

Standardised Age Group Mortality Trend by States, Malaysia 1995-2010

Mohamad Adam Bujang^{1*}, Abdul Muneer Abdul Hamid¹,
Nurina Musta`ani Hamedon^{1,2}, Tg Mohd Ikhwan Tg Abu Bakar Sidik¹ and
Shahrul Aiman Soelar^{1,3}

¹*Biostatistics Unit, National Clinical Research Centre, Jalan Pahang 53000 Kuala Lumpur, Malaysia*

²*Quality Unit, Hospital Kuala Lumpur, Jalan Pahang, 50586 Kuala Lumpur, Malaysia*

³*Clinical Research Centre, Hospital Sultanah Bahiyah, 05460 Alor Setar, Kedah, Malaysia*

ABSTRACT

This ecological study aims to examine the pattern of Age Standardised Mortality Rate (ASMR) among the states within Malaysia and its relationship with Gross Domestic Product (GDP), population density and age. In addition, the five-yearly patterns of ASMR for a fifteen-year period between 1995 and 2010 were studied. Death data from the National Registration Department (NRD), Malaysia and other important statistical data (i.e. data on GDP and population density) from the Department of Statistics, Malaysia from the same period were also analysed. It was found that GDP has a strong negative correlation with ASMR (Spearman's rho coefficient=-0.543, $R^2=0.295$); however, the strength of correlation between population density and ASMR is very weak (Spearman's rho coefficient=-0.084, $R^2=0.008$). Those states with higher ASMR generally have higher proportion of elderly people. In addition, states with higher GDP Malaysia showed decreasing trend of ASMR from 1995 to 2010. It can be concluded that in Malaysia, states with a higher level of ASMR have lower GDP and a higher proportion of the elderly.

Keywords: Age Standardised Mortality Rate, elderly people, Gross Domestic Product, Malaysia

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E-mail addresses:

adam@crc.gov.my (Mohamad Adam Bujang),

muneer@crc.gov.my (Abdul Muneer Abdul Hamid),

nurina@crc.gov.my (Nurina Musta`ani Hamedon),

tgikhwan@crc.gov.my (Tg Mohd Ikhwan Tg Abu Bakar Sidik),

soelar.sa@gmail.com (Shahrul Aiman Soelar)

* Corresponding author

INTRODUCTION

The role of economic development as an important determinant for population health has been widely researched (Cutler et al., 2002), Khang et al., 2005; Leon et al., 1997; Men et al., 2003; Preston, 1975; Shkolnikov et al., 2001). These studies

showed that severe economic downturns could pose a risk to human health and eventually increase mortality rate. However, poverty or poor economic conditions alone may not be causally related to population health (Marmot et al., 1991; Musgrove, 1987; Notzon et al., 1998). Socioeconomic factors such as level of income and/or wealth, occupation, level of education, social class or ethnic group can also be associated with population health or mortality rate (Kawachi, 2003).

There are ongoing debates with regard to the role of income inequality as a contributing factor to worsening population health (Judge, 1995; Wilkinson, 1996; Kawachi et. al., 1999). Some studies have found that variations between the states with due to an inequality of income were associated with an increased mortality rate (Kennedy, 1996). Some studies looked at differences in mortality rates in more specific locations, such as the urban/rural differences in mortality rates (Ingram et. al., 1989; Barnett et. al., 2000; Smith et. al., 1995).

People living in the more developed states usually have better access to good education, better jobs with higher level of income, enjoy better healthcare services and good infrastructure. Therefore, this research study aimed to determine whether the states with higher GDP in a developing country such as Malaysia, have an effect on the mortality. Besides GDP, this study also aimed to find out how population density and age distribution affect mortality. In this study, we measured the mortality based on Age Standardised Mortality Rate (ASMR).

The ASMR is a method of comparing rates between two or more different geographical areas where it takes into consideration the differences of age-group distributions among the states by applying the observed age specific mortality rates for each population to a standard population. Comparing crude death-rate would provide an inaccurate assessment of the state's mortality rate as it does not take into account the different age patterns of mortality for the various age-groups. Therefore, the ASMR will provide a more meaningful comparison of mortality rates between the various states in Malaysia.

This research aims to correlate Gross Domestic Product (GDP), population density and distribution of age towards mortality rate. It was initially hypothesised that among the fourteen states within Malaysia, states with higher GDP would experience a lower mortality rate. Published research is lacking in this area, especially in Malaysia. Therefore, this ecological study will provide an insight into the pattern of ASMR in each of the states within Malaysia and its association with other factors such as population density, GDP and age-group distributions. In addition, the five yearly patterns of ASMR during the 15-year period from 1995 to 2010 were studied.

METHODS

This study collected population data by states for the 2010 while GDP data were derived from the official portal webpage of Department of Statistics Malaysia, 2010. Death data for 1995 until 2010 were obtained

from the National Registration Department (NRD). Age standardised mortality rate (ASMR) for each state within Malaysia was calculated based on population data.

The adults were grouped into three categories – adults (aged between 20 and 39), middle aged (40 to 64-year-old) and elderly (older than 65 years) (Mohamad et al, 2012). This age-based grouping helps to identify the ASMR pattern of adults among the various states within Malaysia. The difference in status of development of states is determined by its GDP. Developed states are those with high GDP which usually have good infrastructure for industry, development and living.

Each of the fourteen states in Malaysia was ranked from one to fourteen according to GDP, population density and ASMR. The ASMR was ranked in ascending order, with the state having the lowest ASMR being ranked first and the state having the highest ASMR being ranked last. This was opposite from the ranking method of both the GDP and population density, both of which were ranked in a descending order, with the state having the highest GDP and population density being ranked first.

Since this was purely a descriptive population-based study, no inferential analysis was performed. All data were analysed using Microsoft Excel 2007, and SPSS was subsequently used to calculate the correlation coefficient and the R-squared for correlation between the two variables (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.).

RESULTS

The five states with the highest GDP were Wilayah Persekutuan (WP) Kuala Lumpur, Pulau Pinang, Selangor, Sarawak and Negeri Sembilan while the densest states were WP Kuala Lumpur, Pulau Pinang, Selangor, Melaka and Perlis (Table 1). It was shown that GDP had strong negative correlation with ASMR (Spearman's rho coefficient=-0.543, $R^2=0.295$). However, population density had a very low level of correlation with ASMR (Spearman's rho coefficient=-0.084, $R^2=0.008$) (Table 2). Kelantan, Terengganu, Perlis, Pahang and Kedah which had a higher proportion of elderly had higher ASMR (Table 3). In addition, states with highest GDP (WP Kuala Lumpur, Pulau Pinang, Sarawak, Negeri Sembilan, Melaka, Pahang and Johor Bharu) except Selangor have shown consecutive improvement by having a lower ASMR. Selangor has also shown some consecutive improvement except in 2010 (Figure 1).

DISCUSSIONS AND CONCLUSIONS

Results from this study showed an inverse association between GDP and mortality (ASMR). This supported the fact that economic conditions will have some impact on mortality (Brenner, 2005). On the other hand, population density has very little or no association with mortality (Wang, 2013). This finding shows that population density in Malaysia might not be a direct determinant of mortality, especially in a particular geographical area with a stable

Table 1
Socioeconomic indicator, population density and ASMR of Malaysia, 2010

State	GDP Per Capita at Current Price, 2010 (RM)	Ranking based on GDP Per Capita at Current Price, 2010 (RM)	Population Density, 2010 (person per km ²)	Ranking based on Population Density, 2010	Age standardized mortality rate (ASMR), 2010	Ranking based on ASMR, 2010
Johor	20,911	8	174	7	358.64	4
Kedah	13,294	13	209	6	397.62	10
Kelantan	8,273	14	111	10	473.74	14
Melaka	24,697	6	467	4	362.91	5
Negeri Sembilan	27,485	5	152	8	389.87	8
Pahang	22,743	7	43	13	402.95	11
Perak	16,088	11	117	9	393.82	9
Perlis	15,296	12	302	5	456.59	12
Pulau Pinang	33,456	2	1549	2	372.64	6
Sabah	17,242	10	44	12	277.01	1
Sarawak	33,307	3	20	14	314.41	3
Selangor	31,363	4	633	3	288.21	2
Terengganu	19,225	9	81	11	458.65	13
WP Kuala Lumpur	55,951	1	7088	1	374.45	7
Malaysia	27,113		779			

Table 2
The correlation between gross domestic product and population density with the ASMR

Factors	Pearson's coefficient	R-squared
Gross Domestic Product	-0.543*	0.295*
Population density	-0.084	0.008

*P-value < 0.05

or relatively high income. However, some studies revealed that population density has association with incidence of cancer and mortality (Mahoney et. al., 1990; Howe et. al., 1993)

The association between proportion of elderly and ASMR was also studied. Results showed that most states in Malaysia with

a higher proportion of elderly will also have a higher ASMR. The findings were consistent with those of previous studies in which among the adults, mortality of people with lower socioeconomic status was higher than those with higher status (Fox, 1989; Illsley et. al., 1990; Kunst et. al., 1994; Mackenbach et. al., 1997). Hence, this

Table 3
Distribution of adults, middle age and elderly in Malaysia by states, 2010

State	Adults (20-39)	%	Mid-Age (40-64)	%	Elderly (≥65)	%
Johor	1,163,500	11.91	809,500	12.20	176,800	12.43
Kedah	567,700	5.81	491,500	7.40	119,900	8.43
Kelantan	402,900	4.12	363,200	5.47	87,500	6.15
Melaka	256,300	2.62	206,200	3.11	50,400	3.54
Negeri Sembilan	327,500	3.35	258,400	3.89	58,300	4.10
Pahang	472,300	4.83	343,900	5.18	74,900	5.27
Perak	663,200	6.79	644,200	9.70	182,600	12.84
Perlis	64,400	0.66	60,200	0.91	16,900	1.19
Pulau Pinang	552,700	5.66	422,600	6.37	100,500	7.07
Sabah	1,266,000	12.96	582,700	8.78	94,400	6.64
Sarawak	791,100	8.10	589,700	8.88	138,100	9.71
Selangor	2,273,400	23.27	1,214,400	18.29	194,700	13.69
Terengganu	304,200	3.11	227,300	3.42	50,600	3.56
WP Kuala Lumpur	663,300	6.79	424,100	6.39	76,900	5.41
TOTAL	9,768,500	100	6,637,900	100	1,422,500	100

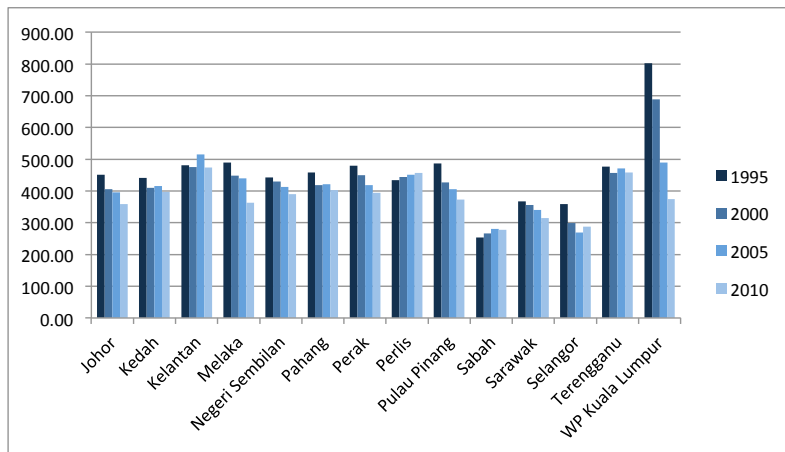


Figure 1. ASMR for states in Malaysia, from 1995 to 2010

study postulates that in general, there will be higher probability of increased mortality rate if there are more elderly people living in states with lower income level or GDP.

Generally, those who are older than 65 years may not be contributing to household income. Therefore, states with higher proportion of elderly may likely to suffer

from low GDP, which in turn may also contribute to their increased mortality rate (i.e. ASMR). Thus, the populations in these states may have a higher risk of mortality if demographic trends (i.e. proportion of elderly within the population) and overall GDP (i.e. overall economic performance) remain unchanged.

The GDP among the various states within Malaysia ranged from USD2694 to USD10,893 (Department of Statistics Malaysia, 2010). This difference had encouraged in-migration especially among people in the working age group. In-migration recorded positive correlation with the percentage of population aged between 15 and 64. Besides, there is a strong relationship between in-migration and the states' GDP (Asan Ali Golam Hassan, 2004). People migrate to more developed states to seek for better opportunities, resulting in these states becoming the focus of development, investment and industry. Between the two-year period from year 2010 and year 2011, at least 21.9% of migration was due to occupation (Department of Statistics Malaysia, 2011).

The productive age is between 20 and 50, and generating income or producing output for the state in which they live. For states with a higher proportion of the elderly, the government may consider expanding or generating more economic activities to encourage younger people to in-migrate and eventually contribute to the economic productivity of these states. States such as

Sarawak, Pulau Pinang, Negeri Sembilan and Melaka have experienced this. Although these states have higher proportion of elderly, they were among the top six states having higher end of the GDPs and as a result, those were also among the top eight states at lower end of the ASMRs.

Apart from Selangor, states which are among the top eight in GDP demonstrated a consistent decrease in ASMR for a 15-year period. Selangor experienced a decrease in ASMR for at least 10 years since 1995. This finding supported the proposition that a good economic performance is associated with better population health (Lochner et. al., 2001; Judge et. al., 2002). This proposition can be explained by various factors. There is mounting evidence of an association between an optimal delivery of primary healthcare service and an optimal level of population health, where both theoretical and empirical evidence for this association exist (Starfield, 1994; Starfield, 1998; Starfield, 2002). In addition, previous studies found that, among the medical care variables, the optimal delivery of primary healthcare service was by far the strongest contributing factor for better health outcome (Shi, 1994, 1995).

It can therefore be concluded that states within Malaysia with lower gross domestic product (GDP) and higher proportion of elderly are associated with higher ASMR. However, population density has no significant effect on ASMR. These findings suggest that it is important to develop and

strengthen the economic production and growth of each state within Malaysia. In addition, it is timely for better primary healthcare delivery system for the elderly people (especially within the less developed states) because it is expected that the proportion of the elderly in Malaysia will increase over time (Mohamad, 2012). Although Sabah and Sarawak recorded the lowest and third-lowest levels of ASMR respectively, this finding should be interpreted with caution due to the possibility of under-reporting of deaths.

LIMITATIONS

This study has few limitations. As an ecological study, the relationship of the parameters might be explained by various factors. Future studies may consider investigating these factors in relation to ASMR, GDP and population density. Besides, the results should be interpreted with caution especially with regards to the ASMR when there is possibility of under reporting of deaths especially in rural areas.

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