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FACTORS ASSOCIATED WITH MEASLES COMPLICATIONS IN GWERU, ZIMBABWE
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ABSTRACT

Objective: **To investigate factors associated with complications or death among measles cases.**
Design: **A cross-sectional study.**
Setting: **Health facilities in the city of Gweru, Zimbabwe.**
Subjects: **Six hundred and thirty seven measles cases randomly selected from measles surveillance data.**
Main outcome measures: **(a) Associations of respiratory complications and diarrhoea with death among complicated cases; (b) associations of age at infection, gender of cases and vaccination status of cases with occurrence of either respiratory complications or diarrhoea or death among measles cases.**
Results: **Among cases with respiratory complications, twenty two (29%) had died, while five (5%)had died among those with diarrhoea (OR=7.06, 95% CI=2.55-22.35, p<0.001). On rates of respiratory complications among cases, age groups 24-59 and 60+ months were protective by 57% (95% CI=11-79%) and 76% (95% CI=52-88%) respectively compared to the age group <24 months, and vaccination was protective by 42% (95% CI=2-65%) compared to those unvaccinated. Concerning rates of diarrhoea among cases, the age group 60+ months was protective by 80% (95% CI=62-89%) compared to age group <60 months, while vaccination was protective by 64% (95% CI=42-77%) compared to those unvaccinated. With respect to rates of mortality among cases, age was protective by six per cent (95% CI=3-9%) for every year older.**
Conclusion: **It was concluded that: (a) the risk of death was higher in cases with respiratory complications than diarrhoea; (b) the risk of complications and death was inversely related to age at infection and older age groups were protective against occurrence of complications or death; (c) the risk of complications was higher in unvaccinated cases and vaccination was protective against occurrence of complications.**

INTRODUCTION

The city of Gweru in Zimbabwe has a population of 124735. In this city an investigation was carried out to identify factors associated with measles complications or death in order to work out modalities for reducing their occurrence. This paper presents the findings of that investigation.

MATERIALS AND METHODS

A cross-sectional study that used surveillance data for the period 1980-89 compared measles cases with complications or had died with those without complications or had not died.

In Gweru, measles cases and deaths were identified through a surveillance system which recorded cases and deaths that were reported from the city's health centres and those reported through active case searches in the community. Data on the measles cases and deaths were entered on line lists which indicated date of identification of a case, age at infection, gender, vaccination status, presenting features, whether admitted into hospital or not and outcome of illness (alive or dead).

Selection of participants for the study: Measles surveillance data for the period January 1980 through December 1989 were reviewed. It was decided that all deaths that had occurred in that period be included in the study. Measles cases that had had complications in that period were estimated at about thirty per cent. Based on this estimate on the occurrence of complications among measles cases, the optimal sample size (at 95% confidence level) was 620 using Stat-calc of EPI-info version 5. A one in four systematic sampling procedure was used to select participants into the study from the surveillance line lists.

Data analysis: (a) Respiratory complications and diarrhoea were correlated with rates of deaths among complicated cases and; (b) age at infection, gender and vaccination status of cases were correlated with rates of occurrence of respiratory complications, diarrhoea and deaths among cases. Initial analysis entailed bivariate analysis of age, gender and vaccination status and either rates of respiratory complications or diarrhoea or deaths. Further analysis to adjust for possible confounding variables entailed logistic regression analysis of age, gender and vaccination status on rates of either respiratory complications or diarrhoea or deaths among cases.

Main outcome measures: (a) The study investigated associations of respiratory complications and diarrhoea with

death among complicated cases and; (b) the study also investigated associations of age at infection, gender of cases and vaccination status of cases with occurrence of either respiratory complications or diarrhoea or deaths among measles cases.

Limitations of the study: Complications and deaths cited in this study are immediate complications and deaths attributed to acute measles and not delayed complications(1) or post-measles deaths(2,3) which may not have been recognised as measles complications or deaths after the acute measles episode. Phenomena such as overcrowding and intensive exposure that are said to affect severity of measles cases(4,5) were not examined in this study because the study relied on measles surveillance data where that information was not available. Malnutrition is said to be associated with the occurrence of complications among measles cases(1). This association was not examined in this study.

RESULTS

Characteristics of the sample: Six hundred and thirty seven cases of measles were enrolled into the study. One hundred and three cases (16.2%), 93 (14.6%), 154 (24.2%) and 287 (45.1%) were aged 0-11, 12-23, 24-59 and 60+ months respectively. There were 352 (55.3%) males and 285 females. Three hundred and thirty five (52.6%) cases had been vaccinated against measles while 302 (47.4%) had not had vaccination. Twenty eight (4.4%) of the cases in the sample had died.

Measles complications and occurrence of deaths among complicated cases: Two hundred and nine cases in the sample had complications. Among the complicated cases, 76 (36.4%) had had respiratory complications while 110 (52.6%) had had diarrhoea. Another 23 (11.0%) cases had other complications which included malnutrition, stomatitis, encephalitis and otitis media. Among the 76 cases with respiratory complications, 22 (28.9%) had died while six (5.5%) had also died among the 110 cases with diarrhoea. The difference between occurrence of deaths among cases with respiratory complications and diarrhoea was significant (OR=7.06 (95% CI=2.55-22.35, p<0.001). No deaths occurred among cases with other complications.

Age-specific rates of respiratory complications: In the age groups 0-11, 12-23, 24-59 and 60+ months, rates of respiratory complications declined from the order of 23.3% to 5.9% as shown in Table 1. The declining trend in age-specific rates of respiratory complications was statistically significant (χ^2 for trend=31.35, df=3, p<0.001).

Table 1

Age-specific rates of respiratory complications among cases

Age in months	With respiratory complications n (%)	No respiratory complications n (%)	Total
0 - 11	24 (23.3)	79 (76.7)	103
12 - 23	20 (21.5)	73 (78.5)	93
24 - 59	15 (9.7)	139 (90.3)	154
60+	17 (5.9)	270 (94.1)	287

Gender-specific rates of respiratory complications: Among the 76 cases with respiratory complications, 44 (57.9%) were males while 32 were females. There was no significant association between gender and rates of respiratory complications among cases (χ^2-Yates corrected=0.73, df=1, p=0.391)

Vaccination status-specific rates of respiratory complications: Among the 335 vaccinated cases in the sample 28 (8.4%) had respiratory complications while 48 (15.9%) of the 302 unvaccinated cases also had respiratory complications. There was a significant association between vaccination status and rates of respiratory complications among cases(χ^2-Yates corrected=7.88, df=1, p=0.005)-

A logistic regression analysis of age, gender and vaccination status on rates of respiratory complications showed that age groups 24-59 and 60+ months were protective by 57% (95% CI=11- 79%) and 76% (95% CI=52-88%) respectively compared to the age group <24 months, and vaccination was protective by 42% (95% CI=2-65%) compared to the unvaccinated against occurrence of respiratory complications among cases.

Age-specific rates of diarrhoea: In the age groups 0-11, 12-23, 24-59 and 60+ months, rates of diarrhoea declined from the order of 32.0% to 7.0% as shown in Table 2.The declining trend in age-specific rates of diarrhoea was statistically significant(χ^2 for trend=44.38, DF=3, p<0.001).

Table 2

Age-specific rates of diarrhoea among cases

Age in months	With diarrhoea n (%)	No diarrhoea n (%)	Total
0 - 11	33 (32.0)	70 (68.0)	103
12 - 23	25 (26.9)	68 (73.1)	93
24 - 59	32 (20.8)	122 (79.2)	154
60+	20 (7.0)	267 (93.0)	287

Gender-specific rates of diarrhoea: Among 352 males in the sample, 57 (16.2%) had diarrhoea while among 285 females, 53 (18.6%) had had the same complication. There was no association between gender and rates of diarrhoea among cases (χ^2-Yates corrected=0.48, DF=1, p=0.489).

Vaccination status-specific rates of diarrhoea: Among the 335 vaccinated cases in the sample, 34 (10.1%) had diarrhoea while among the 302 unvaccinated cases 76 (25.2%) had the same complication. Association between vaccination status and rates of diarrhoea was significant (χ^2-Yates corrected=24.03, DF=1, p<0.001). A logistic regression analysis of age, gender and vaccination status on rates of diarrhoea among cases showed that age group 60+ months was protective by 80% (95% CI=62-89%) compared to <60 months age group while vaccination was protective by 64% (95% CI=42-77%) compared to non vaccination.

Age-specific mortality rates: In the age groups 0-11, 12-23, 24-59 and 60+ months deaths had occurred in the order of 13 (12.6%), 13 (14.0%), one (0.6%) and one (0.3%) respectively. The declining trend in age-specific mortality rates was significant (χ^2 for trend=42.73, df=3, p<0.001).

Gender-specific mortality rates: Of the 28 measles deaths in the sample 16 were males wile 12 were females. Among the 352 males enrolled into the survey, sixteen deaths represented 4.5% of this gender while twelve deaths among 285 females represented 4.2% of that gender. The gender-specific mortality rates were not significant (χ^2=0.01, df=1, p=0.991).

Vaccination status-specific mortality rates: Among the 28 measles deaths, eight had been vaccinated against measles while 20 had not. Among the 335 vaccinated cases eight (2.3%) died while 20 (6.6%) of the 302 unvaccinated cases had also died (χ^2-Yates corrected=5.81, DF=1, p=0.016). Logistic regression analysis of age, gender and vaccination status on rates of deaths among cases showed that only age was protective by six per cent (95% CI=3-9%) for every year older.

DISCUSSION

The spectrum of complications found in the current study confirms findings of studies from other developing countries. In these countries the major complications were pneumonia, croup and diarrhoea. Other complications included malnutrition, otitis media, severe stomatitis and neurological problems(1,6,7).

Studies carried out elsewhere found that respiratory complications and diarrhoea were attended with higher mortality than other complications among cases and that cases with respiratory complications had a higher mortality than those with diarrhoea(1,7). In a measles epidemic in Harare, Zimbabwe, in which 20 cases died, pneumonia was the most frequent complication associated with death (eleven cases) followed by diarrhoea with dehydration (six cases)(7). A study in Afghanistan which looked at 784 measles cases admitted in a Kabul hospital found that respiratory complications including bronchopneumonia and croup were the commonest causes of death followed by encephalitis and gastroenteritis(8). Case fatality rates of 20-46%, 7-40% and 25% were reported among hospitalised measles cases with pneumonia, croup and diarrhoea respectively(1). Findings of the current study concur with those of previous studies where it was found that respiratory complications and diarrhoea were associated with deaths among cases and that this was more so for cases with respiratory complications than diarrhoea.

Studies have shown that the risk of serious measles complications is higher in young children and adults(3,9). In a measles epidemic in Harare, Zimbabwe, it was found that among cases admitted into hospital, rates of all major complications (diarrhoea with dehydration, pneumonia, croup and convulsions) declined with age, with higher rates of complications among the young age groups of 23 months of age and under(7). In a measles outbreak in Rwanda reported age-specific case fatality rates decreased with age: 0-8 months, 3%; 9-23 months, 1.4%; 24-59 months, 1%; and 60 months and older, 0.5%(2). In Niakhar, Senegal, a major increase in measles vaccination which occurred between 1987 and 1990 saw the mean age at infection increase from four to seven years. The change in the age structure was said to have accounted for a 20% decline in measles case fatality rate(10). This change in age at infection has been observed in many countries with high vaccination coverage rates and the decline in measles mortality that has been observed in these countries has partially been attributed to this change in the age structure among measles cases(11). Findings of the current study confirm those of other studies where it was found that occurrence of respiratory complications, diarrhoea and deaths among cases declined with age and that increase in age at infection was protective against their occurrence.

In this study, it was found that the rate of complications among the vaccinated cases was significantly lower than among the unvaccinated. This contradicts the finding in a study in Harare, Zimbabwe, where the rate of complications was significantly higher among immunised cases than among those that were not(7). It would seem that this finding in Harare may have been influenced by factors such as a high prevalence of undernutrition among cases aged under fifteen years which is thought to have contributed to the severity of measles in that study(7). Studies that have been carried out in the general childhood population, not just among measles cases, have found measles vaccination protective against morbidity and mortality associated with pneumonia and diarrhoea. A case-control study to determine whether measles vaccination is associated with reduced mortality rate in rural Bangladeshi children (10-60 months of age) found that measles vaccine was associated with a 36% reduction in the overall rate of death and a 22% reduction in the rate of acute lower respiratory infection-related deaths(12,13). In a study by Feachem and Koblinsky(14), it was estimated that measles immunisation at the ages of 9-11 months, with coverage of 45-90% can avert 44-64% of measles cases, 0.6-3.8% of diarrhoea episodes, and 6-26% of diarrhoea deaths among children under five years of age. Although the current study did not look at the protection afforded the general childhood population against pneumonia and diarrhoea through vaccination, its findings seem to support those of other studies where it has been observed that vaccination is protective against these conditions.

Some studies found that vaccination was directly protective against occurrence of mortality among cases(3). A study from Zambia found that case fatality rates in vaccinated cases was 6.4% while that in unvaccinated cases was 17%. This same study observed that while measles vaccine cannot prevent infection it can reduce the severity of infection(15). A study in Senegal found that vaccinated children who contracted measles had significantly lower case fatality rate than unvaccinated

children with measles and concluded that vaccination contributes to lower mortality indirectly through less severe infection for vaccinated cases(10). A study in Guinea-Bissau had similar findings and conclusions(16). In the current study, although in bivariate analysis it was found that vaccination was protective against occurrence of mortality, on logistic regression analysis of age, gender and vaccination status on rates of mortality among cases only age was protective. Vaccination status may, therefore, have been confounded by age or gender and thus may not have a direct influence on occurrence of mortality among cases. Findings of the current study therefore contradict findings of studies indicated above in that no relationship was found between vaccination status and occurrence of mortality among cases.

Review studies(10,15,16) have equated mild measles disease (reduced severity) with a lower case fatality rate which has been observed in vaccinated children. In these studies the role of complications in causing mortality is not explicit when it has been observed that most measles deaths are attributed to complications(12). Findings of the current study seem to suggest that vaccination makes measles disease mild directly through protection against occurrence of complications and indirectly through increasing age at infection(11) which was also found to be protective against occurrence of complications and deaths. However, the suggestion that vaccination could make the measles disease mild contradicts the observation that many cases of measles in persons with a history of vaccination are typical and severe, and occurrence of milder measles in previously vaccinated persons may represent one end of a spectrum of measles illness, independent of vaccination(3).

The current study found no association between gender and occurrence of respiratory complications, diarrhoea and deaths among measles cases. Studies in Bangladesh and India found excess measles mortality in females(17,18). Studies in Africa have not shown these gender mortality differences. It has, thus, been suggested that the differences that have been observed could be due to gender-specific patterns of child care and response to illness rather than biological difference between sexes(2).

In conclusion, the current study found that: (a) the risk of death was higher in cases with respiratory complications than those with diarrhoea; (b) the risk of measles complications or death was inversely related to age at infection and older age groups were protective against occurrence of complications or death; (c) the risk of respiratory complications and diarrhoea was higher in unvaccinated cases, and vaccination was protective against the occurrence of these complications.

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