This is not explained by the process of data collection as care has been taken to make the data from both sources comparable. To determine the reasons for this marked difference in outcome more extensive investigation is required.

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Contributors: GH had the original idea for the study and coordinated the data analysis. LMI supplied the data from Norway. RTL supplied the statistical expertise. The paper was written jointly by GH, LMI, and RTL.

Conflict of interest: None.

1 Hawthorne G, Robson S, Ryall EA, Sen D, Roberts SH, Ward Platt MP. Prospective population based survey of outcome of pregnancy in diabetic women: results of the Northern Diabetic Pregnancy Audit, 1994. *BMJ* 1997;315:279-81.
2 Casson IF, Clarke CA, Howard CV, McKendrick O, Pennycook S, Pharoah POD, et al. Outcomes of pregnancy in insulin dependent diabetic women: results of a five year cohort study. *BMJ* 1997;315:275-8.
3 Hadden DR, McCance D, Traub AI. Ten year outcome of diabetic pregnancy in Northern Ireland: the case for centralisation. *Diabetic Med* 1998(suppl 1);15:S16.
4 Hellesen HB, Vikane E, Lie RT, Irgens LM. Maternal diabetes: falling perinatal mortality but still high foetal growth. *Tidsskr Nor Laegeforen* 1996;116:3465-9.
5 Diabetes Care and Research in Europe: the Saint Vincent Declaration WHO/IDF Europe. *Diabetic Med* 1990;7:360.

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Decrease in effectiveness of routine surveillance of *Haemophilus influenzae* disease after introduction of conjugate vaccine: comparison of routine reporting with active surveillance system

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In October 1992 routine immunisation with *Haemophilus influenzae* type b conjugate vaccine was introduced in the United Kingdom, and the incidence of disease was subsequently reported to have decreased 15-fold.[1] The surveillance systems in place were primarily routine and were known to underestimate the burden of invasive *H influenzae* disease.[2] This study aimed to determine whether underreporting continued after introduction of the conjugate vaccine, and how this might affect the reported success of the vaccine. Results of routine surveillance were compared with active surveillance for invasive *H influenzae* disease in the West Midlands health region of England.

Subjects, methods, and results

Invasive *H influenzae* disease was defined as an illness in which the organism was isolated from a sterile site in children aged <5 years admitted to hospital in the West Midlands from October 1990 to September 1992 (pre-vaccine) and from October 1992 to September 1994 (post-vaccine).

Data from voluntary laboratory reports to the Public Health Laboratory Service Communicable Disease Surveillance Centre (routine system) were compared with a system that combined data from the Communicable Disease Surveillance Centre, statutory notifications, laboratory records, hospital paediatricians, and the British Paediatric Surveillance Unit study of conjugate vaccine failures (active system). Hospitals and laboratories were visited to validate reports and collect demographic data. Only children aged <5 years who lived in the West Midlands are included in the analysis.

Of 244 West Midlands cases identified, only 200 cases had been reported to the routine surveillance system (table). Significantly fewer cases were reported to the routine surveillance system than to the active surveillance system in the post-vaccine period than in the pre-vaccine period (P=0.0018, table). Overall, the proportion of children aged <2 years identified by the routine surveillance system was significantly lower than that of children aged >2 years (P=0.0065, table). Reporting by ethnic group, sex, or mortality did not differ significantly. Of seven cases reported to the British Paediatric Surveillance Unit, only three were reported to the routine surveillance system. Incidence rates based on reports to the routine surveillance system for the pre-vaccine and post-vaccine periods were 23.4 per 100 000 children <5 years old (95% confidence interval 19.9 to 27.2) and 5.1 (3.6 to 7.1) respectively. This compares with 27.1 (23.3 to 31.2) and 7.7 (5.8 to 10.0) using active surveillance data. The table shows that effectiveness of routine surveillance decreased by 23% after introduction of the vaccine, with consequent overestimation of the effectiveness of the immunisation programme.

Comparison of cases of invasive *Haemophilus influenzae* disease in children <5 years identified by active surveillance and reports to the Communicable Disease Surveillance Centre (routine system) before and after introduction of the vaccine: West Midlands Health Region 1990-4

	Routine surveillance system	Active surveillance system	Proportion (95% CI) of routine: active cases
Total number of cases:	200	244	81.9 (76.8 to 86.4)
Oct 1990-Sept 1992	164	190	86.3 (80.9 to 90.7)
Oct 1992-Sept 1994	36	54	66.7 (53.4 to 78.2)
Cases of meningitis:	136	165	82.4 (76.0 to 87.7)
Oct 1990-Sept 1992	113	130	86.9 (80.3 to 91.9)
Oct 1992-Sept 1994	23	35	65.7 (49.0 to 79.9)
Cases of non-meningitic invasive disease:	64	79	81.0 (71.2 to 88.5)
Oct 1990-Sept 1992	51	60	85.0 (74.3 to 92.4)
Oct 1992-Sept 1994	13	19	68.4 (45.5 to 86.1)
Age group (months):			
0-23	139	179	77.7 (71.1 to 83.3)
24-59	61	65	93.8 (85.8 to 98.0)

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Comment

The reliability of surveillance systems can affect the observed effectiveness of public health interventions. *H influenzae* meningitis is a life threatening disease and most cases occur before the age of 2 years.[3] In this study cases of *H influenzae* meningitis in this age group were those most likely to be missed. The publicity surrounding the launch of the vaccine and the national study of vaccine failures[4] might have been expected to improve reporting efficiency. However, we found that the introduction of the vaccine was associated with significantly increased underreporting, perhaps because of factors such as complacency following the success of the vaccine in reducing the incidence of the disease or an assumption that reporting to the British Paediatric Surveillance Unit was sufficient. These findings are relevant as continuing surveillance is needed to assess the effectiveness of the programme, identify vaccine failures, and monitor changes in predominant strains of the organism. A meningococcal vaccine is being introduced into the immunisation schedule in the United Kingdom.[5] To measure the impact of this and other new vaccines accurately, the quality of the data sources for communicable disease surveillance must be ensured.

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1 Hargreaves RM, Slack MPE, Howard AJ, Anderson E, Ramsay ME. Changing patterns of invasive *Haemophilus influenzae* disease in England and Wales after introduction of the Hib vaccination programme. *BMJ* 1996;312:160-1.
2 Macleod CA. *Haemophilus influenzae*: the efficiency of reporting invasive disease in England and Wales. *Commun Dis Rep CDR Rev* 1994;4:R13-16.
3 Nazareth B, Slack MPE, Howard AJ, Waight PA, Begg NT. A survey of invasive *Haemophilus influenzae* infections. *Commun Dis Rep CDR Rev* 1992;2:R13-16.
4 Salisbury DM. The introduction of *Haemophilus influenzae* type b immunization into the United Kingdom: practical steps to assure success. *Pediatr Infect Dis J* 1998;17:S136-9.
5 Wise J. UK introduces new meningitis C vaccine. *BMJ* 1999;319:278.

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Reduced risk of hospital admission for childhood asthma among Scottish twins: record linkage study

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A recent study of Swedish army conscripts found a reduced prevalence of asthma and allergic rhinitis among twins.[1] We analysed routine data on hospital admissions in Scotland to compare risks of asthma and other respiratory complaints among twins and singletons.

Subjects, methods, and results

We identified all twins born in Scotland during 1981-4 from computerised maternity records. Subsequent admissions of twins to Scottish hospitals during 1981-94 were ascertained by probability matching on the basis of date of birth, sex, and surname. This matching is considered 99% accurate for singletons, but for twins it is reliable only at the level of the pair: which twin is admitted cannot be identified with certainty.

We identified hospital admissions for respiratory disease (ICD-9 (international classification of diseases, 9th revision) codes 464, 466, 480-486, and 490-496) for all Scottish children born during 1981-4. Rates of hospital admission among singletons and twins up to 10 years of age were compared by cause and sex, assuming Poisson errors in the numerators.

Twins were significantly less likely than singletons to be admitted for respiratory diseases (table). This was attributable to a reduced risk of admission for asthma among twins (code 493) by more than half throughout the age range 0-10 years. In contrast, twins were at significantly increased risk of admission for acute bronchitis and bronchiolitis (code 466). Admissions for other respiratory diseases were divided more equally between twins and singletons (table).

No significant differences were found between twins of the same or different sex in admission rates for any cause or all respiratory diseases combined. The relative difference in rates of admission with asthma for twins of the same sex compared with singletons was greater for males than for females, although this sex interaction was not significant.

Comment

Our record linkage study confirms that twins are at reduced risk of asthma but not of other respiratory diseases than are singletons. The twofold difference in rates for admissions with asthma between Scottish twins and singletons is greater than the difference in asthma prevalence (4.9% versus 5.9%) reported among Swedish army conscripts.[1] Cases admitted to hospital possibly represent more severely affected patients among whom the "twin effect" is more influential.