of life are detected by child health surveillance.*

Keywords: child health surveillance; screening; patient-held records.

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Introduction

THE content and value of pre-school child health surveillance (CHS) have been debated for many years.[1,2] Despite recommendations on content and organization,[2-6] widespread variation in the provision of CHS, has continued.[7] There is a paucity of research about CHS,[2] and recent systematic reviews of screening in child health continue to cast doubt on its effectiveness.[8]

As a result of the 1990 Contract,[9] most CHS in England and Wales is provided in general practice by primary health care teams.[7] There have been concerns that general practitioners (GPs) might not have sufficient training or interest to provide CHS of an appropriate standard.[7,10,11] Few publications have considered the quality of CHS provided in primary care since 1990.[12-15]

In 1993, we began an evaluation that covered many aspects of the structure, process, and outcomes of CHS in Nottingham. This paper focuses on the effectiveness of screening as one outcome measure of CHS.

In selecting aspects of CHS screening to evaluate, we considered the British Paediatric Association recommendations on outcome measures for child health,[16] prevalence, and extent of agreement on the diagnosis and treatment of conditions. As a result, we decided to study the effectiveness of CHS screening in primary care for five key physical conditions during the first 18 months of life. These were undescended testes, congenital heart disease, squints, developmental dysplasia of the hip, and congenital hearing loss.

Between 1990 and 1996, a locally agreed schedule of CHS reviews was used in Nottingham (Box 1).[17] In 1992, the personal child health record (PCHR) was introduced.

Method

The social and geographical characteristics of practices in Nottingham had been analysed using 1981 census data and practice area, categorizing them by 'social area'.[18] Initially, all 10 Nottingham practices involved in medical student teaching were contacted and five agreed to participate. A further 30 practices were selected using a stratified random sample based on the 'social area' categories, and 26 agreed to participate. One practice was excluded because one-third of patients lived in an adjacent health authority, another because the GPs did not provide child health surveillance, and a third because the practice disbanded during the first six months of the study.

All babies born to mothers registered with the 28 participating practices from 1 September 1993 to 31 August 1994 entered the study. We were notified of all births to mothers registered with the study practices in the two Nottingham hospitals by University Hospital, and of home births or births outside Nottingham by Nottingham Community Health NHS Trust.

From the initial cohort, all children who remained registered with the study practices were followed up at age 15 to 18 months. We identified all outpatient referrals for these children to the two Nottingham hospitals via the hospital computer systems using date of birth and practice code. The hospital notes were searched for referrals made for one of the five physical conditions. Referrals to the Children's Hearing Assessment Centre

Neonatal review (hospital paediatric SHO or GP)
Birth review (midwife)
Ten to 14-day review (health visitor)
Six-week review (GP or community paediatrician with occasional health visitor input)
Three- to four-month hip check (health visitor, practice nurse, GP or community paediatrician)
Six- to nine-month review (health visitor with occasional doctor input)
Hearing test (two health visitors or one health visitor and trained assistant)
Heart and testes check between one and three years of age (GP or community paediatrician)
Eighteen- to 24-month review (health visitor)
Thirty-six- to 42-month review (health visitor)

Box 1. Schedule of CHS reviews used in Nottingham.

were identified from their manual records system.

In addition, copies of the children's CHS reviews that had been recorded in their PCHRs were sent to us by the health visitors attached to the study practices. Any possible abnormalities of testes, hearts, eyes, hips, or hearing were collated. The hospital records of these children were then searched for referrals for the five physical conditions in case we had not previously identified them.

We used the PCHR copies of CHS reviews and GP referral letters in the hospital records to determine whether or not referrals were made directly as a result of CHS reviews. If there was no documented evidence of a referral having been made from a CHS review, it was assumed not to have been identified through CHS. The results of referrals were categorized as 'normal' or 'abnormal'; an abnormal result being an abnormality that required treatment or follow-up at the hospital. In the case of hearing loss, sensorineural loss and conductive loss sufficiently severe to require referral to an ENT specialist were both included. Using these definitions, we assessed CHS as a screening test for each of the five key conditions by calculating the sensitivities, specificities, positive and negative predictive values, and false–positive and false–negative referral rates.[19]

Data were analysed on SPSS 6.1 and EpiInfo 6. Chi-squared and Mann–Whitney U tests for significance are quoted where appropriate.

Results

Study sample

The study practices were representative of all practices in Nottingham Health Authority for Jarman deprivation scores[20] and proportion of practices that were fundholding and single-handed (Table 1). The study practices were more likely to be registered for child health surveillance, as this was an inclusion criterion for participating in the study, and were more likely to be involved in undergraduate or postgraduate teaching.

Between 1 September 1993 and 31 August 1994, 2308 babies were born to mothers registered with the study practices. At age 15 to 18 months, 1972 (85%) children were still registered with the study practices and these were all followed up. Of the remainder, 11 had died and 314 (13.6%) had moved practice.

Identification of referrals

Of the children who were followed up, 824 (42%) had been referred to hospital for any problem during the first 18 months of life. We could not locate hospital records for 21 (2.5%) of the children. From the notes that were available, we identified 348 children who had been referred for either undescended testes, congenital heart disease, squint, developmental dysplasia of the hip, or hearing loss.

From CHS reviews returned to us, we identified a further 65 children who had been referred for one of the five physical conditions. However, some CHS review records were not returned; these ranged from 256 (13%) 10- to 14-day reviews to 592 (30%) six- to nine-month reviews.

In total, 413 (21%) children had been referred by 18 months of age for one of the five conditions; 22 children having been referred for more than one problem. Only 49 children were found to have an abnormality that required treatment or follow-up; i.e. 2.5% of the children remaining in the cohort at the time of follow-up and 11.9% of children who were referred for one of the five physical conditions.

Effectiveness of CHS screening

Of the children referred for one of the five conditions, 395 (90.8%) were referred directly from CHS reviews (Table 2). Of the children who were found to have an abnormality, 41 (83.7%) were referred directly from CHS reviews. The largest proportion of abnormalities was identified from the six-week review, but most referrals were from the neonatal review and the health visitor distraction test.

The sensitivities of CHS as a screening test for the five conditions were generally high but the specificities were low (Table 3). The positive predictive values were particularly low for developmental dysplasia of the hip and hearing loss requiring treatment. The false–positive rates for all five conditions were high, particularly for developmental dysplasia of the hip and hearing loss.

At the time of follow-up, four of the seven boys with undescended testes had undergone orchidopexy, two were listed for surgery, and one was being observed. Three boys were referred between the ages of 12 and 18 months when they had been noted as having undescended testes at earlier CHS reviews.

The most common heart abnormality was a ventricular septal defect (six children). Three children were identified between the neonatal and six-week reviews. There were no apparent delays in referral. All children with innocent heart murmurs were discharged at their first outpatient appointment.

Of the children with visual abnormalities, eleven had hypermetropia and six had squints. There was a delay in referring three children recorded as having a squint at their six-week review. They were later referred at six, 13, and 15 months. All children referred to ophthalmology were followed up in the outpatient clinic until they were two-and-a-half years old, when monocular vision could be tested.

We did not identify any delays in referral of children for developmental dysplasia of the hip. Of these children, 142 (72%) who initially had a normal examination and ultrasound scan were followed up by an X-ray at five months of age and then discharged. Only 21 (11%) children were discharged as normal after their initial appointment.

One child was found to have sensorineural hearing loss and was identified by the health visitor distraction test. This child had hearing aids fitted at nine months of age. Four children had conductive loss sufficiently persistent and severe enough to require referral to an ENT specialist. Of the children referred for hearing problems, 80 (59%) were discharged after one assessment at the Children's Hearing Assessment Centre.

Discussion

The majority of children with undescended testes, congenital heart disease, squint, developmental dysplasia of the hip, or sig-

Table 1. Characteristics of study practices.

Characteristic	Study practices n = 28	Practices in Nottingham Health Authority n =120	Statistical significance
Registered for child health surveillance	28 (100%)	103 (86%)	$c^2 = 3.2$; $P = 0.04$
Fundholding	5 (18%)	10 (8%)	$c^2 = 1.34$; $P = 0.16$
Single-handed	6 (21%)	40 (33%)	$c^2 = 1.00$; $P = 0.32$
Teach medical students or GP registrars	15 (54%)	30 (25%)	$c^2 = 8.1$; $P = 0.004$
Jarman score	3.99 (-15.67–24.72)[a]	3.32 (-25.4–24.43)[a]	$Z = 0.37$; $P = 0.71$

[a]Mean and range.

Table 2. Pattern of referrals and number of children found to have undescended testes, congenital heart disease, squints, developmental dysplasia of the hip, or significant hearing loss.

	Number of referrals (Number found to be abnormal)					
Source of referral	Undescended testes	Congenital heart disease	Squint	Developmental dysplasia of hip	Hearing loss	Total
Neonatal review	–	3 (1)	–	140 (6)	–	143 (7)
Birth review	–	1	–	1	–	2
Ten- to 14-day review	–	1	3	7	–	11
Six-week review	7 (4)	14 (5)	10 (5)	19 (2)	1	51 (16)
Three-month hip check	1 (1)	1	4 (1)	12	–	18 (2)
Six- to nine-month review	1 (1)	1 (1)	24 (5)	11 (1)	–	37 (8)
Hearing test	–	–	–	–	130 (7)	130 (7)
Heart and testes check	–	3 (1)	–	–	–	3 (1)
Not from CHS review	3 (1)	6 (3)	21 (4)	6	4	40 (8)
Total	12 (7)	30 (11)	62 (15)	196 (9)	135 (7)	435 (49)

Table 3. Effectiveness of child health surveillance as a screening test for undescended testes, congenital heart disease, squints, develop- mental dysplasia of the hip, and hearing loss.

	Undescended testes	Congenital heart disease	Squint	Developmental dysplasia of hip	Hearing loss
Prevalence	7/1000[a]	5.6/1000	7.6/1000	4.6/1000	0.5/1000[b]
Sensitivity	86%	72%	73%	100%	100%[c]
Specificity	40%	16%	36%	3%	3%[c]
Positive predictive value	67%	34%	27%	5%	5%[c]
Negative predictive value	67%	50%	81%	100%	100%[c]
False–positive rate	60%	84%	63%	97%	97%[c]
False–negative rate	14%	27%	26%	0	0[c]

[a]Boys only; [b]sensorineural hearing loss; [c]hearing loss requiring treatment.

nificant hearing loss were identified from CHS reviews. The highest yield was from the six-week review.

The proportion of children with abnormalities identified by CHS was high. The sensitivities for congenital heart disease and squint may appear to be low but, for these two conditions, abnormal findings are not always present from birth.

For all five conditions, many referred children were found to be normal. Such high false–positive rates are of concern because they cause unnecessary parental anxiety, referrals, procedures, and costs to the National Health Service.[2,21-23] The positive and negative predictive values of screening tests are dependent on the prevalence of the condition being sought. For rare conditions, for example, sensorineural hearing loss, the positive predictive value will be reduced and more of the children who are screened as abnormal will later be diagnosed as normal.[19] For these reasons, the ethics of CHS screening have to be carefully considered and screening tests need to be rigorously evaluated.[2,21,23]

The false–positive rates were highest for developmental dysplasia of the hip and significant hearing loss. Yet in Nottingham, these conditions have detailed referral protocols. The cost of follow-up and the anxiety caused to parents might be greatest for developmental dysplasia of the hip, as most of these children had an initial ultrasound scan and were followed-up until they had an X-ray at five months of age. Internationally, universal neonatal screening for developmental dysplasia of the hip by ultrasonography has been suggested because of concerns about the accuracy of clinical examination. So far, its introduction has not been recommended because it would not be cost-effective and because of variability in scanning techniques and reporting of scans.[2,24-27] There has also been much criticism of the effectiveness of the health visitor distraction test, and recent reviews have recommended the introduction of universal neonatal hearing screening.[2,22,24]

Although the false–positive rate was also high for congenital heart disease, most of these referrals were from GPs at the six-week review. It is unrealistic to expect GPs to have the skills to recognize innocent murmurs in babies and it is appropriate for them to refer.[2] Also, all the referred babies with innocent mur-

murs were discharged at their first hospital appointment without incurring costs of investigation.

It could be of concern that a few children were not referred immediately when thought to have undescended testes or a squint. At the time of the study there were no local guidelines suggesting when GPs should refer these problems. National recommendations were that boys with possible undescended testes should be referred by 18 months with the hope that early orchidopexy might improve testicular growth and future fertility.[6,29] The third Hall Report has since recommended that boys with possible abnormalities be referred at the six-week check.[2] There were also no specific recommendations on how soon to refer a child with a squint, although the second Hall Report highlighted that some parents were falsely reassured that a squint could be normal before six months of age.[6] Whether or not treatment of early squints prevents amblyopia is still under debate, but prompt referral is now recommended.[2,22]

The numbers of abnormalities found in our study were small and any conclusions from our data should be drawn with caution. The study practices were over-representative of teaching practices because of our initial sampling procedure. Therefore, it could be argued that CHS in the study practices might be better than average. Also, as the practices knew they were being studied, their performance may have improved with the Hawthorne effect.[30] From the initial cohort, 14% of children were lost to follow-up. They may have differed from the remaining children, as children who change practice may be less likely to be referred or are referred late for problems because they are more difficult to follow-up.

Compared with previously published data, prevalences in our study were low for congenital heart disease (5.6/1000 versus 6.5/1000),[2] sensorineural hearing loss (0.5/1000 versus 1.16/1000),[2,28] and particularly undescended testes (7/1000 versus 16/1000).[2] This could be explained by the incompleteness of our data despite having traced referrals through the hospital systems and via CHS reviews. Also, we may have found more abnormalities if we had followed the children until they were older.

In conclusion, our study suggests that most undescended testes, congenital heart disease, squints, and significant hearing loss that present during the first 18 months of life are detected by CHS in primary care. Pre-school CHS is an effective means of detecting important physical abnormalities, and the six-week review, now usually performed by GPs, is worthwhile.

To improve the efficiency of CHS screening, we would support the recommended introduction of universal neonatal hearing screening. In the future, universal neonatal screening for developmental dysplasia of the hip using ultrasonography may also become sufficiently reliable and cost-effective to be introduced. These changes could have the greatest impact on improving CHS screening for the five conditions we studied. They would reduce anxiety for parents and the costs of follow-up caused by unnecessary referral of normal children.

Screening is only part of CHS. The importance of health promotion and the opportunity that CHS reviews provide for other activities should not be forgotten.

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