Original article

Child and Adolescent Mortality Across Malaysia's Epidemiological Transition: A Systematic Analysis of Global Burden of Disease Data

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A B S T R A C T

Purpose: A rapid epidemiological transition in developing countries in Southeast Asia has been accompanied by major shifts in the health status of children and adolescents. In this article, mortality estimates in Malaysian children and adolescents from 1990 to 2013 are used to illustrate these changes.
Methods: All-cause and cause-specific mortality estimates were obtained from the 2013 Global Burden of Disease Study. Data were extracted from 1990 to 2013 for the developmental age range from 1 to 24 years, for both sexes. Trends in all-cause and cause-specific mortality for the major epidemiological causes were estimated.
Results: From 1990 to 2013, all-cause mortality decreased in all age groups. Reduction of all-cause mortality was greatest in 1- to 4-year-olds (2.4% per year reduction) and least in 20- to 24-year-olds (.9% per year reduction). Accordingly, in 2013, all-cause mortality was highest in 20- to 24-year-old males (129 per 100,000 per year). In 1990, the principal cause of death for 1- to 9-year boys and girls was vaccine preventable diseases. By 2013, neoplasms had become the major cause of death in 1–9 year olds of both sexes. The major cause of death in 10- to 24-year-old females was typhoid in 1990 and neoplasms in 2013, whereas the major cause of death in 10- to 24-year-old males remained road traffic injuries.
Conclusions: The reduction in mortality across the epidemiological transition in Malaysia has been much less pronounced for adolescents than younger children. The contribution of injuries and non-communicable diseases to adolescent mortality suggests where public health strategies should focus.
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IMPLICATIONS AND CONTRIBUTION

Across the first 25 years of life, 1- to 9-year-old Malaysian children have seen greater recent improvements in their health than 10- to 24-year-olds. National policies and strategies that target the causes of adolescent and young adult mortality are required, particularly those that address road traffic injuries in young males.

The shift in high- and middle-income countries (HMICs) from an agriculturally based economy in the early 19th century to a more knowledge-rich economy in the later 20th century has been associated with reduced poverty and a changing burden of disease in adults that is increasingly characterized by

noncommunicable diseases (NCDs) [1]. The survival of infants into childhood is also increasingly common in low- and middle-income countries [1]. With these shifts, adolescents now constitute a greater proportion of the population than in high-income countries, which is one reason why interest in the health of adolescents has recently grown [2]. However, in most low- and middle-income countries adolescent health needs remain poorly described [1—3]. One reason is that until recently, many countries have been focused on the high burden of fatal disease in young children. Over the past 15 years, targeted investments toward the Millennium Development Goals have resulted in many countries achieving impressive improvements in the health of infants and young children. Globally, under-5 mortality reduced by 35% in the two decades from 1990 to 2010 [3,4], with further reduction of over a third from 2010 to 2015 [5].

In contrast to the extensive knowledge of the causes of mortality in young children throughout the world, mortality shifts in older children and adolescents have been largely overlooked, perhaps due to the assumption that this period is the healthiest time of life [2]. Using time-trend data from 50 selected HMICs with comprehensive national death registration, Viner et al. [4] showed that mortality in 1- to 9-year-old children had improved by 80%—93% over 50 years due to steep declines in communicable disease deaths. The improvement in mortality of 15- to 24-year-olds was only half that of younger children, largely due to static or rising injury-related deaths. In most HMICs, adolescent mortality was higher than in young children [4,6], but the contributors to these patterns of death were not reported. Viner et al. focused predominantly on middle-income countries in Eastern Europe and Latin America; there have been few reports of the changing pattern of mortality across the developmental years in Asia, Oceania, and Africa. Primary data are most notably absent or less accurate in these regions which have had rapid social, economic, and demographic changes [4,5].

Malaysia exemplifies these changes. Its under-5 mortality rate halved from 17 per 1,000 deaths in 1990 to 7 per 1,000 deaths in 2015, an annual reduction of 3.5% [7]. This steep decline in a relatively brief period reflects the success of efforts to reduce poverty and hunger, robust public health interventions such as improved sanitation, provision of clean water to households and expanded immunization programs, as well as higher quality and more accessible medical treatments, especially in rural areas [8]. The extent to which such improvements have been experienced by older children and adolescents in Malaysia is less clear. Scarce local data reflect the application of inconsistent age bands to mortality data across childhood and adolescence [9,10]. For example, the second Malaysian burden of disease and injury study presented data for 0- to 4-year-olds, 5- to 14-year-olds, and 15- to 29-year-olds, resulting in the relative invisibility of adolescents. Although Bujang et al. [10] showed that in Malaysia all-cause mortality had reduced from 1995 to 2010 across all age groups including infants, 1- to 4-year-olds, 5- to 19-year-olds, and 20- to 39-year-olds, cause-specific mortality was not reported which limits its usefulness for prioritizing public health interventions. Furthermore, primary data from Malaysia's vital registration system are insufficiently accurate for detailed cause of death analysis (see Box 1). Hence, in this study, we use Global Burden of Disease (GBD) 2013 data to report the pattern of all-cause and cause-specific mortalities in children and adolescents in Malaysia from 1 to 24 years by age (1—4, 5—9, 10—14, 15—19, and 20—24 years) and sex from 1990 to 2013.

Box 1. Summary of Malaysia's vital registration system

- At least 85% of deaths in Malaysia are registered. The Registration of Birth and Death Act (1957) states that all deaths must be registered no later than 3 days before burial permits being issued. Death registration has improved since the completion of online vital registration in 2000.
- Under-registration is more likely in Sabah and Sarawak due to the historic lack of requirement for burial permits in East Malaysian states.
- The system allows deaths in the community to be certified by police officers, who code deaths according to the Code Book for Uncertified Causes of Deaths. This was developed by the Department of Statistics based on discussions with the Ministry of Health, National Registration Department, Royal Malaysia Police, and Kuala Lumpur City Hall [9]. The validity of this process has not been assessed.
- Medically certified cause of death follows verification by a medical officer or coroner, who code deaths using the International Statistical Classification of Diseases and Related Health Problem, 10th Revision. Approximately 80% of deaths of 1- to 24-year-olds are medically certified [11].
- Lack of coding training for medical officers and police officers will result in suboptimal data.
- The cause of death for uncertified deaths is almost certainly less reliable for stigmatized conditions than for unintentional injury deaths. A robust coronial system that is respectful of the sensitivity of these deaths will improve the accuracy of certification.

Methods

Global Burden of Disease

GBD 2013 includes an annual assessment covering 188 countries from 1990 to 2013. It covers 306 diseases and injuries, 1,233 sequelae, and 79 risk factors. Detailed descriptions of the methodology and approach of GBD 2013 have been published elsewhere [12—18]. Key methodological advances from GBD 2010 are the inclusion of new data through updated systematic reviews and through the contribution of unpublished data sources from many collaborators, together with improvements in data processing and estimation methods including modification of garbage coding algorithms and revised modeling strategies. Garbage coding refers to the practice of assigning untenable, unspecified, and improbable causes of deaths (e.g., cervical cancer in males) to other categories. There are four categories of "garbage codes": causes that cannot serve as underlying causes of death (R codes or all codes under chapter 18 of the International Statistical Classification of Diseases and Related Health Problem, 10th Revision); intermediate causes of death (heart failure, septicemia, peritonitis, osteomyelitis, or pulmonary embolism); immediate causes of death that are the secondary rather than primary causes on a disease pathway leading to death (e.g., disseminated intravascular coagulation or defibrination syndrome [D65]); and unspecified causes within a larger cause grouping such as an unspecified site for neoplasms [19]. The methodology of Wang et al. [13] was used to generate the child mortality rate and adult mortality rate under the influence