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Tsunami Mortality and the Future: The Case of Sri Lanka

MANORI WEERATUNGA
Lecturer
Department of Demography
University of Colombo
Sri Lanka
and
LAKSHMAN DISSANAYAKE
Professor
International Development & Post-disaster Reconstruction
Leslie Silver Inernational Faculty
Leeds Metropolitan University
United Kingdom

Introduction

The main objective of this paper is to examine the morality implications after the tsunami disaster in Sri Lanka with the use of one of the worst tsunami hit district in Sri Lanka. The study attempts to observe and examine changes in relation to mortality among tsunami affected population in the district by comparing the pre-tsunami situation. Although Sri Lanka has been experiencing gradual changes in mortality and fertility as predicted by the demographic transition theory, this natural disaster may have produced some imbalances with regard to both levels and patterns of fertility and mortality in the affected areas.

Although Sri Lanka was devastated only recently by the tsunami disaster during the past 20 years, earthquakes have caused more than 1 million deaths worldwide. The Asian and Pacific Region alone has recorded 70 percent of the world's earthquakes measuring 07 or over on the Richter scale, at an average rate of 15 percent per year. The most devastating earthquake in the world in recent history, the Tangshan earthquake, occurred in People's Republic of China on 28 July 1976, and is reported to have claimed over 240,000 lives. Other countries of the region which are badly affected by earthquakes include Japan, the Philippines, India, Nepal, Afghanistan, Islamic Republic of Iran, countries of the Central Asian republics and the Pacific Islands (Sinha, 2006). Although the present study concentrates mainly on one out of the 13 districts, (Galle district) affected by the tsunami disaster, this district can be regarded as one of the worst tsunami affected districts as indicated earlier. Table 1 shows the number of deaths, number of injured people and number of missing persons in Galle district in a comparative perspective with other tsunami affected districts.

Table 1
Impact of Tsunami Disaster, 26th December 2004, Sri Lanka

District	No. of deaths	Number of Injured	Number of Missing
Jaffna	2,640	1,647	540
Mullaitivu	560	670	1
Kilinochchi	3,000	2,590	552
Trincomalee	1,078	n.a.	337
Batticaloa	2,840	2,375	1,033
Ampara	10,436	120	876
Hambantota	4,500	361	963
Matara	1,342	6,652	613
Galle	4,216	313	554
Kalutara	256	400	155
Colombo	79	64	12
Gampaha	6	3	5
Puttalam	4	1	3
	30,959	15,196	5,644

Source: *http://www.cenwor.lk/Tsunamistat.html*

Theoretical Underpinning

An increase of death rates in unpredictable situation can be seen all over the world at any moment of time, either due to natural or man-made disasters. We currently witness that mortality rate differs according to the environmental factors such as climate, weather and political conditions which can lead to war situation. Environment factors influence individual mortality which influences the normal death rate in a country. In developed countries mortality is low, maintaining a low stationery level. Although death rates stationing at a low level, natural disasters can still have a great influence in increasing the death rate.

Malthus (1926) described two categories of checks on population:

1. *Positive checks*: related to cause of death and an increased death rate. These include poverty, disease, epidemics, famine and war
2. *Preventive checks*: on the birth rate. These include 'improper arts' such as abortion

Although the Malthusian theory was dropped from favour during the 19th century, interest has revived in recent years due to the relationship between population growth in developing countries, the wastage of natural resources, and concern over food supply. In fact, sudden deaths occurring due to disasters like tsunami disaster lead us to revisit Malthusian theory, since he had made an emphasis on how natural disasters can act as a check on population growth in a country.

Sri Lanka's pattern of mortality before 1945 exemplifies the Age of Pestilence and Famine. Many of the peaks and high plateaus of mortality observed were due to the epidemics, which recurred periodically, throughout this period (Dissanayake, 2003). This has been explained with the use of Omran's theory of epidemiological transition (Omran, 1971). This provides a unique opportunity to understand the relationship between mortality and epidemiological situation during a disaster period by examining the peaks occurred in mortality levels.

This study uses information available on mortality and fertility from the 'Department of Census and Statistics' and Registrar Generals Office in Sri Lanka. It is important to mention that the 'Department of Census and Statistics' collected demographic and housing data immediately after the tsunami disaster and such information was extensively used in the analysis as they provide better insight into the demographic changes occurred after the disaster. Although there are many sources which provide information on demographic patterns, it was decided to use data available from the above sources such as the 'Department of Census and Statistics' and Registrar Generals Department as they can be regarded as reliable.

Mortality from 1968-2004

Table 1 provides a unique opportunity to understand the severity of the disaster and also its implications on the mortality level. Figure 1 shows the number of deaths occurred in Galle District from 1968 to 2004, without considering the deaths that occurred due to tsunami disaster. The crude death rate in the Galle district was oscillating around six per 1000 deaths from the year 1980 onwards, a trend very similar to the national level of mortality. Therefore, the mortality depicted in Figure 1 was the normal situation in the District. Figure 2 includes the normal deaths in the district as well as tsunami deaths in order to show how the tsunami disaster affected the mortality level in the District. It is clearly visible that the crude death rate increased in an unpredictable manner with the tsunami disaster. In fact, mortality has increased more than any level observed during the past 25 years.

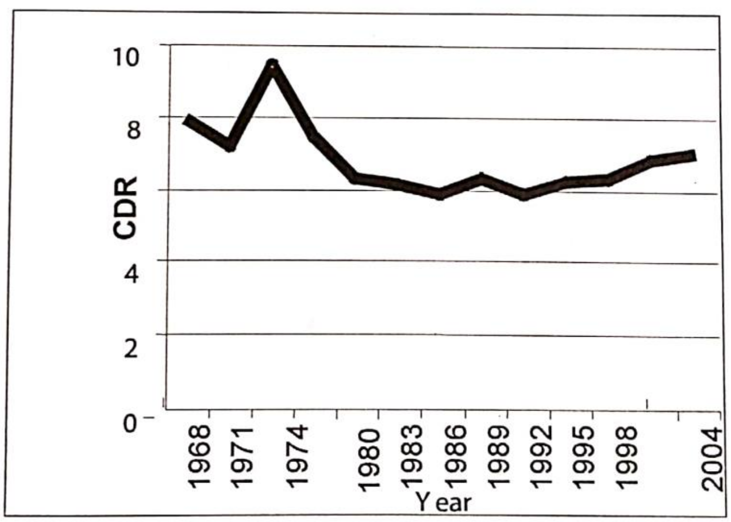

Figure 1. Mortality in the Absence of the Tsunami Disaster in Galle District

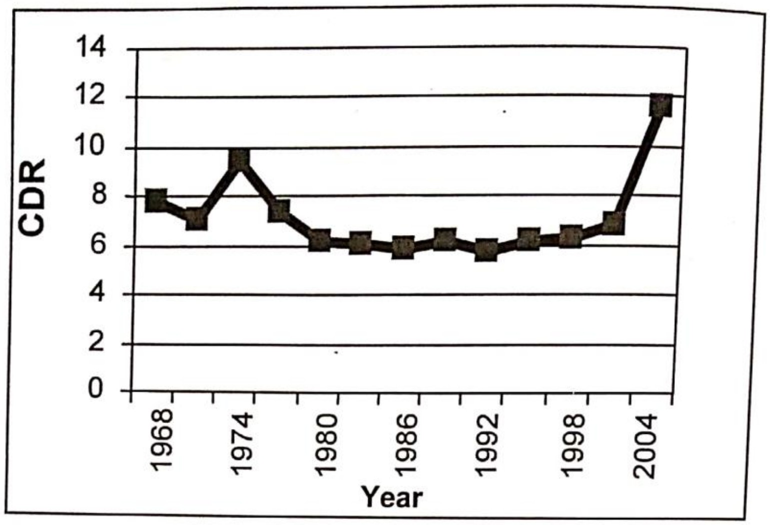

Figure 2. Mortality with the Tsunami Disaster in Galle District

Age Specific Mortality in the District before the Tsunami Disaster

It is quite interesting to observe the age specific mortality rates before the tsunami disaster since it will provide a distinctive opportunity to compare that with the post-tsunami mortality to ascertain the impact of the natural disaster on the mortality pattern in the Galle District. It is evident that the age-specific mortality among the infants and older people is comparatively high as usual (Figures 3 & 4). However, there is a clear differentiation by gender, especially at young ages. In general, it appears mortality of males is higher than that of the females in all age groups. Figure 3 shows the male and female age specific mortality rates in the absence of tsunami disaster, depicting that it follows a usual pattern in any low mortality community in the world.

Figure 3 shows the age-specific mortality rates for males from 1981-2001, a trend during a 20 year time period. It clearly exhibits that age specific mortality rate is high for infants who are under 1 year of age but gradually it has decreased during the young ages. However, with the anticipation of ageing effects observed in the Sri Lankan population, a slight increase is shown in adult mortality in the year 2001.

Figure 4 shows the age specific mortality rates for females in the absence of tsunami disaster. This also shows that the infant mortality in 1981 was higher and a gradual decrease thereafter. Mortality rates for females after 65 years of age has decreased in subsequent years compared to the values in 1981. When we compare both men and women, we can see that life expectancy of females has increased more than that of males. Although females usually have longer life expectancy than males, these findings suggest that a natural disaster can disrupt such a normal situation.

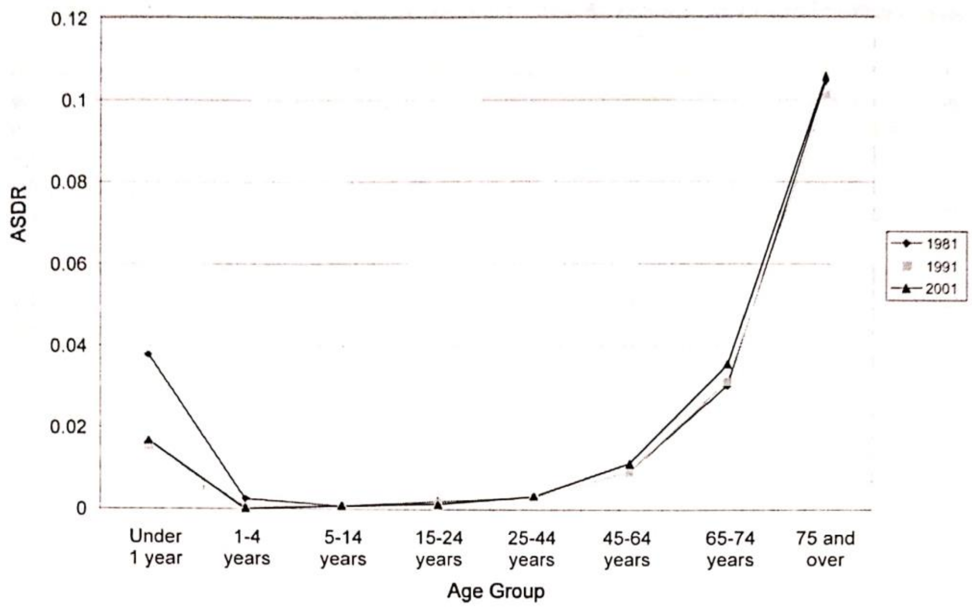

Figure 3. Age-specific Mortality Rates for Males, Galle District, 1981, 1991 & 2001

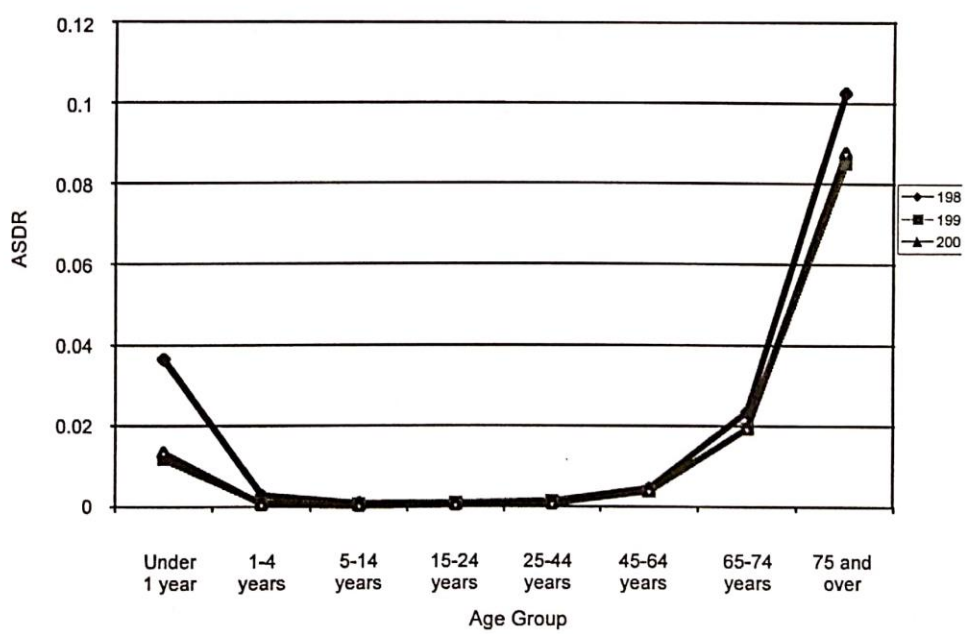

Figure 4. Age-specific Mortality Rates for Females, Galle District, 1981, 1991 & 2001

Age Specific Mortality before and after the Tsunami Disaster

This section attempts to explore how mortality after tsunami has deviated from the pre-tsunami pattern. The Figure 5 shows the pre-tsunami mortality situation in Galle District. It is quite clear that the pattern is normal where infant mortality is at low level in the case of both males and females. Female morality has become less when compared to male mortality at all ages, but the gap widens at the adult ages. This is the usual pattern one observes in a low mortality community like Sri Lanka. Therefore, Galle District does not deviate from such normal pattern. It clearly shows a low stationary mortality situation.

Figure 5 exhibits the post-tsunami mortality pattern in Galle District. It is clearly visible that tsunami disaster has made a great impact in increasing mortality level in all the age groups. The increase however, has become very much noticeable after age 30, but has started to increase steadily. Therefore, the mortality effects of tsunami were much greater in the adult ages.

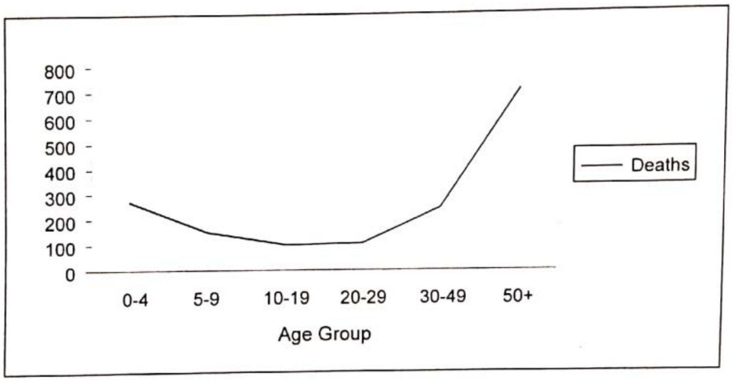

Figure 5. Distribution of Tsunami Deaths for Males in Galle District

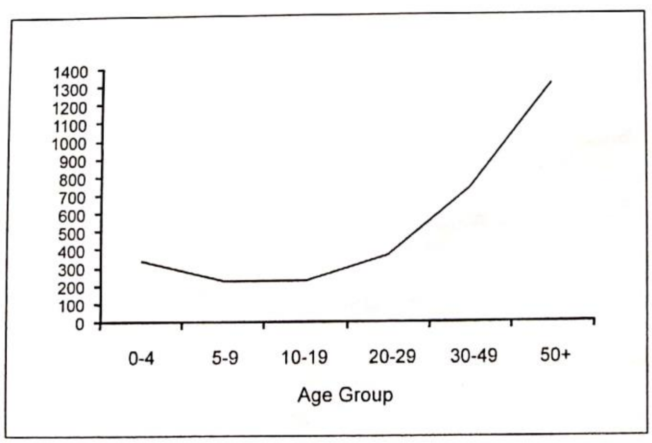

Figure 6. Distribution of Tsunami Deaths for Females in Galle District

One of the most interesting features observed in the mortality pattern after tsunami is the gender-wise differences in deaths. The Figures 5 & 6 indicate that males were less vulnerable to deaths at the time of the disaster compared to females in Galle district. In addition, female adult mortality was greater and it clearly shows their vulnerability. This has resulted in more single-parent families and more male widows.

A clear division of the mortality impact was clear by gender according to their employment states. It appears that those engaged in trade and fishery sectors were mainly males who died due to the disaster, while those engaged in the coir industry, especially females were at the high mortality risk.

Table 2
Distribution of Dead/Disappeared Persons by Their Employment which They Were Engaged before the Tsunami Disaster

	Dead			Disappeared			Total		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Agriculture / Farming	5	1	6	0	2	2	5	3	8
Fishing (for sale)	22	3	25	4	0	4	26	3	29
Other fishery related	11	0	11	0	0	0	11	0	11
Coir Industry	0	42	42	1	5	6	1	47	48
Lime stone industries	5	0	5	0	1	1	5	1	6
Other manufacturing industries	4	22	26	1	2	3	5	24	29
Trade	41	34	75	11	4	15	52	38	90
Tourism related industry	6	2	8	1	0	1	7	2	9
Other related industry	35	16	51	9	1	10	44	17	61
Other	34	26	60	2	6	8	36	32	68
Government sector	18	28	46	0	7	7	18	35	53
Total	181	174	355	29	28	57	210	202	412

Source: Department of Census and Statistics

Changes in Infant Mortality Rate

When we examine the infant mortality data, we can observe a decline in infant mortality rate (IMR) dramatically over the years, but it has increased to a significant level in 2005. Although one can expect the mortality to rise during the year 2004 due to the tsunami disaster, what is observed with data obtained from the Registrar Generals' Department is an unchanged situation because of registering tsunami deaths in 2005. Therefore, Figure 7 shows that IMR has increased to a record level in the recent history.

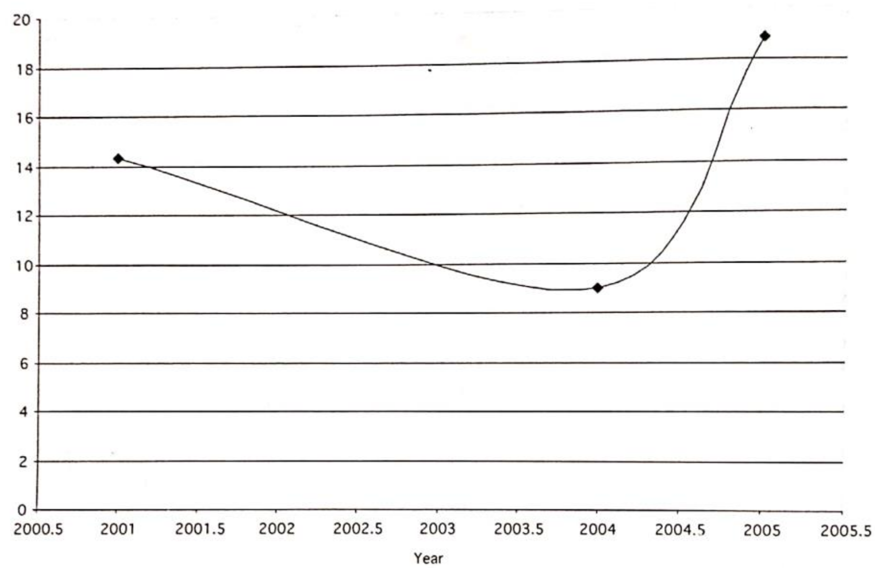

Figure 7. Infant Mortality Rate, Galle District, 2001, 2004 and 2005

Risk of Death Due to Tsunami

Cause-specific death ratio is usually calculated to show the relative risk due to any particular cause of death. In the present study, deaths due to tsunami disaster can be regarded as a cause of death and therefore a tsunami disaster-specific death ratio is calculated for the district of Galle as follows:

Tsunami disaster-specific death ratio for Galle District in 2005 =

$$\frac{\text{Number of deaths due to the tsunami disaster}}{\text{Total number of deaths in Galle district in 2005}} \times 100{,}000$$

The ratio calculated is 46.22 per 100 people in the Galle district, which shows a high relative risk of death due to tsunami disaster in Galle District.

Natural disaster is intimately connected to the processes of human development. Disasters triggered by natural hazards put development gains at risk. At the same time, the development choices made by individuals, communities and nations can pave the way for unequal distributions at risk. Meeting the Millennium Development Goals is extremely challenged in many communities by losses from disasters triggered by natural hazards. The destruction of infrastructure, the erosion of livelihoods, damage to the integrity of ecosystems and architectural heritage, injury, illness and death are direct outcomes of disaster. However, disaster losses interact with and can also aggravate other stresses and shocks such as financial crisis, a political and social conflict, disease and environmental degradation. Such disaster losses may set back social investments aiming to ameliorate poverty and hunger, provide access to education, health services, safe housing, drinking water and sanitation, or to protect the environment as well as economic investments that provide employment and income. In the present study, an attempt has been made to address "How the tsunami disaster risk distributed locally between small area population levels" This will provide us a great opportunity to map out how the disaster risk is distributed among small area population level so the government policies can be directed to eradicate their vulnerable position. In order to do this, a map was developed for Galle District by computing the risk of death for all the Divisional Secretary (DS) divisions[1] in Galle district. Similarly for the Hikkaduwa DS division, another map was being developed by calculating the risk of deaths for all *Grama Niladhari*[2] Divisions. This can be an innovative contribution to the field of disaster mitigation since these maps provide a sound basis to understand the different exposure of the risk due to any disaster situation.

Table 3
Risk of death, 2001, Prior to Tsunami Disaster and with the Tsunami Disaster

DS division	Risk of death, pre-tsunami situation	Risk of death, post-tsunami situation
Balapitiya	0.007009	0.008539
Galle Four Gravets	0.007981	0.01479
Ambalangoda	0.007656	0.012311
Bentota	0.007687	0.006029
Hikkaduwa	0.007171	0.016249
Habaraduwa	0.007571	0.012517

Table 3 shows that Hikkaduwa has the highest risk to tsunami disasters and the lowest risk is observed for Bentota DS division. Prioritization of the risk of death by DS division will be very important for those who make disaster interventions as they can prioritize the areas needing more attention. Figure 8 further highlights the risk of death pattern in Galle district and it clearly shows four high-risk areas in the district. It is also quite important to mention that the risk of death prior to tsunami was almost equal and relatively low in each division as mortality has been stable in the country during the last 30 years (Dissanayake, 1987).

1. Divisional Secretary Division is smaller than a district and comprised of more than one Village Headman Division
2. *Grama Niladhari* or Village Headman Division is comprised of more than one village

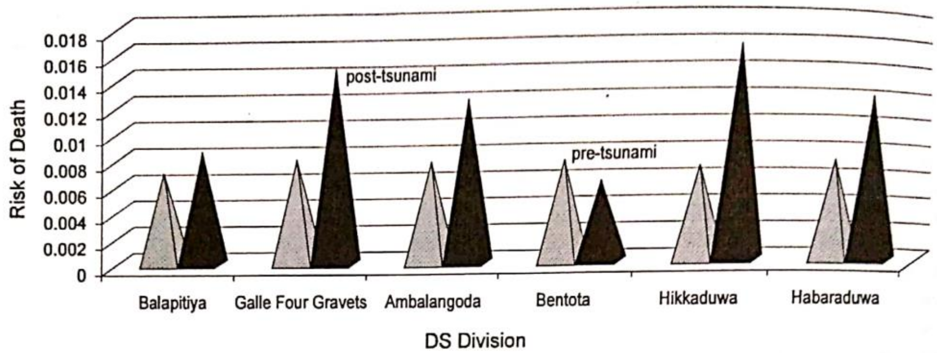

Figure 8. Risk of Death, Galle district by DS Division, Pre and Post Tsunami Situation

Changes Observed in Life Years

It will be quite interesting to examine whether tsunami disaster has had any impact in changing the life expectancies. For this, the authors have computed life tables for males and females for the years 2001 and 2005. It is quite amazing to observe the effect the tsunami disaster had on the life expectancy values (see Tables 4 & 5). Women have lost 6.53 life years compared to men who had lost 5.04 years during just four year period from 2001 to 2005. When annual change in life expectancy is calculated, the authors observe more than 1 life year lost by both sexes during this 4 year time period.

The required life tables for 2005 were computed by adjusting the estimated population for tsunami mortality. Although there is a limitation of not considering fertility and migration changes, it is expected that the present analysis will not be affected severely because the focus here is

Table 4
Changes in Life Years, Males, 2001 – 2005, Galle District

Initial life expectancy (2001)	68.78
Final life expectancy (2005)	63.74
Change in life expectancy	-5.04
Annual change	-1.26

Table 5
Changes in Life Years, Females, 2001 – 2005, Galle District

Initial life expectancy (2001)	75.31
Final life expectancy (2005)	68.78
Change in life expectancy	-6.53
Annual change	-1.63

to examine the changes that have occurred to mortality and its relationship with the population structures and growth. It is also quite visible from the lx columns of the said life tables since they are smooth and compatible with the lx columns of the 2001 life tables. Figures 9 and 10 show the lx columns of the life table survivors at exact age x for males and females for the years 2001 and 2005. Figure 9 for the males indicates that the number of survivors at each age in 2005 is less than that of the 2001 and greater differences can be observed in the middle ages. This is mainly due to the impact of infant and child mortality that appears to show signs of their impact mainly during the middle ages where mortality is usually low. It is also important to note that the pattern observed for female survivors is similar to male survivors but a significant difference is observed between 2001 and 2005. This can be attributed to more female mortality occurring with the tsunami disaster.

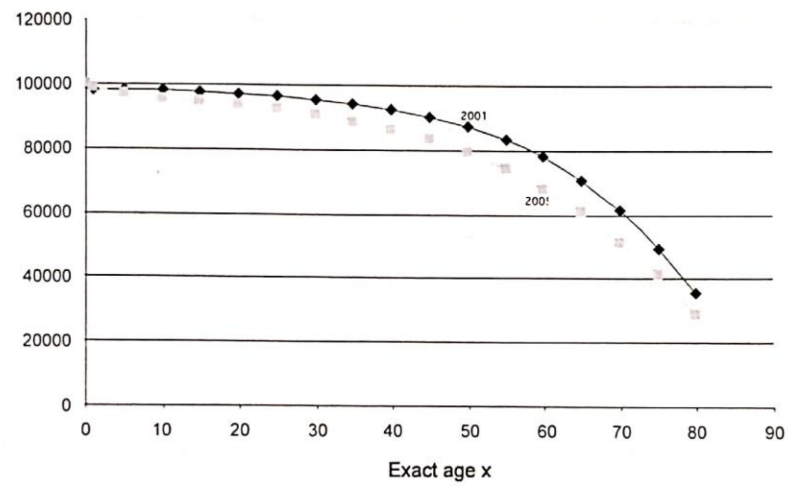

Figure 9. Life Table Survivors at Exact age x, Males, Galle district, 2001& 2005

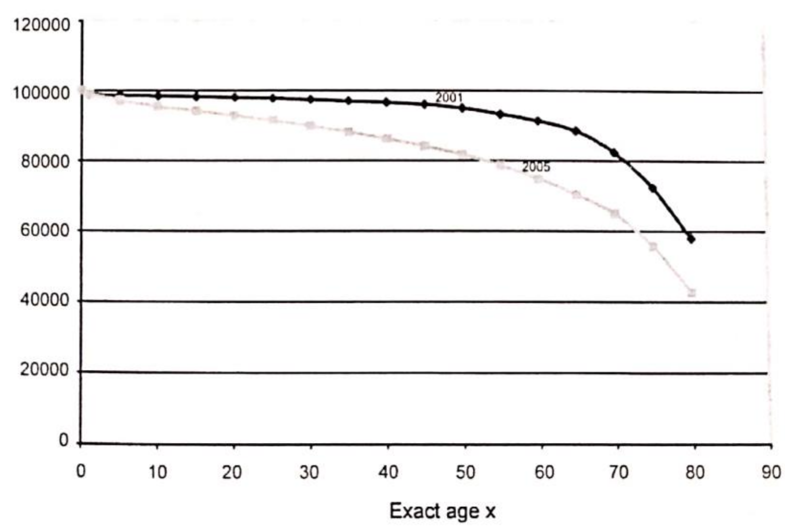

Figure 10. Life Table Survivors at Exact Age x, Females, Galle District, 2001 & 2005

Impact on population growth

Sudden events like tsunami disasters may usually not be taken into consideration when population predictions are made as the authors often base their information concentrating on census years. If someone does not know the magnitude of the impact of a disaster on mortality level of a particular locality, the predictions made on population for future years can be severely affected. Therefore, this study has made an attempt to show the severity of the tsunami disaster and its impact on future population predictions by considering the Galle district mortality and its population. Figure 11 shows the population estimates for males in Galle district. Tsunami mortality has reduced the population number and the population growth.

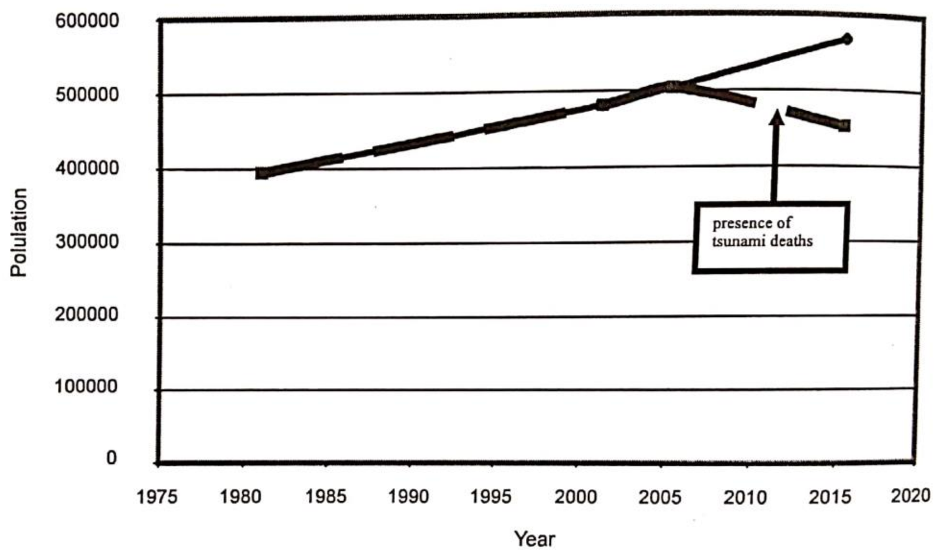

Figure 11. Estimates of Population by Incorporating Tsunami Male Deaths, Galle District

When we calculate the rate of growth of the population after tsunami until 2015, we find that the population is expected to decline by 1.07 during that 10 year period. It is important to mention here this is mainly in the absence of any change in migration and fertility. However, the decline of female population during this 10 year period from 2005 to 2015 is higher as the average annual growth calculated is -.2.50 percent. This is mainly due to higher tsunami morality experienced by females in Galle District.

Conclusion

This paper attempted to show how a natural disaster can affect mortality in a country by taking one of the worst tsunami hit districts in Sri Lanka. Galle was one of the districts in the southwest of Sri Lanka, which underwent both fertility as well as mortality transition, and therefore, it was quite interesting to see how a disaster can upset post-transitional mortality pattern. The present analysis clearly showed that normal mortality pattern even in such society can greatly change and this will have a huge impact on the population structures as well as social status at the family leby producing

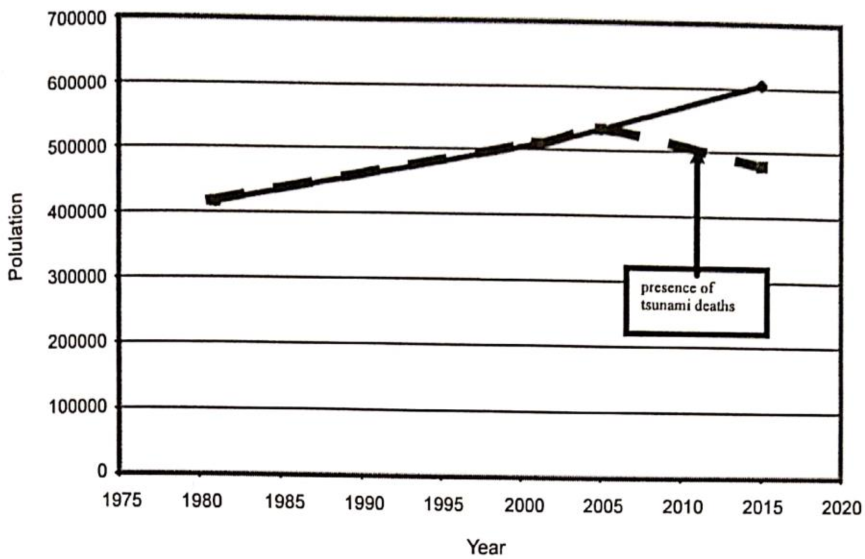

Figure 12. Estimates of Population by Incorporating Tsunami Female Deaths, Galle District

a significant number of single parent families and large number of male-widows. A relatively high female mortality at adult ages call for some social protection measures for the elderly males since they are already in a vulnerable position with fewer number of children who can look after them at their adult age due to early fertility transition in this district. Therefore, it is expected that this study provides a unique opportunity for the population planners as well as policy makers to look at what adjustment procedures need to be implemented in order to recover from such a population loss, at least in the medium term.

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