



Background

It is well-documented that diarrhea is a common complication of measles infection in the acute phase of the disease, the 5-week period starting 1 week before rash onset and ending 4 weeks after rash onset [1–12]. However, it is unclear if the increased risk of diarrhea extends longer than 1 month after rash onset. Shahid et al., found in a study in Bangladesh, that children were at increased risk of dysentery for 5 months following measles infection [13]. This led Feachem et al. to speculate that there may be a “post-measles diarrhea” phenomenon that occurs in the 4–26 weeks following measles rash onset [14]. It would appear to support their hypothesis that measles vaccine trials have shown decreases in all-cause mortality

Results

Literature search

A total of 732 documents were identified in the database search. Seventy-one abstracts met the initial screening criteria, and those documents were retrieved for full text review. Twelve additional documents were identified by review of the references of the documents retrieved in the initial search and retrieved for full-text review. Six articles representing five unique studies were deemed

authors found that the increased risk of diarrhea caused by measles seems to be limited to the period immediately following rash onset. However, the authors did not present results for the period 8–

They followed the cohort and additional severe cases for 12 months. There was no significant difference in mortality between measles cases and non-measles cases observed at any of the time points during follow-up. At 1 month of follow-up and 6 months of follow-up, there was a significantly higher rate of gastroenteritis among severe cases of measles (7/22, 32%), compared to uncomplicated cases of measles (4/42, 9.5%). It is not stated by the authors what proportion of the gastroenteritis cases experienced diarrhea and how many experienced only vomiting or other gastrointestinal symptoms. There was no significant difference in incidence of gastroenteritis at 12 months of follow-up between the groups, and there was no significant difference in mortality at any time point during follow-up. Only three deaths were observed in the cohort and severe cases during 12 months of follow-up. Two were

in the severe measles group by the 1-month follow-up visit and one between the 1-month and 6-month follow up visits. One death occurred in the uncomplicated mea-

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References

1. Koenig M, Khan M, Wojtyniak B, Clemens JD, Chakraborty J, Fauveau V, et al. Impact of measles vaccination on childhood mortality in rural Bangladesh. *Bull World Health Organ.* 1990;68:441–7.
2. Koster FT, Curlin GC, Aziz KNA, Haque A. Synergistic impact of measles and diarrhoea on nutrition and mortality in Bangladesh. *Bull World Health Organ.* 1981;59:901–8.
3. Grais RF, Dubray C, Gerstl S, Guthmann JP, Djibo A, Nargaye KD, et al. Unacceptably high mortality related to measles epidemics in Niger, Nigeria, and Chad. *PLoS Med.* 2007;4:0122–9.
4. Clemens JD, Stanton BF, Chakraborty J, Chowdhury S, Rao MR, Ali M, et al. Measles vaccination and childhood mortality in rural Bangladesh. *Am J Epidemiol.* 1988;128:1330–9. <http://www.ncbi.nlm.nih.gov/pubmed/3195571>
5. Greenberg ABL, Sack RB, Budge E, Gutierrez M, Visberg A, Yi A, et al. Measles-associated Diarrhea in hospitalized children in Lima, Peru: pathogenic agents and impact on growth. *J Infect Dis.* 1991;163:495–502.
6. John TJ, Joseph A, George TI, Radhakrishnan J, Singh RPD, George K. Epidemiology and prevention of measles in rural south India. *Indian J Med Res.* 1980;72:153–8.
7. Marufu T, Siziya S, Mudambo KST. Factors associated with secular trends in mortality attributed to measles in Gweru, Zimbabwe, in 1967–89. *J Trop Pediatr.* 2008;54:114–9.
8. Marufu T, Siziya S. Secular changes in rates of respiratory complications and diarrhoea among measles cases. *J Trop Pediatr.* 1998;44:347–50. <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=med4&NEWS=N&AN=9972078>.
9. Marufu T, Siziya S, Murugasampillay S, Mason E, Manyame B, Tshimanga M. Measles complications: the importance of their management in reducing mortality attributed to measles. *Cent Afr J Med.* 1997;43:162–5.
10. Narain JP, Khare S, Rana SRS, Banerjee KB. Epidemic measles in an isolated unvaccinated population, India. *Int J Epidemiol.* 1989;18:952–8.
11. Scrimshaw NS, Salomon JB, Bruch HA, Gordon JE. Studies of diarrheal disease in central America. *Am J Trop Med Hyg.* 1966;15:625–31.
12. Taufan I, Rampengan T. Measles enteritis in Gunuug Wenang general hospital Manado. *Paediatr Indones.* 1991;31:212–8.
13. Shahid NS, Clauquin P, Shaikh K, Zimicki S. Long-term complications of measles in rural Bangladesh. *J Trop Med Hyg.* 1983;86:77–80.
14. Feachem RG, Koblinsky MA. Interventions for the control of diarrhoeal diseases among young children: measles immunization. *Bull World Health Organ.* 1983;61:641–