

THE PROCESS AND EFFECTS OF DEMOGRAPHIC TRANSITION IN PENANG, MALAYSIA

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This article describes the demographic transition in Penang, Malaysia based on the demographic transition theory, which explains the decline of birth and death rates in European countries during the 18th century. It has been noted that the birth and death rates in Penang decreased by more than 62% between 1950 and 2009, although the standard of living increased. The decline in birth and death rates, including infant mortality, and the improvement in the standard of living may be associated with rapid urbanisation, industrialisation and modernisation. The decline in birth and death rates is associated with the opportunities for women to become highly educated and participate in the labour force, particularly in the industrial sector. This has resulted in delayed first marriages and an increase in the proportion of unmarried women who are age 30 or older. These trends have clearly affected the fertility rate in Penang, which was below 2.1 and 1.8 children per couple in 2001 and 2009, respectively. As a developed state, Penang currently has an aging population with 10.2% of its residents being older than 60. This article concludes that the problem of an aging population cannot be avoided and will characterise Penang in the coming years.

Keywords: demographic transition, fertility, mortality, marriage, urbanisation, industrialisation, infant mortality

INTRODUCTION

Most developing countries in the world experienced a rapid decline in the mortality rate after World War Two. The decline was mainly due to the increase in the standards of public health, disease control measures and preventive medicine and an improvement in the standard of living (World Bank, 1974; Bhende and Kanitkar, 1978: 133; Agyei, 1988: 1–2). At the same time, fertility rates in developing countries, particularly those in Asia, began to fall sharply after the 1960s, concurrent with the implementation of family planning programmes. Most African countries continued recording high fertility rates due to the absence of family planning programmes and lack of socio-economic development (Caldwell, Orubuloye and Caldwell, 1992).

When mortality rates declined and fertility rates increased, most developing countries (particularly those in Eastern Europe) experienced a period of rapid population growth or "population explosion," and their populations are

believed to have increased between 2.5% and 3% annually since the 1950s (Chandrasekhar, 1967). In European countries, the process of such a demographic transition began in the second half of the 18th century. Notestein formulated the theory of demographic transition to describe the demographic change that has occurred in developed nations and in European countries (Weeks, 1986; Kim, 1993). The demographic transition in developed countries resulted from socio-economic development, modernisation and industrialisation (Taeuber, 1967; Agyei, 1988). Mortality rates began to decline in northern and western Europe around the 1750s, and birth rates declined from the 1880s until the transition was complete in the 1930s. The low fertility and mortality rates resulted in reduced or static population growth in those countries (Gille, 1960). The demographic transition theory was developed to address the decline in fertility and mortality rates in western Europe, North America, Australia and New Zealand and, as mentioned above it was caused by modernisation and industrialisation.

THE THEORY OF DEMOGRAPHIC TRANSITION

The principle behind the demographic transition theory was first presented in 1929 by Warren Thompson. Frank Notestein subsequently developed Thompson's idea in 1945. He identified a three-stage growth pattern for the world population and created the so-called demographic transition theory (Weeks, 1986). The first stage is the high potential growth stage, the second is the transitional growth stage and the third is the incipient decline stage (United Nations, 1973; Matras, 1977). The demographic transition theory was subject to various interpretations and definitions. For instance, Todaro (2000) concludes that demographic transition is the process by which fertility eventually declines to replacement levels, whereas Stokes (1995) stresses that the theory of demographic transition served as the principal descriptive tool for fertility change in developing nations for more than 30 years. Potts and Selman (1979) assert that the theory of demographic transition is an attempt to explain the shift from high to low birth and death rates in the course of industrialisation in developed nations. Demeny (1972) describes the theory of demographic transition as a set of generalisations that is capable of explaining the onset and the final outcome of past demographic transitions, hinting at future transitions. Thus, if developing countries follow the experience of Western countries, their fertility and mortality rates are likely to drop as the countries develop and advance socio-economically (Kirk, 1972). McNamara (1982) determines that the theory allows for the description of the changes that occur in birth and death rates as a population transforms from a traditional or pre-modern society to an urbanised and industrial modern society. Scholars have also argued that the difference between fertility and mortality rates in countries at different stages of economic development or modernisation is a manifestation of the theory of demographic transition

(Kammeyer, 1971). Lutz and Sanderson (2005) suggest that in the conventional theory of demographic transition, which predicts that as living standards rise and health conditions improve, mortality rates decline first and fertility rates decline later.

In sum, the theory of demographic transition stresses that the population will grow rapidly for some time because the mortality rate declines while the fertility rate remains high. After a period of higher population growth, the fertility rate begins to decline, and the population growth rate decreases or slows down when both the mortality and fertility rates become low in the final stage of demographic transition. It must be noted that the demographic change in any country begins when birth and death rates shift from high to low due to improved socio-economic projects, including health care (curative and preventive); improved education, particularly for women; increased urbanisation; improved nutrition, increased industrialisation and a desire to limit family size. As indicated by Hirschman (2001), the demographic transition model emphasises that socio-economics and modernisation cause a decline in fertility.

The first stage of demographic transition is the high growth potential stage, and there is significant population growth in this stage mainly due to a decline in the mortality rate while the fertility rate remains high. Most countries in Africa, Asia and Latin America are in this stage. The second stage is the transitional growth stage in which a continuously high fertility rate and a decline in the mortality rate are a result of improvement in health conditions. However, a decline in the birth rate has also occurred in countries such as the Soviet Union, Japan, and certain countries in Latin America (United Nations, 1973). The final stage, called incipient decline, is characterised by low fertility and mortality rates followed by effective implementation of birth control programmes and development in healthcare services that result in a slow population growth rate (e.g., in the United States, Europe and Australia) (United Nations, 1973; Matras, 1977; Forbes, 2007). During this stage, fertility may continue to decline, producing a negative natural increase (an excess of deaths over births), and the population size will decline. For example, France experienced negative natural population increase between 1937 and 1945, and Belgium experienced it between 1940 and 1944 (Matras, 1977). In Japan, population growth in the period of post demographic transition since 1975 was below replacement levels, and fertility continued to decline (Kaneko, 2000). The European experience has demonstrated that fertility and mortality rates responded positively to modernisation, and fertility began to decline following the widespread use of contraceptives, the growth of individualism and the increased level of inspiration in urban industrial societies (United Nations, 1973). According to Kammeyer (1975), the demographic transition model has received support as a valid generalisation describing the demographic concomitants of modernisation, but it has also been subjected to criticism.

Criticisms of the demographic transition model focus on its limitations as a theory, particularly in the comparison of the factors that contribute to the decline of fertility in developed and developing countries. Some scholars have labelled the theory unsatisfactory, whereas others argue that the theory of demographic transition provides a satisfactory framework and a means for wider empirical generalisation in the study of population change (United Nations, 1973). Teitelbaum (1975) concludes that the theory only offers a partial explanation of European trends and is ambiguous in its account of developing countries. Although scholars have different opinions about the theory of demographic transition, it is clear that the Asia-Pacific region has been undergoing rapid demographic change in parallel with its dramatic economic growth (Ogawa, Jones and Williamson, 1993). A renowned economist, Ghosh (1993), stresses that the theory of demographic transition is equally applicable to developed and developing countries because it is based on the actual trends of population growth in different phases of economic growth and it considers the effect of economic growth on population growth. He asserts that a few particularly undeveloped countries in Africa are still in the first stage of demographic transition, whereas all other developing countries are in the transitional stage (Ghosh, 1993). Kim (1993) also supports this claim, adding that the theory can be used to help explain the demographic changes that have occurred in Asian countries in the past three decades. This paper argues that the theory provides a useful conceptual framework for studying the population changes in a specific period of time. Previous studies have concluded that the theory of demographic transition in developing countries has followed the same fundamental mechanism as in Europe, although the theory has received many criticisms and has weaknesses.

Japan's demographic transition, which ended in 1957, was the first demographic transition experience outside the Western world (Kaneko, 2000). According to Okita et al. (1979), the rapid post-war demographic transition began in Japan in 1950. Japan's status as a country with low fertility and mortality rates ended in 1972, parallel with the full-scale economic reconstruction that started in 1950.

The demographic transition in Latin America, on the other hand, began at the end of the 19th century with declining mortality rates as a result of public health benefits from medical innovations, particularly in large cities (De Casio, 1996). In the Caribbean region, the decline in fertility rates started in the 1960s in the context of rapid changes such as improvements in education, urbanisation and expanded access to mass media (Guengant, 1996). Chackiel and Schkolnik (1996), who provide an overview of the fertility rate transition in Latin America between 1950 and 1990, reveal that Argentina, Uruguay, Cuba, Chile, Brazil, Colombia, Costa Rica, Ecuador, Mexico, Panama, Peru, Dominican Republic, Haiti and Paraguay are countries with an advanced transition of fertility rates.

They emphasise that the fertility rate transition was much more advanced in urban areas, particularly in large cities and among the upper and middle classes.

Based on previous research, it can be concluded that socio-economic development and demographic transition are interrelated and the combination causes both fertility and mortality rates to decline at various stages of development. In any country, socio-economic progress is expected to first increase fertility and mortality rates and then to lower them. This leads to the conclusion that the theory can be applied to developing countries, although the pace of and reasons for decline in population growth rates are different. Penang has demonstrated its ability to become an urbanised state, and it has become the most important industrial location of the free trade zone in Northern Malaysia. Further progress definitely will affect the state's demographic transition. Experiences in Asia and Latin America have demonstrated that urbanisation, education for women and a subset of development changes are sufficient to reduce fertility and mortality rates as a result of modern public health and medical technologies (Ogawa et al., 1993; De Casio, 1996). Thus, the theory of demographic transition can help demographers to understand a decline in fertility and mortality rates in an urban industrial society and attempt to relate the decline to the increase in living standards and socio-economic advancement of the population.

In Asia, a few newly industrialised countries have experienced decreased fertility rates. For example, East Asian countries, such as China, Taiwan, and the Republic of Korea, have completed, or nearly completed, the transition from high to low fertility rates (Kim, 1993). Western industrial nations required more time for their demographic transitions, whereas in Japan, Hong Kong, the Republic of Korea, Singapore, Indonesia, Taiwan, China and Thailand, the transition has generally occurred in fewer than two decades (Kim, 1993). Southeast Asian countries such as Malaysia, Brunei, Myanmar, Vietnam, Philippines, Cambodia, Laos and East Timor will join the countries with low fertility rates in the next two or three years. Poor countries that lack socio-economic development and have a low standard of living will experience high fertility and mortality rates. In this case, it is true that the demographic transition theory is an attempt to explain the shift from high to low birth and death rates in developed nations during industrialisation (Potts and Selman, 1979). Since 1750, Europe has experienced the various stages of demographic transition and the gradual shift from high birth and death rates to comparatively low fertility and mortality rates (Lee, 1979). The same demographic change will occur in developing countries as their social and economic development increases.

All developing countries will experience demographic transition in the future. If this transition is complete, the theory of demographic transition is the only theory available to explain the decline in fertility and mortality rates as a result of socio-economic advancement in health, income, education, urbanisation, industrialisation and effective birth control programmes. People are waiting for

economic progress in their countries before voluntarily reducing their family size by having fewer children.

HISTORY OF PENANG

Historically, the British obtained possession of the Island of Penang through the East India Company in 1786 to provide themselves with trading port facilities between India and China and a naval base (Tarling, 1969). The establishment of Penang, later named Georgetown, gave the British a base in the Malay Peninsular and helped prevent Dutch expansion (Chiang, 1978). In subsequent years, Penang grew rapidly and soon became a British entrepot (Baker, 1991). To boost business activities, Penang and Malacca were declared free ports in 1826. Penang, Singapore and Malacca were later recognised as the Straits Settlements, and they experienced a rapid expansion of trade due to the freedom of the ports and their geographic location conducive to trade between Southeast Asia, China, India, Britain and Europe (Chiang, 1978). Penang is now an important port in the Northern Corridor, covering an area of 1,031 square kilometres and consisting of five main districts: Timur Laut, Barat Daya, Seberang Perai Utara, Seberang Perai Tengah and Seberang Perai Selatan. Based on the recent census, Penang has recorded the highest population density in Malaysia—6,696 people per square kilometre (Department of Statistics Malaysia, 2010a: 25–27).

To strengthen its position and acquire an area to grow food for the island, the East India Company (EIC) acquired a strip of land opposite Penang Island from Sultan of Kedah and renamed it Province Wellesley in 1800 (Mill, 1960). This acquisition provided accessibility for the British and the EIC to penetrate to mainland Malaya. After the establishment of Penang and Province Wellesley, the influx of ethnic Chinese immigrants from Kedah and Malacca into the state had increased. Chinese immigrants also continually arrived at Penang from other ports in the region, but most of them were originally from China (Saunders, 1977). By 1835 and 1836, the population of Province Wellesley had swelled from 6,000 in 1820 to 47,000 people, predominantly Malays, but also including approximately 2,000 Chinese and 1,000 Indians. By 1850, the population had increased to 61,000, and eight years later, it was more than 67,000. Of these 54,000 people were Malays, 8,000 Chinese and more than 5,000 were Indians (Turnbull, 1972).

However, according to Turnbull (1972), by the 1850s, the Chinese were the largest single ethnic community in Penang, numbering 24,000 in 1858 out of a total population of nearly 58,000, compared to 12,000 Indians and more than 20,000 Malays. According to Saunders (1977), approximately two-thirds of the Malays were rice farmers whereas the rest were mostly fishermen. The Chinese were shopkeepers, tradesmen or employees in the Chinese-owned sugar estates or in the sugar mills, and the Indians were mainly labourers in European-owned sugar estates, which were established in the 1850s. Turnbull (1972) concluded

that throughout the first half of the 19th century, Penang continued to be predominantly an Indo-Malay settlement. For many years, Penang was the centre of administration of the Straits Settlement. However, the administration was transferred to Singapore in 1832 due to the growth of trade there since its foundation in 1819. Penang and Malacca became less important than Singapore between 1830 and 1867 (Mill, 1960).

Although Penang competed with Singapore and Malacca, the Chinese and Indian populations grew rapidly compared to the Malays. The population size of Penang by ethnic group between 1911 until 2005 is displayed in Table 1. The figures presented indicate that the population of Penang increased from 272,744 people in 1911 to 1,520,143 people in 2010. Between 1911 and 1957, the Chinese population in Penang grew approximately 260,503 persons or 233.1%. At the same time, Malays increased by 50,324 people or 43.9%. The striking feature of Penang's population was that the percentage of Chinese increased from 41.0% in 1911 to 57.2% in 1957. However, after independence the total Malay population in Penang continued to increase gradually from 28.8% in 1957 to approximately 40.9% in 2005. Moreover, from 1957 to 2000 the Malay population experienced an increase of 368,342 people or 223.5% compared to the Chinese with 216,452 persons or 58.1%. Based on the 2000 census, the average annual population growth rates of Malay and Chinese people in Penang for the period of 1991 to 2000 were 3.09% and 1.32%, respectively (Department of Statistics Malaysia, 1995a: 13).

POPULATION CHANGE IN PENANG

Based on the statistics, the rate of natural population increase in Penang decreased slowly from 2.78% from 1950 to 1955 to 1.21% from 2000 to 2005. The analysis of census data since the early 20th century reveals that the average annual population growth rate in Penang from 1911 to 1947 was 1.30%. It increased sharply to 2.44% from 1947 to 1970. However, due to a decline in fertility and emigration rates, the average annual population growth rate dropped to 1.49% between 1970 and 1980. However, the 2010 population census indicates that the growth rate increased again to 1.52% from 1980 to 1991, 1.62% from 1991 to 2000 and 2.11% from 2000 to 2010. The increase in the population growth rate during the last three decades, particularly from 2000 to 2010 was the result of positive net migration. According to Malaysia's Department of Statistics (2009: 46), the net migration in Penang was 5,980 in 2003 and 11,190 in 2007. During the same time, the fertility rate that had been instrumental in the state's population growth was minimal, and the crude birth rates had declined from 19.9 per 1,000 people in 2000 to 15.6 per 1,000 in 2009 (Department of Statistics Malaysia, 2003a; Department of Statistics Malaysia, 2010b: 65).

Table 1: Total population of Penang, Malaysia, by ethnic group, 1911–2005

Years	Total	Malay		Chinese		Indian		Other bumiputera		Others		Non-Malaysian citizen	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1911	272,744	114,441	41.9	111,738	41.0	46,565	17.1	–	–	–	–	–	–
1921	299,009	110,382	37.0	135,288	45.2	53,339	17.8	–	–	–	–	–	–
1931	340,009	108,543	31.9	169,449	49.8	53,080	15.6	–	–	9,187	2.7	–	–
1947	446,321	133,004	29.8	247,262	55.4	57,129	12.8	–	–	8,926	2.0	–	–
1957	572,100	164,765	28.8	372,241	57.2	69,796	12.2	–	–	10,298	1.8	–	–
1970	775,440	234,582	30.3	435,366	56.2	89,319	11.5	–	–	12,975	1.7	2,480	0.3
1980	900,772	303,176	33.6	485,161	53.9	102,830	11.4	–	–	9,852	1.1	–	–
1991	1,064,166	405,348	38.1	523,211	49.2	112,583	10.6	1,146	0.1	5,770	0.5	15,861	1.5
2000	1,313,449	533,111	40.6	588,693	44.8	133,899	10.2	3,926	0.3	5,438	0.4	48,382	3.7
2005	1,468,800	600,300	40.9	631,800	43.0	147,200	10.0	5,200	0.4	6,100	0.4	78,300	5.3

Source: Nathan, 1922: 162; Del Tufo, 1949: 39; Department of Statistics Malaysia, 1995a: 15; 2001b: 32; 1972: 72–76; Fell, 1960: 6

During the same period, the total fertility rate also decreased from 2.2 children per woman to 1.8, a rate of fertility below population replacement. Comparing the fertility levels of the three main ethnic groups indicates that the Chinese fertility rate was lower than that of Malays and Indians. Owing to this overall decline in the birth rate, future population growth in Penang will depend entirely on interstate migration patterns. It can safely be assumed that Penang has the capacity to attract migrants from other states via its human capital innovation and foreign direct investment which contribute significantly to its economic industrialisation and social development projects.

URBANISATION

Urbanisation refers to the changes in the proportion of the population of a nation living in urban places, that is, the process of people moving to cities or densely settled areas. Urbanisation has also been defined demographically as the percentage of a nation's population living in urban areas (Palen, 1997). A study by Jones (1975) states that urbanisation has proceeded more slowly in Southeast Asia during the past 20 years than in Latin America, Africa, East Asia or the Middle East but he stresses that Malaysia has experienced fairly rapid urbanisation. For instance, the urban growth in Penang has been recorded since the beginning of the last century. In Malaysia, by definition, all places with a population exceeding 10,000 have been considered urban centres since 1970. In contrast, from 1911 to 1957, urban centres were places that had more than 1,000 people, but the data in Table 2 are related to gazetted towns of 10,000 people or more. The figures in Table 2 indicate that Penang possessed the highest urban population in Malaysia, except Wilayah Persekutuan Kuala Lumpur, which has a

100.0% urban population. Penang's urban population started at 37.3% in 1911 and increased to 90.8% in 2010. In particular, the census data of 1991, 2000 and 2010 indicate that Selangor had the largest urban population, accounting for 75.2%, 88.3% and 91.4%, respectively (Department of Statistics Malaysia, 2001b: 32–34; 2011: 43). In terms of ethnic composition, the proportion of Chinese in urban Penang decreased from 71.0% in 1957 to 69.9% in 1970, 66.6% in 1980, 52.1% in 2000 and 45.8% in 2010, while the Malay population increased from 12.7% to 15.4%, 18.8%, 31.2% and 36.8% during those years (Kok, 1992; Department of Statistics Malaysia, 2001b; 2011).

The urban population in Penang is expected to increase during the 2010s, and this could occur mainly through inter-urban movement, particularly urban-to-urban migration that comprised 73.5% of the total-state migration in 2001 (Department Statistics of Malaysia, 2002a). Hamzah Sendut (1978) argued that the city of Georgetown can be expected to coalesce with Butterworth and Bukit Mertajam to become the second largest metropolitan area in the country. Urban agglomeration projects are expected to continue growing from Bukit Mertajam and affect its surrounding urbanised areas of Kedah Darul Aman, where the Kulim High Technological Park is located. According to the 2000 census data, Kulim had an urban population of 117,455 that increased from 58,328 people in 1991 (Department of Statistics Malaysia, 2001a).

Table 2: Urban population of 10,000 people or more and average increase in urbanisation rate in Penang, Malaysia, 1911–2010

Years	Urban population		Growth rate	
	Total	Percentage (%)	Years	Percentage (%)
1911	101,182	37.3		
1921	123,069	41.8	1911–1921	1.98
1931	149,408	47.7	1921–1931	1.96
1947	189,068	52.8	1931–1947	1.48
1957	324,381	56.7	1947–1957	5.55
1970	395,615	51.0	1957–1970	1.54
1980	427,805	47.5	1970–1980	0.78
1991	798,276	75.0	1980–1991	5.83
2000	974,779	79.5	1991–2000	2.24
2010	1,418,074	90.8	2000–2010	3.82

Source: Department of Statistics Malaysia, 1977: 40; 2001b: 3; 2011: 43; Del Tufo, 1949: 44; Fell, 1960: 6

INDUSTRIALISATION

The second major development in Penang that influenced the fertility rate trend is industrialisation. The industrialisation process involves educated and/or

uneducated people who are employed as trained workers in the electronic, information and communication technology, pharmaceutical, hospitality, automotive and other industries. The evolution of the industrial process in Penang started in the late 1960s when the Master Plan was formulated in 1969 to chart future economic development in the state. Considering the limited natural resources and the surplus of manpower in the state, the manufacturing and the general services sectors were identified as the main engines of growth for Penang (Lim and Ong, 1995). According to the report, the cornerstone of the economic policies after 1968 was industrialisation, which is still being promoted. Manufacturing, the leading sector, has grown rapidly since three decades ago. Based on 1991 and 2000 census data, the employed population age 15–64 working in the manufacturing sector increased from 37.7% to 42.4% (Department of Statistics Malaysia, 1995a; 2003a). In the 1980 census, employees age 10 and over formed 27.9% of those working in the manufacturing sector in Penang (Department of Statistics Malaysia, 1983a).

A recent report by the Malaysian Department of Statistics (2008b: 238–239) reveals that 35.1% of the employed population in Penang works in the manufacturing sector. Further analysis indicates that Penang has the highest percentage of workers in the manufacturing sector in Malaysia. According to Schatzl (1993), the metropolitan region of Kuala Lumpur is the most important industrial agglomeration in the country by far, followed by Penang.

A detailed analysis of the 2000 census data indicates that 196,415, or 37.8% of the 519,117 people employed in Penang are women. A further examination of the census data reveals that 51.1% of the female workforce works in the manufacturing sector (Department of Statistics Malaysia, 2003a). The analysis of the gender composition of employment indicates that in the past four decades, social policies have enabled women to work in industrial fields, resulting in the increasing number of female employees, and this has catalysed the current processes of industrialisation and modernisation in Penang. The increases in income and social mobility have also caused gradual changes to family functions and structure, housing needs and the costs of raising children. Furthermore, family size and the fertility rates of married working women continued to decline. This demographic change provides strong evidence that the demographic transition process in Penang completed its cycle approximately 2001 when the total fertility rate (TFR) was recorded as 2.07 children per woman. Thus, we can conclude that the demand for children in Penang, particularly among Chinese people, has declined and the new trend of family limitation may have a negative impact on population growth and marriage patterns in Penang in the next few decades. Most discussions of the changes in fertility patterns are related to the complex network of factors that interact to determine fertility rates (Simmons, 1974). Most importantly, according to the theory of demographic transition, the traditional family system that supported higher fertility has been undermined by the expansion of urbanisation and industrialisation (McDonald,

1993). According to Andorka (1978), the new ideal of small family size typically arises in urban societies that have stripped the family of many functions in production, consumption, recreation, and education. The United Nations (1993) indicates that the decline in fertility rates also led to a slow growth rate of the working age population and labour supply. This effect of a decline in fertility rates is expected to be visible in Penang two or three decades from now.

THE FERTILITY TREND

By definition, fertility refers to actual birth performance, compared with fecundity, which refers to the physiological capacity to reproduce (United Nations, 1958: 38; Spiegelman, 1973: 84; Shryock, Siegel and Larmon, 1976). In this article, the measurements used for fertility levels and trends are crude birth rate, total fertility rate, age-specific fertility rate and gross reproduction rate. The available data since the 1940s indicate that the crude birth rate of Penang—43.3 per 1,000 people in 1947—was higher than that of other states in Malaysia (Malayan Union, 1948). From 1947 to 1957, the crude birth rate was approximately 41.6, and it gradually declined after 1958. However, a sharp decline of fertility was observed after 1975, with a crude birth rate of below 30.0 per 1,000 people. According to official statistics, the crude birth rate dropped from 27.4 to 19.9 per 1,000 people between 1975 and 2000, a reduction of 27.4% (Department of Statistics Malaysia, 1977a: 29; 2003b). Observing the trend for a longer period, from 1947 to 2000, the crude birth rate declined 54.0% or 57.6% by grouping five years of crude birth rates (Table 3). Analysis of the fertility rate trend according to ethnic groups indicates that fertility among Chinese and Indian people declined much faster than the Malay fertility rates. The crude birth rate for Chinese people declined substantially from 43.6 in 1947 to 17.2 per 1,000 in 1990, a decline of 60.5% (Malayan Union, 1948; Department Statistics of Malaysia, 1992). Meanwhile, the crude birth rate for Malays declined at a slower rate from 42.4 in 1947 to 27.0 per 1,000 people in 1990, a reduction of 36.3% (Malayan Union, 1948; Department of Statistics Malaysia, 1992: 23). Meanwhile, the crude birth rate for Malays declined at a slower rate from 42.4 in 1947 to 27.0 per 1,000 people in 1990, a reduction of 36.3% (Malayan Union, 1948; Department of Statistics Malaysia, 1992: 23). By 2000, the crude birth rates of Malays, Chinese and Indians were 23.5, 17.4 and 21.3 per 1,000 people, respectively. From 2001 to 2007, data are not available for the crude birth rates according to ethnic composition. In 2008, the crude birth rates for Malays, Chinese and Indians were 21.0, 13.5 and 15.8 per 1,000 people, respectively.

This study indicates that socio-economic development and motivation have affected the decrease in fertility rate. Socio-economic development involved increased rates of urbanisation and industrialisation, expanded opportunities for education and an increase in marriage age and the number of women working in Penang, and these have greatly influenced the Chinese fertility level in the state.

In response, Leete (1996) emphasises that the decline in fertility rates among the Chinese in Peninsular Malaysia and Penang is related to several trends including increased educational pursuits, later marriages, fertility control at older ages and family planning during the early years of marriage to reduce family size and regulate the timing of births. Based on the theory of demographic transition, Penang is in the third stage of the demographic transition because it is experiencing significant reductions in death and birth rates.

Because the crude birth rate is influenced by the age structure and sex of the people, age-specific fertility rate (ASFR) and TFR are more refined measures of fertility. Table 4 displays the TFR and ASFR of Penang for 1970, 1980, 1991, 2000 and 2005. A drastic reduction of fertility is apparent in the 15–19 and 20–24 age groups. The fertility rate for the 15–19 age group experienced a decline from 35 to 8 children per 1,000 women, whereas the 20–24 age group experienced a decline from 195 to 59 births per 1,000 women between 1970 and 2005. Declining fertility also occurred in the 35 and above age group, and it is clear that women age 45 and over contributed a very small proportion of the recorded births. The TFR declined from 4.12 to 1.79 children per woman, and this fertility rate was below the population replacement level of 2.1 children per woman between 1970 and 2005. The demographic analysis indicates that, in the long run, fertility conditions will shrink the population size with an increase in the ageing population. In 2000, 7.9% of the total population of Penang comprise people age 60 and above; 10.4% of the Chinese population were 60 or older (Department of Statistics Malaysia, 2001b). Similarly, the United States and Europe have experienced an increase in the proportion of elderly widows living alone (Kramarow, 1995; Grundy, 1996).

Table 3: Crude birth rates, crude death rates and rates of natural population increase, Penang, Malaysia 1950–2005

Years	Rate per 1000 people		
	Crude birth rate	Crude death rate	Rate of natural increase
1950–1955	41.3	13.5	2.78
1955–1960	39.6	10.6	2.90
1960–1965	36.2	8.6	2.76
1965–1970	31.2	7.5	2.37
1970–1975	28.5	7.1	2.14
1975–1980	26.6	6.6	2.00
1980–1985	25.2	5.9	1.93
1985–1990	22.5	5.5	1.70
1990–1995	21.9	5.6	1.63
1995–2000	21.3	5.7	1.56
2000–2005	17.5	5.4	1.21

For approximately half a century, Penang has passed through a series of demographic transformation processes, and the following four phases of change have been clearly identified in Figure 1:

1. From 1950 to 1960, the demographic gap widened as the fertility rate declined at a slower rate than the death rate;
2. From 1960 to 1985, the birth and death rates began to decline rapidly, but the rate of natural population increase was still high;
3. From 1986 to 2000, death rates continued to decline with slight fluctuations, and there was a steady decline of birth rates and a rapid decline in the rate of natural population increase;
4. The period between 2001 to the present in which the death rates continue to decline and the fertility rate is below the replacement level.

Empirical studies of socio-economic, political and environmental conditions have revealed that the adoption of urban norms, culture and the technology of the urban environment have been associated with low fertility and the strengthening of a new ideal of a small family size (Andorka, 1978). In this situation, the United Nations (1973) has concluded that the urban environment contributes to the reduction of human fertility in the long run. According to analysis of the factors responsible for the low fertility among the Chinese in Penang, increased education, employment, changes in societal and housing conditions resulting from rapid urbanisation and industrialisation are the important factors that led to the decline in Chinese fertility (Heah, 2005). An observation by the United Nations in 1973 strongly suggests that the idea of an urban mentality is responsible for the decline of family size in France and England in the 19th century. Similarly, a study by Leete and Tan (1993) concludes that increasing recognition of the economic advantages of smaller family size, including the awareness of the high cost of raising and educating children and the availability of contraceptive methods most likely caused a decline in fertility level among Chinese and Indians in Malaysia. Evidence from other Southeast Asian countries appears similar, with the emergence of a high percentage of literacy, urbanisation, industrialisation and female employment rates. Rele and Iqbal (1993) claim that the simultaneous acceleration of fertility decline in many Asian countries demonstrates that the countries were undergoing substantial socio-economic development that led to delayed first marriages, particularly among those living in urban areas who had gained a high level of education.

Table 4: Age-specific fertility rates in Penang, Malaysia, 1970–2005

Age groups	Years									
	1970	1980	1991	1996	2000	2001	2002	2003	2004	2005
15–19	35	24	12	13	8	8	9	8	8	7
20–24	195	141	82	106	64	62	59	60	59	59
25–29	255	200	165	163	140	129	124	116	113	114
30–34	185	147	130	137	142	124	123	115	107	104
35–39	111	72	66	66	74	73	67	65	64	59
40–44	43	24	19	18	18	17	17	15	15	14
45 and above	8	3	2	1	1	1	1	1	1	1
Total fertility rate (TFR)	4,160	3,055	2,380	2,521	2,242	2,071	1,998	1,902	1,835	1,791

Source: Department of Statistics Malaysia, 2001c:73; 2003b: 60; 2006: 180–183; 1995b: 189; 1973a: 164–165; 1973b: 6, 39; 1980: 164–165; 2008a: 149.

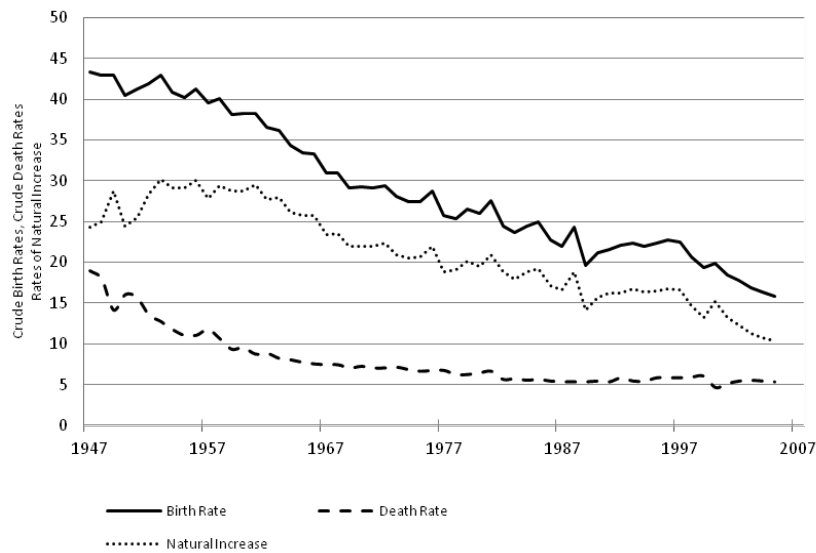


Figure 1: Crude birth rates, crude death rates of natural increase for Penang 1947–2005

MARRIAGE PATTERNS

Table 5 reveals the proportion of married women by ethnicity in four age groups, 15–19, 20–24, 25–29 and 30–34 for the census of 1970, 1980, 1991 and 2000.

Previous studies have indicated that Chinese and Indians in Malaysia opted for marriages at a later age compared to Malays (Hirschman, 1980; Leete, 1996). The data in Table 5 indicate that the proportions of married women between 15–19 declined from 8.5% to 2.6%. The steep decline was recorded among the women of all three ethnic groups. The lowest proportion of married women in 2000 was among the Chinese, with only 1.7%. On the other hand, the 20–24 year age group demonstrated a clear increase in the proportion of marriage with more than 50.0% of Malay and Indian women in 1970 recorded as married, but this gradually declined to around 30.0% in 2000. Fewer Chinese women were recorded as married, with only 15.8%. More than 80.0% of Malay and Indian women in the 25–29 age group were married, but the percentages declined to 71.8% and 65.8%, respectively, in 2000. On the whole, the proportion of women who were married in the 25–29 age group dropped from 77.6% to 59.4% by 2000. The 2000 census also indicated that approximately 76.7% of Chinese women, 82.6% of Malay women and 79.5% of Indian women were married. Most importantly, the lowest proportion of married women were those from 15–19 years old, which was fewer than 3.0%. Meanwhile, approximately 23.0% of women were never married, according to the 2000 census, compared to 44.6% of women in 1970 for the same age group. Because most children are born before their mother is 30, the declining percentage of women age 15–19 or 20–24 who were ever married contributes to the lowering fertility rate for these age groups. From 1970 to 2005 (Table 5), the ASFR for women age 15–19 and 20–24 had declined by more than 70.0%, while for the 25–29 age group the decline was 55.6%. The increase in the age of marriage obviously will lead to a significant reduction in marital fertility among younger groups of women in Penang.

In conclusion, the main reasons for the decline in the fertility rate in Penang are the decrease in the number of married women as well as the fact that late marriages have become a socially accepted norm in modern societies. In addition, most women participate in the labour force after completing their studies (Von Elm and Hirschman, 1979). According to the Malaysian Department of Statistics (1975a: 24–25) the mean age of the first marriages of women in Penang from 1970 to 2000 increased from 22.9 to 25.7. In contrast, the average age of marriage for European women was higher and more people remained single (Hajnal, 1965). However, in Penang almost 83.6% of women between 45 and 50 years old were married and only 8.6% never married (Department of Statistics Malaysia, 2002b). Based on this information, we can conclude that marriage practice is universal in Malaysia, where the proportion of people who were never married in the 45–49 age group in 2000 was 5.4% for Malays followed by Indians and Chinese at 9.3% and 10.5%, respectively (Department of Statistics Malaysia, 2002b).

Table 5: The proportion of married women by ethnicity and age group, Penang, Malaysia, 1970–2000

Age group	Total women					Married women (%)				
	Malay	Chinese	Indian	Others	Total	Malay	Chinese	Indian	Others	Total
15–19										
1970	13,315	26,468	4,774	450	45,007	12.5	5.3	14.5	17.1	8.5
1980	19,648	28,151	6,528	310	54,637	6.0	4.2	6.9	6.1	5.2
1991	21,157	25,399	25,399	278	52,800	3.9	2.7	5.9	2.5	3.6
2000	25,587	23,269	23,269	193	56,369	2.7	1.7	4.4	6.7	2.6
20–24										
1970	10,729	20,467	3,793	847	35,836	52.2	37.0	59.2	75.4	44.6
1980	18,172	24,519	5,867	446	49,004	39.3	34.8	40.3	59.4	37.4
1991	25,364	23,721	5,827	301	55,785	25.3	21.9	30.0	34.9	24.6
2000	27,291	23,364	5,821	266	64,660	31.3	15.8	29.2	29.7	23.1
25–29										
1980	13,668	211,331	4,645	582	40,226	72.2	67.7	70.9	86.6	69.9
1991	20,082	23,333	5,740	263	49,951	64.3	59.6	63.0	65.8	62.0
2000	23,808	23,131	5,410	309	59,267	71.8	51.4	65.8	55.3	59.4
30–34										
1970	6,951	13,957	2,300	444	23,652	88.4	84.4	89.2	88.5	86.1
1980	10,480	18,930	3,702	532	33,644	82.4	80.9	83.6	88.9	81.7
1991	16,590	23,056	5,438	294	45,872	80.4	78.8	78.1	78.9	79.4
2000	20,392	22,472	5,424	240	51,628	82.6	76.7	79.5	80.8	78.8

Source: Department of Statistics Malaysia, 1975b: 364–368; 1983b: 138–142; 1995a: 72–89; 2002b: 476–485

THE MORTALITY TREND

The crude death rate is a very useful indicator of the level of mortality in any population. Another indicator is the infant mortality rate (the rate of mortality of children under age 1), which has been widely accepted as an indicator of the level of health in a community (Spiegelman, 1973: 84). In this case, high infant mortality is associated with low economic development; poor health conditions; inadequate medical facilities; poverty; illiteracy, particularly among women, low education levels and malnutrition. According to various sources, the crude death rate in Penang declined from 19.0 per 1,000 people in 1947 to 5.5 in 2006, a reduction of 71.0% (Malayan Union, 1948; Department of Statistics Malaysia, 2003b; 2006). Meanwhile, the infant mortality rate for Penang was 90.0 per 1,000 live births in 1947, and it continued to decrease sharply and became similar to that of developed Western countries, at a level of 5.7 per 1,000 live births in 2000. It increased slightly to 8.1 deaths per 1,000 people in 2004 (Malayan Union, 1948). The infant mortality rate in Penang and in Malaysia as a whole

during the past few decades has been attributed to socio-economic and demographic development and modernisation such as improvement in nutrition, housing and literacy; expansion of water purification and supply and increased sanitation and preventive health programmes, particularly the spread of rural health clinics, which began in the early 1960s (Kwok, 1982). Saw (1965/66) emphasises that the favourable mortality conditions in Penang and Selangor may be attributed first to the greater degree of social and economic advancement, particularly in terms of better food, housing and education, and, second, to the relative abundance of medical and public health facilities. According to Tiun (1992), the reduced mortality level in Peninsular Malaysia was mainly a result of the change in the socio-economic well-being of the population, the expansion of medical health services and the improvement of education and living conditions. DaVanzo (1988) and DaVanzo and Habicht (1986) also concluded that there is an inverse relationship between the infant mortality rate and socio-economic development, particularly relative to improved women's education and improvements in water and sanitation.

Earlier in this article, we emphasised the importance of socio-economic development such as urbanisation, education and industrialisation that resulted in a declining fertility and mortality rate in Penang. Many factors are responsible for the decline, and it can be generalised that the decline is the direct result of several complicated social and economic forces. Between 1900 and 1950, the infant mortality rate was higher in the Federation of Malaya. The decline started immediately after the turn of the last century. A report by Manderson (1987) states that, by 1954, the infant mortality rate had dropped to 83 per 1,000 live births in the Federation of Malaya, and it was down to 69.0 per 1,000 in 1960. Research has demonstrated that many factors contributed to this reduction, including improvement in public health and sanitation, control of malaria, increased inoculation of infants, the supervision of midwives, and medical care and advice provided by maternal and child health centres (Manderson, 1982). Now the question that arises is what additional factors have caused the fertility and mortality rates to decline. It has been noted that in 1950–2000, the infant mortality rate in Penang declined by 93.3% from 86.0 to 5.7 per 1,000 live births (Federation of Malaya, 1952; Department of Statistics Malaysia, 2003b). During the same period, the crude birth rate declined by only 51.0% from 40.5 to 19.9 per 1,000 people. By assessing these two demographic indicators, we estimated that in Penang more than 40% of the decline in fertility from 1950 to 2000 could be attributed to the decline in infant mortality during the same period. It is obvious that when the rate of infant deaths dropped, the phenomenon became important in encouraging people in Penang to accept the idea of limiting the number of children in their families, which suggests that families no longer planned extra births to ensure some of their children would survive to adulthood. Therefore, the people of Penang began to value smaller families—a trend that is still the practice in Penang.

The rapid decline in infant mortality in Penang was also perceived to be a result of medical advancement that started during the British administration. During the early period of British rule, public medical services such as hospitals and health centres were established in towns and ports for the benefit of administrative and merchant classes and their workers, the majority of whom were foreigners and Asian immigrants (Leng, 1982). According to a study before independence, limited efforts were made to improve the general standard of health in the country (Abdul Majid, 1974). Manderson (1987) reveals further that poor environmental, living and health conditions during pregnancy significantly influenced the infant mortality rate in Malaya during the early 20th century. Instead of focusing efforts on urban areas as occurred during British colonisation, the government of Malaya after independence in 1957 took substantial steps to reduce the infant mortality rate through various public health service programmes in rural areas.

DISCUSSION

The rapid decline of fertility in Penang is a result of socio-economic progress, particularly due to increases in urbanisation, industrialisation, education, the number of women in the workforce and preference for small family size due to the increase in cost of living and raising children. The increase in the number of women receiving higher education contributed to the average increase in the age of marriage, which changed fertility-related behaviour, particularly in decisions about the number of children in a family. The demographic transition in Penang indicates that there was a rapid decline in fertility between 1947 and 2005. The fertility rate currently is 1.7 children per woman, which is far below the population replacement level of 2.1 children. In the future, fertility rates in Penang will continue to decline. This demographic change will have a significant impact on the age structure of the population and is likely to contribute to an increase in the average age of the population. As indicated by Casterline (2001), the continuing pace of fertility decline will affect the size of both the future population and its age groups. In this regard, the pace of fertility decline during the next several decades will determine the size and age structure of Penang's population in the next 50 years. Therefore, we argue that the role of internal migration in population growth rate cannot be ignored if fertility rates decline to a very low level.

Low fertility levels have several significant socio-economic consequences. First, the proportion of children age 0–14 in Penang has declined from 41.1% in 1970 to 26.7% in 2000. At the same time, the dependency ratio declined from 80.5 to 46.8. Second, the most important feature of low fertility countries was the increase in the number of people older than 60. The rapid ageing of Penang's population due to fertility transition has raised important concerns about socio-economic consequences such as facilities for an ageing

society, particularly living arrangements (Palloni, 2001). It is important to note that the drive to provide proper living arrangements for the elderly also requires strong family support in both developed and developing countries (Sokolovsky, 2001; de Jong Gierveld, de Valk and Blommesteijn, 2001).

In Penang, the number of elderly people increased from 3.5% to 5.0% or from 27,310 people in 1970 to 65,470 people in 2000—an increase of 58.2%—while the number of children age 0–14 increased by only 9.7% from 318,754 people to 352,956 people between 1970 and 2000 (Department of Statistics Malaysia, 1973a; 2001b). In 2008, the number of elderly people in Penang increased to 85,100, an increase of 5.5% (Department of Statistics Malaysia, 2008b). The Chinese have the largest number of elderly people, which has increased from 6.5% in 2000 to 7.6% in 2008 (Department of Statistics Malaysia, 2001b; 2008b). At the same time, the Chinese population age 0–14 decreased from 41.1% in 1970 to 26.9% in 2000 (Department of Statistics Malaysia, 1973a; 2001b). A report by the Department of Statistics Malaysia indicates that youth comprised 27.6% of the total population (Department of Statistics Malaysia, 2008b). Meanwhile, Penang also recorded the oldest median age in Malaysia, which increased from 22.0 years in 1980 to 25.3 years in 1991 and 27.0 years in 2000 (Department of Statistics Malaysia, 2005; Usman, 2006).

The negative impact of the increased number of elderly people has been demonstrated in many studies. For instance, Coale (1987) argues that the substantial increase of persons over 65 would impose a burden on the government's pension scheme and subsidised medical care and welfare. In contrast, Preston (1986) asserts that the increase in the number of the elderly has contributed to their improved well-being, whereas the decrease in the number of children has worsened their relative position. Another interesting point in Penang's pattern of demographic transition is that the number of Chinese elderly who are 60 or older more than doubled from 3.9% in 1970 to 10.4% in 2000, compared to the number of Malay elderly, which grew from 3.3% to 5.7% (Department of Statistics Malaysia, 2001b). Another demographic change caused by the low fertility level is the slow increase in the number of births. In Penang, the number of live births in 1947 was 19,314, which increased 37.2% to 26,499 in 2000. In Kelantan, the annual number of live births increased by 259.0% from 11,162 to 40,061 in the same years. Kelantan is unique because it has the highest fertility rate in Malaysia, with an increase in crude birth rate from 25.1 per 1,000 people in 1947 to 29.4 in 2000 (Malayan Union, 1948; Department of Statistics Malaysia, 2001b). Both Penang and Kelantan had the same estimated population size of 1.31 million people in 2000 (Department of Statistics Malaysia, 2001b). According to 2010 statistics, Kelantan and Penang had 1.46 and 1.52 million people, respectively (Department of Statistics Malaysia, 2010b).

A more serious consequence of low fertility is that the proportion of fertile women, particularly those age 20–29, has slowly declined, which was also observed in China between 1980 and 2000 (Jiang, 1999). Based on the 2000

census report, there were 134,404 women in Penang age 20–29 years, but in the next two or three decades, this group of women will enter the 45–49 age group and will have stopped having children. Therefore, the birth rate in Penang in 20 years or more depends entirely on births from 2001 onwards. Because the birth rate since 2001 is already below the replacement level, the number of childbearing women will naturally decrease. At that time, the most urgent problem besides the low fertility level will be the increase in the state's responsibility to care for an elderly population that is expected to comprise approximately 20% to 30% of Penang's population. Without the support of internal migration, population growth in Penang will be negative because the death rate will exceed the birth rate. If fertility continues to decline and remains below replacement level for the next 10 to 20 years, the number of fertile women gradually will decline. We contend that the demographic conditions discussed in this article will be documented in Malaysia's census by 2030.

According to Coale (1987), continued low fertility will also affect enrolments in primary schools and colleges, as observed in the United States since the late 1990s, which subsequently reduced the demand for public school teachers. Moreover, low fertility inevitably implies a slower growth rate and the eventual negative total population growth. Therefore, the decline in the total fertility rates in Penang and Wilayah Persekutuan (Kuala Lumpur) should be considered an important demographic issue by the government and the community. They must fully understand that the socio-economic, political and ecological effects of low fertility rates can have negative repercussions on nation building and development plans. Future fertility trends in Malaysia and other parts of the world today depend entirely on acceptance of the family formation process. Therefore, the role of marriages and fertility levels are important determinants in ensuring positive fertility behaviour among married couples. In Germany, a renewed fertility increase would require more families to have three or more children (Dorbritz and Hohn, 1999). In Singapore, due to low fertility, there appears to be an urgent need to promote Singapore as a "pro-family" society (Pereira, 2006). In Malaysia, although the fertility rate is still high, the former Prime Minister Dr. Mahathir Mohamad launched a pro-natalist 70 million population policy in 1982 to be achieved by 2100. This policy was implemented to halt the fertility decline in Malaysia and support large domestic markets that result from modernisation and industrialisation (The Ad-hoc Committee on Population Issues, 1984). It is interesting to note that Malaysia launched its family planning programme in 1966 to reduce the growth rate from 3.0% to 2.0% in 1985 (Abdul Razak, 1996).

CONCLUSION

This article uses a model based on the theory of demographic transition in an attempt to adequately explain the changing fertility and mortality levels in

Penang, Malaysia from the early 1950s until the early 2000s. This study demonstrates that a variety of development indicators including urbanisation, industrialisation and modernisation (increased education and the inclusion of women in the workforce) have played important roles in decreasing the fertility rate below the population replacement level since 2001. This article also observed that the continuous, rapid socio-economic development process in Penang will definitely reduce family size. The increase in costs associated with raising children, particularly in education, will become an important determinant of the decision to bear children among women of reproductive age. This study also noted that fertility levels continued to decline below the replacement level, particularly among Chinese and Indians; women of both ethnic groups experienced faster fertility transition than Malays.

In conclusion, the gradual processes of industrialisation, urbanisation and modernisation in Penang over four decades has affected the fertility of married women. As a result of low fertility, fewer births and a significant increase in average population age have been recorded. Elderly people who live alone will increase in the future, particularly in urban areas in both developed and developing countries. The increase in the elderly population will also directly correlate with concerns such as healthcare costs, the availability of social support and pension programmes, the existence of savings and financial security and employment for the elderly. This phenomenon has been observed in various countries in Europe, North America, Australia, the Russian Federation, Japan, China, Hong Kong and Singapore. Therefore, this article argues that it is vital to recognise that an ageing society coupled with low levels of fertility and mortality will clearly decrease the number of children, the availability of human capital, school and college enrolment and the number of marriages.

Penang is the first state in Malaysia to have achieved a low fertility rate and high average population age. This will result in serious future consequences. Therefore, preventative measures must be taken to overcome the problems associated with these two demographic issues, which will require all stakeholders—the state, society and individuals—to take responsibility for strengthening the family unit. Women should be encouraged to get married and have children, which will raise the future fertility level. The government should also design an action plan for the elderly population to ensure that their quality of life is not compromised by improving living arrangements and encouraging continuous moral and financial support from their families and society.

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