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Epidemiology of chickenpox in England and Wales, 1967-85

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Abstract

Routine sources of data on chickenpox morbidity and mortality in England and Wales were reviewed for 1967-85. Only two epidemics occurred, one in 1967 and one in 1980, both of which were immediately followed by two to three years of low incidence. The age distribution of the disease appears to be changing, with more cases now being reported in children aged 0-4 years. The number of deaths in adults have, however, increased, particularly those deaths that are associated with pneumonia and immunosuppression. At present in England and Wales more deaths are attributed to chickenpox than to whooping cough and mumps.

Widespread use of selective immunisation against chickenpox might be justified in England and Wales, but before routine immunisation of the child population can be considered special surveys to determine the incidence and severity of chickenpox and the effect of the vaccine on the subsequent development of herpes zoster are needed as well as cost-benefit studies of immunisation.

Introduction

Chickenpox is one of the more readily communicable diseases of man. It first became prominent in Europe during the sixteenth century and was called chickenpox by Morton in 1694 and varicella by Vogel in 1765 (the name chickenpox being derived from *cicer*, a chickpea[1]). In Britain varicella infection is seemingly nearly universal by 40 years of age.[2] It mainly causes a mild illness, especially in children, but may be severe, particularly in immunosuppressed people (the numbers of whom are increasing) and in adults. Vaccines have been developed in Japan and the United States and have been shown to be effective.[3,4]

We review the recent epidemiology of chickenpox in England and Wales.

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Methods and results

Routine sources of data were consulted to study trends in morbidity and mortality between 1967 and 1985. Four main sources were used. General practice morbidity data were obtained from the Weekly Returns Service of the Royal College of General Practitioners, which is based on a sample of 40 general practices which serve a population of about 220 000.[5] Data on first consultations for chickenpox have been available since 1967, and distributions by age and sex since 1976. Laboratory data were obtained from reports made to the PHLS Epidemiological Research Laboratory and after 1977 to the Communicable Disease Surveillance Centre. Data on hospital discharges and deaths were obtained from the Office of Population Censuses and Surveys Hospital In-patient Enquiry.[6] Data on mortality were obtained from death entries from the Office of Population Censuses and Surveys.

MORBIDITY, MORTALITY, AND TRENDS

The annual consultation rate for chickenpox between 1967 and 1985 from the Royal College of General Practitioners' clinical reporting scheme ranged from 243 to 878 per 100 000 population, with an average rate of 500 per 100 000 per year. Deaths from chickenpox for the same period have ranged from nine to 31, an average of 19 a year.

No predictable pattern in the incidence of chickenpox is apparent. There were two epidemics when over 800 consultations per 100 000 population were recorded by the college. The epidemic in 1967 (consultation rate 840) was succeeded by three years of steeply falling incidence to a low rate of 243 cases/10^5 in 1970. A fairly steady rate of 300-400 cases/10^5 was followed by another epidemic year in 1980 when the consultation rate reached 878. Four weekly data from the college showed regular peaks in spring or summer that sometimes extended over several months. Similar seasonal patterns in deaths were also evident. Annual hospital discharges and deaths from Hospital In-patient Enquiry data showed that hospital cases of chickenpox declined steadily from 2180 in 1967 to 940 in 1979, then increased in 1980 to 1210 cases before declining again between 1981 and 1984 (fig 1).

AGE AND SEX DISTRIBUTION

The age distribution of clinical cases, available from 1976 (RCGP), shows that 95% of all consultations for chickenpox were in children in the age

groups 0-4 years and 5-14 years (fig 2). Serological data show that just over a fifth of children aged 0-4 years have antibodies to varicella zoster virus, which rises to almost 80% by the time children have reached 15 years of age.[2] Between 1976 and 1981 the highest annual consultation rates were for those aged 5-14 years. From 1982, however, the consultation rate was higher for those aged 0-4, and the difference in rates between those aged 0-4 and 5-14 appears to be increasing (fig 3). A curious pattern was also noted in the

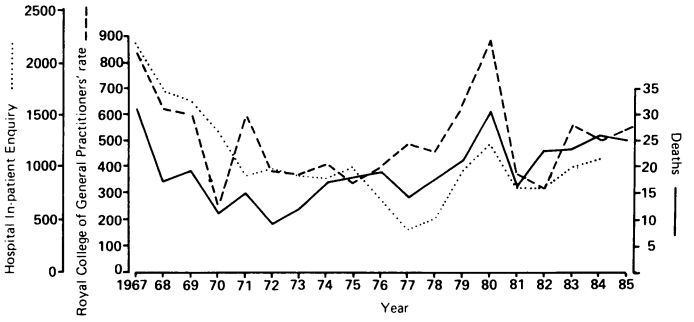

FIG 1—Chickenpox: Royal College of General Practitioners' yearly rate per 100 000; annual estimated hospital discharges and deaths from the Hospital In-patient Enquiry; and total deaths in England and Wales, 1967-85.

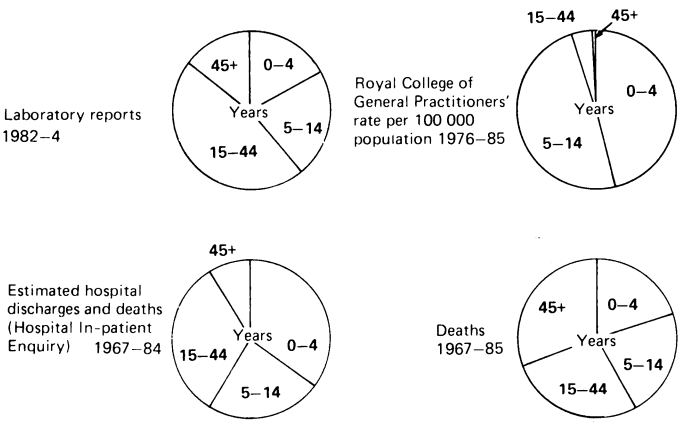

FIG 2—Age distribution for chickenpox.

FIG 3—Chickenpox: Royal College of General Practitioners' yearly rate for all ages and by age groups for England and Wales, 1976-85.

seasonal distribution of cases by age groups. Up to 1979 reports for the age group 5-14 years rose earlier and higher in the year and fell less steeply than did those for the age group 0-4. Between 1980 and 1982 the rates for the two age groups rose and fell together, after which time the rate for the group aged 0-4 gradually rose before and above that of the age group 5-14. For all years between 1976 and 1985 the rate for males exceeded that for females by a ratio of 1·1:1 (RCGP).

The age distribution of laboratory reported cases showed that 60% were in adults aged 15 years or more (fig 2). Hospital In-patient Enquiry data between 1967 and 1984 showed that overall those aged 15-44 accounted for the highest proportion of hospital discharges (35%). Since 1980 the age distribution of hospital cases of chickenpox has changed. The number of cases in the age group 0-4 years has increased from 29% before 1980 to 41% between 1980 and 1984, while cases in adults aged 15-44 years now account for 25% of hospital cases compared with 38% between 1967 and 1979.

SEVERITY

Some indexes of the severity of chickenpox were obtained from laboratory reports, Hospital In-patient Enquiry, and death entries. Laboratory reports for varicella zoster and herpes group were available from 1967 with information on clinical features from 1975. Laboratory reports for varicella zoster virus and herpes group for three recent years (1982-4) were studied in detail: 619 laboratory reports were identifiable as clinical chickenpox from a total of 1866 reports of varicella zoster virus and 1047 reports of herpes group; 11 of these 619 patients died.

Reported complications in the laboratory data included 40 cases of chickenpox in pregnancy between 1982 and 1984. Twelve babies from these pregnancies developed neonatal chickenpox, and one died. Pneumonia was reported in 18 chickenpox cases, of whom three died. The other complications reported included 14 cases of encephalitis with one death, four cases of arthritis, and one case of Guillain-Barré syndrome.

During the period 1967-84 in England and Wales there were an estimated 18 920 hospital discharges and deaths for chickenpox, an average of 1051 hospital cases a year. More cases were admitted during epidemic years, but overall the number of cases admitted to hospital fell by approximately half between 1967 and 1984.

Of the 370 deaths associated with chickenpox between 1967 and 1985, 75 (20% of all deaths) occurred in the age group 0-4 years, 18 (5%) of them taking place in the first month of life and 19 (5%) between 1 and 11 months. There was a fall in the proportion of neonatal deaths from 13 (7%) of 182 total deaths from chickenpox between 1967 and 1977 to five (3%) of 188 chickenpox deaths between 1978 and 1985. Similarly, since 1977 19 of 188 deaths (10%) were in those aged 1-11 months and 1-4 years compared with a total of 38 of 182 deaths (21%) between 1967 and 1977. The age group 5-14 years accounted for 24% of all deaths both before and after 1977. Deaths in adults increased from 88 (48%) in 1967-77 to 120 (64%) in 1978-85. For the 19 year period, 102 (28%) of all deaths from chickenpox were in those aged 15-44 years, with 42 (11%) aged 45-64 years and 64 (17%) aged 65 years and over (fig 4).

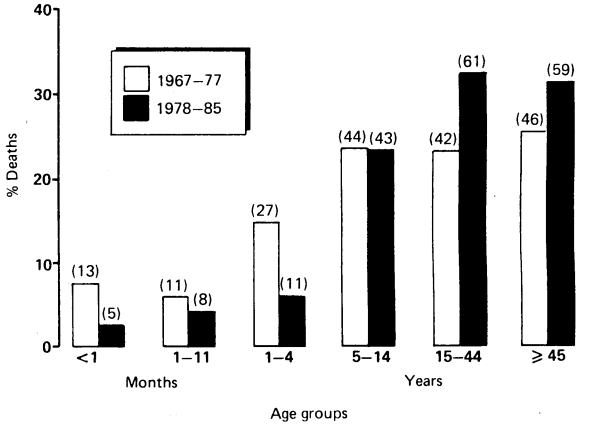

FIG 4—Chickenpox: proportion of total deaths by age group in England and Wales. Source: Death certifications to the Office of Population Censuses and Surveys. Numbers in parentheses.

CAUSES OF DEATH

Death entries were examined where chickenpox was the primary, underlying, or contributing cause of death. Chickenpox as the underlying cause of death formed the largest group with 217 cases (59%), and the commonest specified causes of death were pneumonia or encephalitis. Altogether, 109 (29%) deaths were attributed to complications of chickenpox arising from immunosuppression, and in only 44 (12%) deaths was chickenpox specified as the primary cause. Pneumonia was mentioned on 171 entries, in 43 of those in combination with immunosuppression. The cause of immunosuppression was given on the death entries in 104 of the 109 cases. Leukaemia was reported in 51 cases, Hodgkin's disease in 15, and

renal transplantation in 10. Other associated diagnoses included four with Reye's syndrome, and in 13 herpes zoster was specified in addition to chickenpox as a cause of death, presumably a miscoding for generalised zoster. Since 1967 the number and proportion of deaths from chickenpox pneumonia and immunosuppression have increased in adults, whereas those due to encephalitis have decreased in both children and adults (fig 5). Case fatality rates based on the estimated cases of chickenpox from the general practitioners' consultation data were considerably higher in adults aged 45 years or more than at other ages (table). There were no discernible differences in the death rates from chickenpox by regional health authority except for Wales where the rate per 100 000 population was the lowest at 0·025 compared with the average regional rate in England of 0·07 (range 0·04-0·1).

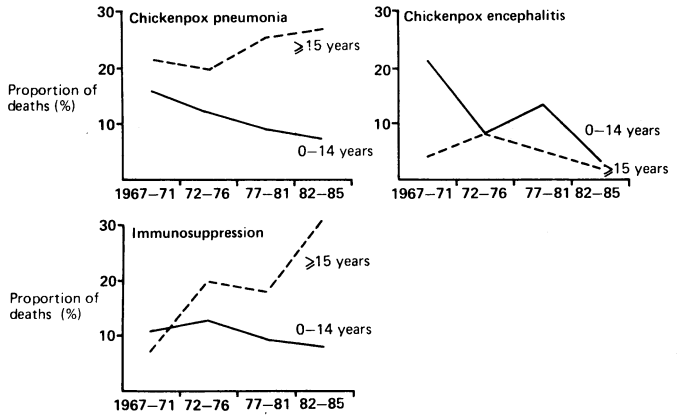

FIG 5—Chickenpox: deaths in England and Wales, 1967-85.

Age distribution of deaths and estimated case fatality rate per 100 000 cases of chickenpox where chickenpox was the primary, underlying, or contributing cause of death in England and Wales, 1967-85 (total deaths 370)*

	Age (years)				
	0-4	5-14	15-44	45	Total (%)
Primary cause:	12	10	12	10	44 (12·0)
Estimated case fatality rate	1·0	0·4	1·6	20·1	1·0
Underlying cause:					
Pneumonia	26	14	44	44	128 (34·6)
Encephalitis	15	28	12	5	60 (16·2)
Other	10	9	5	5	29 (7·8)
Estimated case fatality rate	4·4	1·8	7·9	108·5	4·5
Contributing cause:					
Immunosuppression	12	26	29	42	109 (29·4)
Estimated case fatality rate	1·0	0·9	3·8	84·4	2·2
Total No of deaths	75	87	102	106	370 (100)
Estimated case fatality rate	6·4	3·1	13·3	213·0	7·7

*Chickenpox cases estimated from the Royal College of General Practitioners' annual consultations by age group.

Discussion

Information on the epidemiology of chickenpox was derived from four main sources which essentially cover four different types of population. Data from the Royal College of General Practitioners, which is community orientated, is the most valuable for monitoring the "normal distribution" of chickenpox, its seasonal pattern, and its age distribution, whereas laboratory data, based on both general practitioner and hospital cases, more typically reflect severe or atypical chickenpox. Nevertheless, the seasonal trends and secular patterns in laboratory data were similar to the college's reports. Since most cases of chickenpox are easily diagnosed clinically few cases are referred for laboratory investigation. On the other hand, hospital data were useful as a guide to the number of cases of severe chickenpox but were limited because no information on the severity or nature of the complication of the disease was available. The death entries gave the cause of death from chickenpox and associated complications.

Chickenpox is a notifiable disease in the United States and the second most commonly reported infection after gonorrhoea.[7] An estimated three million cases of chickenpox occur each year and at steady state conditions are said to approximate the yearly birth cohort.[8] Both the college's consultation data and a "serological age profile" (E Miller, personal communication, 1987) of cases were used to estimate the overall level of chickenpox cases each year in England and Wales. Using annual total live births as a denominator, the Royal College of General Practitioners' estimates indicated a range of about 118 000 to 430 000 cases a year, an average of 36% of cases to live births, whereas the serological profile suggested about 635 000 cases a year, more closely approximating the yearly birth rate.

The age distribution of the college's consultation rates was similar to that expected from the serological data except in those aged 45 or over. There was a higher estimate of cases from the consultation data than estimated from serological data, reflecting the greater severity of chickenpox infection in this age group.

The college's data show that since 1982 the highest consultation rates have changed from children aged 5-14 years to those aged 0-4 years (fig 3), and most textbooks also claim that the peak age of infection is between 6 and 10 years. Our findings suggest that there has been a genuine change in the age distribution of chickenpox which may be accounted for by the fact that 1980 was an epidemic year so that children born in the succeeding years became the most susceptible group. A further possibility may be lower immunity in women, resulting in fewer babies with passive immunity. The higher rate of infection in the youngest children may also reflect changes in social organisation with more clustering of young children in nurseries and day care facilities.

Chickenpox is seriously undernotified in the United States.[9] This view was supported by an American telephone survey which found that while most cases were reported by telephone to a physician the rate per physician visit was only 0·5 per case.[10] When the data from the Royal College of General Practitioners were used as a measure of overall morbidity in England and Wales, the shortfall in estimated total incidence with annual live births as a denominator suggested that underreporting of the disease was due to it being so mild in many children that parents recognised it and did not consult the family doctor, or perhaps sought a consultation for only the index case in a family and not for subsequent cases.

Our results confirm that chickenpox commonly affects children, and serological data support this.[2] The change in the age distribution of clinical chickenpox since 1982 has probably accentuated the difference in mortality in age groups. Both the college's returns and hospital discharge data show that the highest incidence of clinical infection from chickenpox is now in the age group 0-4 years, who have, however, a low case fatality rate compared with adults. Moreover, the proportion of deaths in the age group 0-4 fell steadily from 23% of all deaths between 1967 and 1981 to 13·5% between 1982 and 1985. A similar fall occurred in the 5-14 year age group, with 17·5% of all deaths in 1982-5 compared with 26% in 1967-81. Reports of chickenpox in those aged 15-44 between 1982 and 1985 constituted 5% of the college's returns and 35% of death certifications, while those in the age group 45 and over accounted for 0·5% of the college's returns and 39% of death certifications. Deaths in adults, which have increased relative to the total number of deaths each year, appear to be increasingly associated with pneumonia and immunosuppression.

Decisions whether to vaccinate more extensively against chickenpox are difficult to make without knowing the effect that existing vaccines will have on herpes zoster. In view of the relatively high case mortality rates for chickenpox in adults compared with children the length of time for which the vaccine will afford protection is clearly also important. The number of certified deaths from chickenpox exceeds that from mumps in Britain, and complications seem to be more serious than with mumps, an infection against which routine vaccination will shortly be introduced. Live varicella virus vaccines have been successfully used for some years,[3,4] and a combined vaccine with measles, mumps, and rubella has been on trial.[11] A clinical study of the complication rate for chickenpox in all ages and cost benefit studies needs to be carried

out in Britain before the universal use of varicella vaccine can be seriously considered. This does not preclude more extensive selective use of the vaccine in those at special risk, such as immunosuppressed patients.

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Reference values for 75 g oral glucose tolerance test in pregnancy

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Abstract

A 75 g oral glucose tolerance test was performed in 212 pregnant women with no predisposing factors suggesting glucose intolerance to establish the normal pattern of glucose metabolism in pregnancy. Reference values for the test were established for the middle of pregnancy (14-20 weeks, n=43) and late pregnancy (28-37 weeks, n=168). One woman was excluded because she had diabetes that required treatment with insulin. There were statistically significant differences between the two groups for samples taken both one and two hours after the glucose load. Reference ranges for the interpretation of the glucose tolerance test in pregnancy should therefore take account of the period of gestation.

Arbitrary upper limits of normal (represented by the 97·5 centile) two hours after a 75 g oral glucose load are proposed at 7·5 and 9·6 mmol/l for the second and third trimesters, respectively.

Introduction

The oral glucose tolerance test is a well established method of identifying patients with abnormal carbohydrate metabolism. Though the influence of pregnancy on glucose tolerance has often been investigated, there are discrepancies among the reports: the glucose tolerance test has been reported to be unchanged[1] or impaired.[2,3] A possible explanation of these opposing views may be variations in the carrying out of the test and in the interpretation of the data.

Methodological changes have taken place in the measurement of plasma glucose concentrations during the last 20 years. Earlier studies used the alkaline ferricyanide method, but this has been superseded by more specific enzyme assays that give results about 10% lower, are more sensitive, and specify the normal range with better precision.

Criteria for an abnormal oral glucose tolerance test result during pregnancy have been proposed with different glucose loads. O'Sullivan and Mahan reported reference values for 752 unselected pregnant women given a load of 100 g.[4] Although many pregnant women vomit after such a large load, these criteria are still widely accepted in North America (table I). No allowance was made for alteration in glucose tolerance with advancing gestation. Other investigators showed subtle and progressive changes in the response curve to oral glucose with the advancement of the pregnancy.[3,5] Abell and Beischer proposed reference values using a 50 g glucose load; these were obtained from 2000 unselected pregnant women between 32 and 34 weeks' gestation.[6] Their results at the 95th centile were significantly lower than those of O'Sullivan (table II).[2]

TABLE I—*Proposed upper limits of normal plasma glucose concentrations after 100 g oral glucose tolerance test*[4]

	Time (hours)			
	0 (Fasting)	1	2	3
Glucose (mg/100 ml)	90	165	145	125
Glucose (mmol/l)	5·00	9·17	8·06	6·94

TABLE II—*Proposed upper limit of normal plasma glucose concentrations after 50 g oral glucose tolerance test performed between 32 and 34 weeks' gestation*[6]

	Time (hours)			
	0 (Fasting)	1	2	3
Glucose (mg/100 ml)	93	165	128	103
Glucose (mmol/l)	5·17	9·17	7·11	5·89

As a consequence of these opposing views a standardised glucose load of 75 g was recommended by an international working party in 1979,[7] and this has been accepted by the expert committee on diabetes of the World Health Organisation.[8] There have, nevertheless, been no studies to determine the reference values for the 75 g oral glucose tolerance test in pregnancy, and the present study was designed to remedy this.

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