A Method of Illustrating Health Statistics in Peninsular Malaysia*

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THE USE OF rates in which events are related to the size of the population exposed to the risk of their occurrence is accepted practice in epidemiology. This allows for a better interpretation of health indices than the use of absolute frequencies or counts would permit. In particular, the relative importance of health indices is better illustrated by the use of rates. This concept of relative importance has not, however, been extended into common usage in respect of another dimension, namely, geographic area.

In an attempt to depict health statistics more fairly on a geographic basis, Sutherland (1962) devised two methods of presentation both using a series of concentric circles divided into sectors and annuli, with some attempt at maintaining relative geographic positions. In the first method each health unit was allocated an equal area within the circle (concentric sectoral isoarchic representation), while in the second method the area of the circle, sector or annulus was made proportionate to the size of the population served (concentric sectoral isodemic representation). The first method does not take into account different sizes of population at risk, and though the second method does, interpretation of relative size of areas of circles, sectors and annuli is not easy. Levison and Haddon (1965) demonstrated the use of a map, a population-by-area cartogram, the areas of which corresponded to the size of the population of upstate New York. On this they plotted the distribution of cases of Wilms' tumour comparing the effect with that obtained by plotting on a conventional map: the marked clustering seen in the latter was a function of population density and disappeared when areas were related to population size. They suggested that the method could be used for other types of information, such as cases of disease or injury, administrative services, personnel and hospital beds. They further suggested that the map areas could be made proportionate to segments of the population, for example, specific age groups. However, the construction of a map such as the one they demonstrated requires judgment and skill because the shape, relative positions and common boundaries of the areas have to be taken into consideration. Forster (1966) developed a demographic base map for Scotland, weighted in area according to population size, for relating disease or death rates to various sex-age segments of the local population at risk and to geographic position. No attempt was made to retain the geographic shapes of the administrative units; instead, the areas were stylized into shapes, basically rectangular. Due to the combination of rectangles of various dimensions, the ultimate shapes were so varied as to make direct comparison difficult.

The object of this paper is to present a simple method of drawing a demographic base map that can be used for charting a variety of indices in the fields of epidemiology and health administration for Peninsular Malaysia.

Method of Construction

A suitable dimension is selected to represent the total population at risk, in this case, Peninsular Malaysia's population of 8.8 million. In order to facilitate visual comparison between the geographic and demographic maps presented in Figure 1, the

*The territory was formerly named West Malaysia.

estimated area of 7.9384 square inches of a conventional map of Peninsular Malaysia has been used as the basis for the stylized geographic and demographic maps. Populations at risk may consist of segments of the total population, for example, the segment of rural dwellers, women 15 to 44 years of age, children under 15 years of age, or a particular ethnic group. In some instances a registered event, such as live births, or an enumerated characteristic, such as the number of living quarters, may be used as the "population at risk". The total area required may be represented by any value deemed suitable: for example, a total area of 100 square centimetres would permit easier calculation.

Squares are used to depict the area proportional to the size of the population at risk in each state, being calculated by simple proportion from the total area selected. The length of the side of the respective squares is obtained by finding the square root (Table 1) of the area.

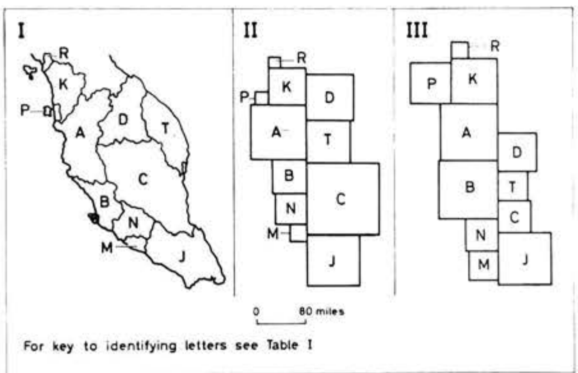

Figure 1.
Comparison of Geographic and Demographic Base Maps, Peninsular Malaysia.
I. Conventional geographic map
II. Stylized geographic base map
III. Stylized demographic base map (area by population).

The squares are assembled as shown in Figure 1 to provide the geographic base map and the corresponding demographic base map, roughly approximating the natural positions of the states and retaining the general shape of the country. Identification of each state in the figure is made easy by using the familiar first letters of the registration number plates of motor vehicles registered in the respective states.

Variation in the values of particular indices can be indicated by differential shading of the squares. This method is suitable for indices such as the one to four year old mortality rates, infant mortality rates, death rates by cause, annual case registration rates for tuberculosis, malaria prevalence in rural

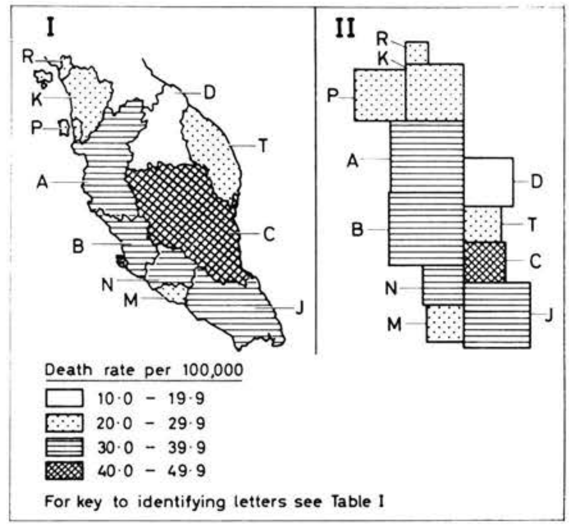

Figure 2.
Death Rates due to Accidents by State, Peninsular Malaysia, 1969-71.
I. Conventional map
II. Stylized demographic base map (area by population).

Malay children aged one to nine years, proportion of deliveries conducted by qualified personnel or proportion of living quarters with no toilet facilities.

Demographic base maps can also be used for smaller administrative areas, such as the districts within a state, or the mukims within a district or the operational areas of a rural health unit.

The technique of illustration described should always be presented with the relevant statistical tables for proper interpretation. It should not be used as a substitute for the statistical tables.

Examples of Application

Example 1

Death rates due to accidents for the states of Peninsular Malaysia averaged over the years 1969-71 are given in Table 2 and are charted in Figure 2 on conventional and demographic base maps for comparison.

Looking at the conventional map, the impression obtained is that the highest death rate due to accidents prevails in a large part of the country. While this is true in terms of geographic area, this part of the country, Pahang, is sparsely populated compared to the other states. The same information charted on a demographic base provides a better interpretation of the magnitude of the problem. The fairly high rates operating in the western states of

Table 1
Basic and Derived Data for the Preparation of Geographic and Demographic Base Maps

State	Identifying letter	Geographic area* (sq. mi)	Geographic Base		Population†	Demographic Base	
			Representative area (sq. in.)	Length of of side of square (in.)		Representa-area (sq. in.)	Length of side of square (in.)
Johore	J	7,330	1.1453	1.07	1,276,969	1.1506	1.07
Kedah	K	3,639	0.5686	0.75	954,749	0.8603	0.93
Kelantan	D	5,765	0.9008	0.95	686,266	0.6183	0.79
Malacca	M	637	0.0995	0.32	404,135	0.3641	0.60
Negri Sembilan	N	2,565	0.4008	0.63	481,491	0.4338	0.66
Pahang	C	13,886	2.1697	1.47	504,900	0.4549	0.67
Penang	P	399	0.0623	0.25	775,440	0.6987	0.84
Perak	A	8,110	1.2672	1.13	1,569,161	1.4139	1.19
Perlis	R	307	0.0480	0.22	120,991	0.1090	0.33
Selangor	B	3,166	0.4947	0.70	1,630,707	1.4693	1.21
Trengganu	T	5,002	0.7816	0.88	405,539	0.3654	0.60
Peninsular Malaysia		50,806	7.9384[y]		8,810,348[x]	7.9384[y]	

*Annual Statistical Bulletin, Malaysia 1972, Table 12.5, p. 91.
†1970 Population and Housing Census of Malaysia; Community Groups, Table 1, p. 45.
[x]Excludes 9,580 wayfarers and persons afloat at the time of the Census enumeration.
[y]A difference of .0001 from the value obtained by adding the figures in the column is due to rounding off error.

Table 2
Data for Calculating Death Rates due to Accidents by State, Peninsular Malaysia, 1969-71

State	Population	Total deaths* due to accidents 1969-71	Average annual number of deaths	Death rate per 100,000 population
Johore	1,276,969	1,249	416	32.6
Kedah	954,749	711	237	24.8
Kelantan	686,266	368	123	17.9
Malacca	404,135	309	103	25.5
Negri Sembilan	481,491	548	183	38.0
Pahang	504,900	630	210	41.6
Penang	775,440	696	232	29.9
Perak	1,569,161	1,557	519	33.1
Perlis	120,991	96	32	26.4
Selangor	1,630,707	1,572	524	32.1
Trengganu	405,539	295	98	24.2
Peninsular Malaysia	8,810,348	8,031	2,677	30.4

*Includes medically certified and inspected deaths classified to BE 47 and BE 48, and uncertified deaths classified to "Accident" and to "Attack from venomous or other animal".
Vital Statistics, West Malaysia: 1969 – Table 50.01, 50.04, 1970 – Table 50.01, 50.04, 1971 – Table 48.01, 48.04.

Perak, Selangor, Negri Sembilan and Johore are given greater emphasis in relation to the whole country on the demographic base map. There is perhaps no doubt that a large proportion of the death rates in these states is contributed to by motor vehicle accidents within the larger towns and along the north-south trunk road which runs through these states. But given approximately similar magnitudes of death rates, for example, in Perak and Selangor, it can be appreciated that the problem in terms of the absolute numbers of deaths is approximately the same although in the conventional map, Selangor occupies less than half the area of Perak. However, in comparing Selangor and Negri Sembilan, the demographic map shows that Selangor has a much bigger problem although these two states are not too different in geographic area. It should also be noted that the four states involved are contiguous in the stylized map, thus retaining the geographic element of location to some extent.

Example 2

This example illustrates the use of live births as the "population at risk" in forming the base for charting infant mortality rates. The infant mortality rates shown in Table 3 are illustrated in Figure 3.

Table 3
Infant Deaths, Live Births and Infant Mortality Rates by State, Peninsular Malaysia, 1971

State	Live births	Infant deaths	Infant mortality rate per 1,000 live births
Johore	46,010	1,731	37.6
Kedah	33,215	1,399	42.1
Kelantan	27,768	1,329	47.9
Malacca	14,188	543	38.3
Negri Sembilan	16,940	603	35.6
Pahang	18,067	738	40.8
Penang	23,903	809	33.8
Perak	54,820	2,110	38.5
Perlis	3,486	149	42.7
Selangor	54,711	1,633	29.8
Trengganu	16,270	871	53.5
Peninsular Malaysia	309,378	11,915	38.5

Vital Statistics, West Malaysia, 1971, Table 9.01, 30.01, 30.02.

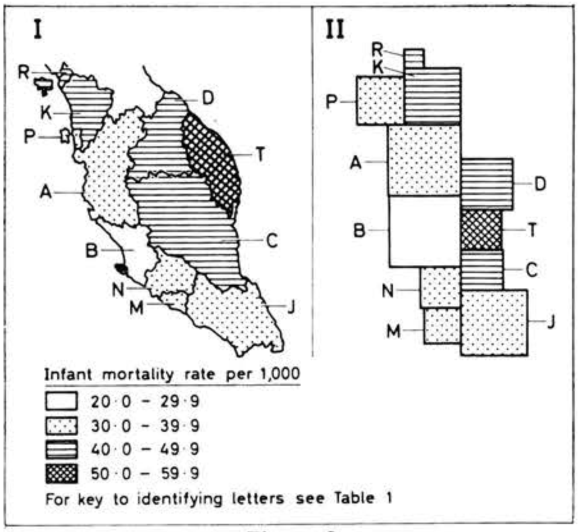

Figure 3.
Infant Mortality Rates by State, Peninsular Malaysia, 1971.
I. Conventional map
II. Stylized demographic base map (area by live births)

The conventional map gives the impression that high infant mortality rates prevail in a large part of the country especially in the states Trengganu, Kelantan, Perlis, Kedah and Pahang. While this is true in terms of geographic area, except for Perlis and Kedah, the corresponding much contracted areas in the stylized map show that these parts of the country have relatively fewer births that form the "population at risk" in the calculation of infant mortality rates. Thus the same information charted on a stylized map based on the number of live births gives the relative magnitude of the problem of high infant mortality rates a truer perspective.

Example 3

This example makes use of the technique for smaller administrative areas, in this case, the districts in Selangor. Table 4 gives data on the percentage of occupied private living quarters in non-gazetted rural areas that have no toilet facilities. This information is illustrated in both the conventional way and in a stylized map based on the number of occupied living quarters in the areas involved.

Looking at Figure 4 one is aware that there is a problem in Ulu Langat, making this district a good starting point for an environmental sanitation project. For districts with percentages in the same range, for example, Klang, Sabak Bernam and Ulu Selangor, the district with the largest number of living quarters, Klang, should perhaps receive

Table 4
Data for Calculating Proportion of Occupied Private Living Quarters with No Toilet Facilities in Non-gazetted Areas by District, Selangor, 1970

District	Occupied private living quarters	Quarters with no toilet facilities	Proportion with no toilet facilities (%)
Klang	15,089	1,009	6.7
Kuala Langat	12,999	1,592	12.2
Kuala Lumpur	38,029	1,659	4.4
Kuala Selangor	18,122	2,470	13.6
Sabak Bernam	11,074	670	6.1
Ulu Langat	8,703	1,552	17.8
Ulu Selangor	10,813	841	7.8
Selangor	114,829	9,793	8.5

1970 Population and Housing Census of Malaysia, Vo.l II, Part V, Table 14, pp. 51, 133, 260, 369, 451, 533.

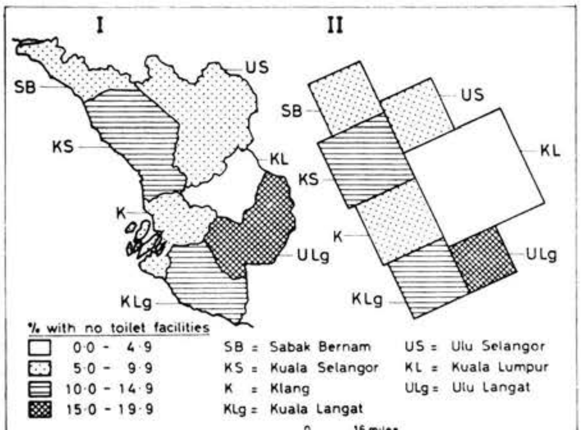

Figure 4.
Percentage of Occupied Private Living Quarters with No Toilet Facilities in Non-gazetted Areas by District, Selangor, 1970.

I. Conventional map

II. Stylized demographic base map (area by number of occupied private living quarters in non-gazetted areas).

priority of attention and the largest share of services available.

It should be noted that in an area with a larger number of living quarters, such as Kuala Lumpur, the absolute number of quarters without toilet facilities may considerably exceed another area with a higher rate, such as Ulu Selangor. In such an instance the absolute figures provided in Table 4 must be referred to and priority consideration may perhaps be given to Kuala Lumpur.

Summary

Area maps proportional to the "population at risk" are useful for the visual appreciation of the relative magnitude of a problem or the progress of a project. A simple method for constructing "base maps" using only squares is described. Three examples of its application using data on death rates due to accidents, infant mortality rates and percentages of living quarters with no toilet facilities, are provided.

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