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EPIDEMIOLOGIC AND HEALTH TRANSITION IN MAURITIUS

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I. INTRODUCTION

The Island of Mauritius is situated in the Indian Ocean, 500 miles east of Madagascar and over 1,000 miles from the south east coast of Africa. It measures 38 miles long by 29 miles wide and has an area of apporximately 720 square miles. The population in 1987 was about one million and is made up of three broad population groups: the Indo-Mauritians, the Sino-Mauritians and the 'General Population.' The Indo-Mauritians comprising of immigrants from India and their descendants make up about two-thirds of the population, while the Sino-Mauritians comprising of immigrants from China and their descendants make up about 3%. The rest of the population is known as the 'General Population' and is made up of persons from European or African or mixed decent.

The Island of Mauritius has experienced one of the most spectacular declines in mortality in the third world, yet somehow it does not receive as much attention as states like Kerala (India) or Sri Lanka. In a period of four decades, from 1942-46 to 1982-84, life expectancy at birth in Mauritius increased from 32.8 to 64.38 for males and from 33.8 to 71.23 for females. This sharp decline in mortality is accompanied by a drastic shift in cause of death structure. This paper aims to describe the evolution of Mauritian epidemiologic transition over the period 1969-1986 and interpret the changes in the light of existing theories of the epidemiologic and health transition.

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II. REVIEW OF EPIDEMIOLOGIC AND HEALTH TRANSITION THEORIES

In reviewing the various theories of the epidemiologic transition, one starts with the original formulation by Omran (1971). The theory he proposed 'focuses on the complex changes in pattern of health and disease in a society and on heir demographic, socioeconomic and biological determinants and consequences' (Omran, 1982). It proposed that disease patterns shift over time so that infectious and parasitic diseases are gradually, but not completely displaced by degenerative and man-made disease as the leading causes of death. According to the theory, the transition consists of three major successive stages: the stage of pestilence and famine with life expectancy at birth of 20-40 years, the stage of receding pandemic with life expectancy at birth of 30-55 years and the stage of degenerative and man made diseases with life expectancy at birth of up to 70 years or more. The theory further proposed four models of the epidemiological transition; the classical or Western model, the accelerated variant of the classical model; the delayed and the transitional variant of the delayed model (Omran, 1982). In the last model belongs countries such as Taiwan, South Korea, Singapore, Hong Kong, Sri Lanka, Mauritius and Jamaica (Omran, 1982). These countries experienced rəpid mortality decline in the 1940's and a few decades after this, fertility started to decline as well in response to efficient, organized family planning efforts supplemented by social development. Furthermore, mortality decline especially with respect to infant and child mortality did not slacken but was sustained (Omran, 1982).

After Omran's initial formulation and subsequent elaborations of the epidemiologic transition theory, many works were done on applying its theoretical framework to analyze mortality change in several countries and among several population subgroups. The results of these researches had three outcomes. First are those that confirmed the applicability of the framework, with some exceptions noted (Broudy and May, 1983). Second are those which called for an additional stage namely the fourth stage to be added to Omran's three stage theory (Olşhansky and Brian Ault, 1986; Rogers and Hackenberg, 1987). Last are those that criticize the evolutionary approach employed by all the formulations of the theory and call for a major modification of the theory (Frenk et al., 1989; Soberon et al., 1986; Sepulveda et al., 1987).

Upon studying the epidemiologic transition among Navajo Indians in the United States, Broudy and May (1983) describe their mortality pattern as straddling stage two and stage three of Omran's theory. They noted however two exceptions. First was the high rate of growth still experienced among the Navajo Indians. The second exception was that Navajo rates of death from 'social pathologies' rose quite rapidly while degenerative diseases showed

only slight increases.

Concerning the proposal for an additional stage to Omran's three stages, Olshansky and Brian Ault (1986: 360) give the general characteristics of the fourth stage as including the following:

> (1)rapidly declining death rates that are concentrated mostly at advanced ages and which occur at nearly the same pace for males and females; (2)the age pattern of mortality by cause remains largely the same as in the third stage but the age distribution of deaths for degenerative causes are shifted progressively toward older ages; and (3) relatively rapid improvements in survival being concentrated among the population in advanced ages.' They remark that the major characteristic that distinguishes the fourth stage from the third is the unexpected shift in the age pattern of mortality by degenerative causes for the population in advanced ages. In short, 'in this fourth stage, the major degenerative causes of death that prevailed during the third stage remain with us as the major killer, but the risks of dying from these diseases are distributed to older ages.' (Olshansky and Brian Ault, 1986:361).

They attribute the source of this change to a combination of factors including shift in the age structure toward older ages, advances in medical technology, health care programs for the elderly and reductions in risk factors at the population level.

The descriptions of the fourth stage by Rogers and Hackenberg (1987) is more substantive. They focus on the different propositions in Omran's theory. One of Omran's propositions is concerned with the existence of mortality differentials among several population subgroups. For example, it is proposed that the epidemiologic transition favours females over males, the young over the old and, in the United States, whites over non-whites. Another proposition of Omran's theory is that infectious diseases will decline but will not be entirely eradicated. Rogers and Hackenberg provide evidence with data from the United States to show that these propositions have changed. They note that the recent decline in chronic diseases observed in the developed countries cannot be explained by Omran's theory. Further, they agree with Olshansky and Brian Ault that the leading caused in this stage are still due to degenerative and man-made diseases, but disagree with them in identifying the source of this change. Rogers and Hackenberg argue that the major source of this change is the increasing influence of individual behaviours and new lifestyles on mortality. This influence may either be positive such as in areas where measures of health promotion are effective or negative such as in areas where potentially destructive lifestyle practices are widespread. On

the negative side, individual behaviours and destructive lifestyle practices include sexual orientations and social pathologies like accidents, suicides homicides, excessive drinking and smoking. Even though Acquired Immunodeficiency Syndrome (AIDS) is an infectious disease, Rogers and Hackenberg consider it a disease belonging to the fourth stage because of its direct relation to an individual's behaviour and lifestyle. They argue that the root cause of these destructive lifestyle practices is 'hybris'—an excessive self confidence, a belief that one cannot suffer and that one is invincible. Hence they refer to this fourth stage as the 'hybristic stage.'

Upon analyzing Canadian epidemiologic transition, Bah and Rajulton (1991) argue that these two formulations of the fourth stage are not exclusive of each other. Rather, they reflect different aspects of this new stage of mortality which is characterised by an interplay between the age-cause patterns of mortality, micro-level determinants such as individual behaviour and social lifestyles, and macro-level determinants such as health care and health promotion programmes. Generally, advances in medical techonolgy help delay death to very old ages. Health promotion programmes, however, affect all ages, not necessarily the oldest ages. They help reduce preventable deaths and morbidity primarily through modifications of individual behaviours and lifestyles. However, certain causes of death are primarily determined by potentially destructive individual behaviours and lifestyles and are products of man-made environment.

In criticizing Omran's formulation, Frenk et al.,(1989) argue that between the countries in the advanced stage of the epidemiologic transition and those in the initial stage lies a third group that is undergoing a new transition experience quite different from that of the developed nations. They describe such countries as belonging to the 'protracted and polarized' transition model. This model is characterised by the following features: (1)Overlap of eras—the stages of the transition do not follow a sequential order but exhibit considerable overlap. (2) Countertransitions—the shift from mortality to morbidity occur not only for degenerative diseases but also for infectious diseases as in some deveolping countries. (3) Protracted transition—the transition process not being clearly resolved as countries exhibit both infectious and chronic diseases. (4) Epidemiologic polarization— a polarization is seen to occur between population subgroups with the poor and rural populations succumbing to the pre-transitional pathology while the urban populations experience post-transitional pathology .

The proposed 'protracted and polarized' model bears close similarity with the transitional variant of the delayed model described by Omran (1982). The formulation by Omran had two aspects; first is the evolutionary aspect in which stages are outlined and second is

the differentiation between the different paces of mortality and morbidity change. As Frenk et al. (1989) have argued, with heterogenous populations, these two aspects take on more complex courses. The protracted and polarized model proposed can be seen as further qualificantions of populations in transition but which cannot adequately described by Omran's delayed model.

The original formulation of 'health transition theory' was by Learner (1973). He coined the term 'health transition' and empolyed the evolutionary approach in describing the phases of health changes. The successive stages of health changes are described as: 'low vitality,' 'increasing control over mortality' and 'broadened conception of health'. Recently, the concept of health transition has received renewed interest. This came out of reasearch findings whcih show that societies with similar levels of health provision and comparable incomes show contrasting levels of mortality and enjoy widely different leveals of health. The explanation of such anomalies gave rise to the recognition of what is now called 'the health transition factor.' The theory of health transition is still being developed and as such there are various formulations of the theory. Health transition is used by Caldwell (1990) to include both the epidemiological transition and the related social change. It is defined as:

> 'The cultural, social and behavioural determinants of health.' (Caldwell and Caldwell, 1991:3)

These are those determinants other than medical interventions and income. Findlay (1991:382) clarifies further:

> 'of interest in the "health transition" are not the changes in diseases but in the social transformations accompanying these changes.'

These social transformations have been described as follows:

> 'In the early transitional societies, neither the family nor society has developed effective technologies or behaviours to protect itself from disease....As the transition progresses, communities and families begin to develop a more effective range of measures which protect then from parasitic and infectious diseases. ...In the late transitional settings, local communities add, to their earlier responsibilities for basic environmental sanitation and public health measures to protect the population from infectious and parasitic diseases, responsibilities for reducing the risk of chronic diseases or accidents.'(Findlay, 1991:382-383).

The aim in health transition research is to focus on other important aspects of health change which have been neglected in favour of biomedical explanations (Van de Walle, 1990).

Although health transition variables are seen as being elusive, they are considered to be of great importance in explaining global mortality decline (Caldwell and Caldwell, 1991). It is even perceived that the most economic route to low mortality is probably to spend more on seeking complimentary behavioural changes rather than increasing direct medical expenditure (Caldwell, 1990). Also, health transition variables help explain the 'role' of social and economic changes in initiating and accelerating a societal transition to better health.' (Findlay, 1991:387). Frenk et al. (1991:23) conceive of health transition as being made up of two components: the epidemiologic transition and the 'health care transition.' The health care transition refers to the change in the patterns of the organized social response to health conditions.

III. METHOD AND MATERIAL

In order to substantiate or refute the theories outlined above, the main approcah employed in this paper is the analysis of cause of death structure over the period 1969-1986. This is later followed by substantive discussion of social and health changes in Mauritius.

Cause of death structure refers to the contribution of various causes of death to total mortality both in the population and among the various age groups. The cause of death structure hardly remains constant but rather undergoes a continuous change reflecting the social, biological, economic and environmental factors pervailing in the given population. There are two aspects of cause of death structure which need investigation; the period aspect or a point in time and the longitudinal or the time trend aspect. Several measures can be used to study cause of death structure. Some of these measures are direct, for example, age-cause-speccific death rates and age-standardised cause-specific death rates. Others are derived measures for example, life table death rates and change in parametric values. In this paper, the measure opted for is the age-standardised cause-specific death rate. This provides a summary index which is free from age effects and is an index that takes into account the death rates in all the various age group.

In this study, the standard population used to obtain the standardised rates was theaverage of the total census population for 1972 and 1983. Such a population had lower index

of dissimilarity with either of the two populations than with the two populations themselves (Bah, 1987). Following the lead of previous studies in cause of death analysis, eleven groups of causes have been used in the analysis including all causes combined and the residual group of 'all other causes' or 'all others.' The final list and their equivalent codes in the eighth and ninth revisions of the international classification of diseases (ICD-8 and ICD-9) has been given in Appendix a. For each of these eleven groups of causes, the age-standardised cause specific death rate is computed separately for gender for each year.

IV. CHANGE IN CAUSE STRUCTURE OF MORTALITY

Table 1 shows the mean and variance of the standardized cause specific death rates obtained for the period 1969-1986. Using the mean values obtained, the order of importance of the causes of death for males are follows: circulatiory causes, 'all other causes,' infectious diseases, external causes of injury, neoplasms, congenital malformations, digestive causes, nutritional disorders and lastly respiratiory causes. The first three of these causes have undergone rapid change hence they have the highest variance. The variances of congenital malformations and neoplasms are close; this is also true for those of nutritional disorders and diseases of the digestive system. Respiratory causes have the least mean and variance showing that the cause is the least important as well as the most constant. The highest variances are obtained for 'all other causes,' infectious diseases and circulatory causes.

Table 1
Mean and variance of standardized cause-specific death rates (per 100,000). Mauritius, 1969-1986.

	Males		Females	
Cause	Mean	Variance	Mean	Variance
ALL	952.533	8754.598	599.834	9856.641
INF	173.937	3186.869	116.935	3068.612
NEO	56.025	54.431	42.263	19.349
NU	29.351	108.260	29.329	75.754
CIR	334.652	4482.664	184.867	576.088
RES	21.457	23.184	13.168	24.538
DIG	44.584	109.258	14.626	6.523
PRG	0.000	0.000	5.991	6.513
CONG	47.293	52.788	35.934	28.477
INJ	66.738	84.004	27.029	8.104
OTH	178.132	4386.938	129.386	3554.489

The number of observations, N=18
See Appendix A for the names of the causes abbreviated above

Using the mean values obtained, the order of importance of the causes of death for females are as follows: circulatory causes, 'all other causes,' infectious diseases and neoplasms. While the order of the first three causes are the same as in males, the magnitudes for those for males are much higher than those for females. For circulatory causes for instance, the magnitude for males is almost double that for females and the variance of the causes for males is more than seven times higher than those for females. The variance is highest for 'all others' followed by that of infectious diseases then circulatory causes, with diseases of pregnancy and childbirth having the least variance. The variances for females are generally less than those for males except for respiratory causes and all causes combined. and females respectively. The age-standardized death rates for all causes during the period 1969-1986 have been plotted in the Figure 1 for both males and females. The age-standarized cause-specific death rates have been plotted in Figures 2 through 7.

For males, The standardized death rates for all causes plotted in Figure 1 show some fluctuation between 1969 and 1974. The rates over this period remained above 920 but less than 990 per 100,000 population. In 1975 however, there was a rapid rise in the age-standardized death rates to 1060 per 100,000. These high rates were maintained till 1977. Between 1977 and 1982, the mortality rates show wide fluctuations but after 1982, the rates show a marked drop to much lower levels. The dramatic change in male mortality over the period 1975-1977 has been commented upon before (Bah, 1987; CSO, 1988). The rise in male mortality colud not have been due to increase in mortality at all ages since the female standardized rates as well as the infant mortality rates declined steadily over the period (Bah, 1987). According to CSO (1988),

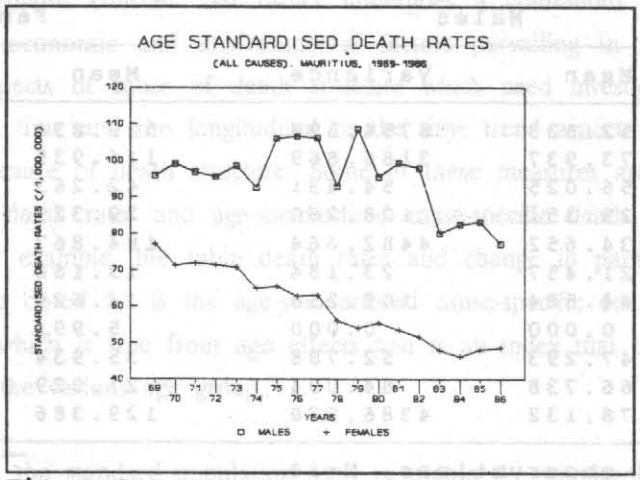

Figure 1

"It was found that while mortality for persons aged 20 has continued its historical decline during the period 1972-83, that for persons age 20 and above was interrupted by a temporary upward shift between 1972 and 1976. The expectation of life at birth for males even declined during this period, from 60.8 years in 1972 to 60.6 years in 1974 and further to 60.1 years in 1976."

For females however, no such interruption in the trend of decline was observed, as seen also from Figure 1. The female standardised rates per 100,000 declined by nearly 40%, from 771.92 in 1969 to 485.97 in 1986. The rise in male mortality was primarily due to increase in deaths due to circulatory causes. Thus the increase is behaviourally related rather than a reflection of overall health conditions in the country.

From Figure 1. four stages can be identified from the trend of standardized death rates for males for all causes combined. The period 1969-1974 witnessed slight fluctuations but close to a mean level. The period 1975-1977 witnessed a rapid rise to a plateau level after which the rates returned again to the pre-1974 level over the period 1980-1982. The period 1983-1986 saw a rapid decline to new low levels. For females, the trend in Figure 1 shows a steadier decline. For the period 1970-1973, the rates were almost constant after with a steady decline started which was sustained till 1984 when the lowest level was reached. There has been a slow rise in the rates after 1984.

The leading causes of death in 1969 were infectious diseases, circulatory diseases and 'all others;' for both males and females. Figures 2 and 3 show the trends for infectious diseases, circulatory diseases and 'all other causes' for males and females respectively. Both graphs show two evident trends; a rising trend for circulatory causes and a declining trend for the other two groups of causes. For males, there was a sharp rise in circulatory causes from 1974 to 1975 prior to which the rates were almost stationary. This rise in circulatioy causes was maintained till a peak was reached in 1982. After 1982, an unsteady decline started; a fall in 1983, a rise in 1984 and 1985 and a fall again in 1986. The rates in the 1980's however were always greater than the pre-1974 rates. This sharp fall in 1983 is also evident for females as shown in Figure 3. However, the increase in the rates for circulatory causes was much smoother for females than for males. For females, there was a steady rise in deaths due to circulatory causes which also reached its peak in 1982. The sudden rise observed for males in 1974-75 is not evident for females. Nonetheless, females experienced uniform increase deaths due to circulatory causes over the period 1973-1977 and followed by a steeper rise over the period 1979-1982.

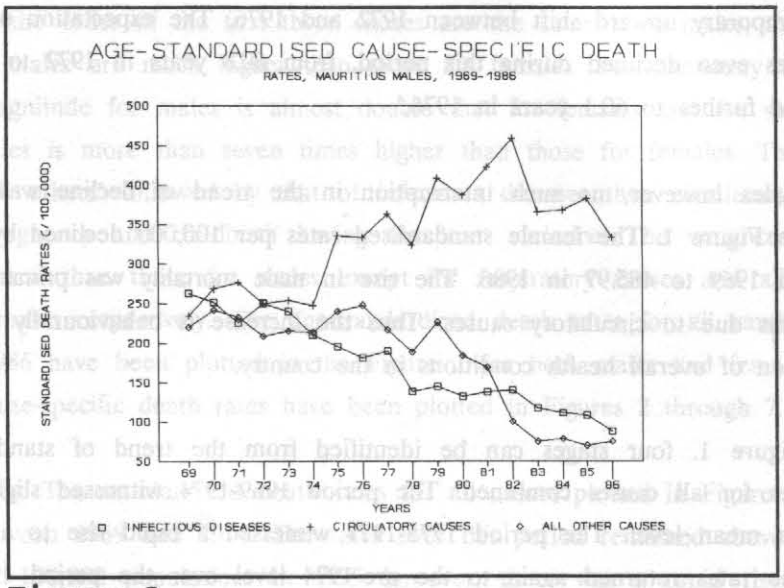

Figure 2

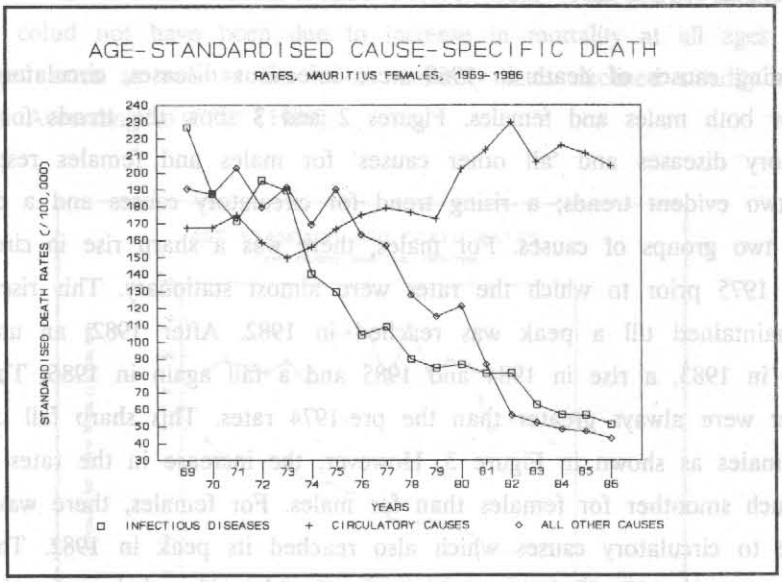

Figure 3

For infectious diseases, the periods 1977-1978 and 1982-1983 shows two breaks when the males rates fell to lower levels. In between these break, the rates were almost stationary and prior to 1977, the rate of decline was slow. From Figure 3, the female rates show very steep decline between 1973 and 1978. This was followed by almost constant trend in the rates for the next four years. The period 1982-1983 showed another sharp decline to much lower levels. The trend in 'all other causes' is similar to that in infectious diseases both for males and females. One difference however is that the sharp decline in infectious diseases over the period 1982-1983 was preceded by a sharp decline in 'all other causes' over the period 1981-1982 for males and 1980-1982 for females. Over the period 1969 to 1986, the rate for the group of infectious diseases has declined by more than half for males and about three quarters for females. The group however had not lost its importance. While the group of infectious iseases ranked first in 1969 followed by circulatory causes, by 1986, it lost its first position to the group of circulatory causes taking the second position.

In a similar manner to the trend in infectious diseases, the residual group 'all others' also showed remarkable decline for both males and females. For females, sustained decline started after 1975 prior to which the rates showed wide fluctuations. For males, a similar decline started later in 1979, before which there was gradual fluctuations. Sudden declines were experienced between 1981 and 1982 for males and between 1980 and 1982 for females. The 'outflow' of deaths caused by the sudden decline could have led to 'inflows' in other causes. This point will be taken up again after the trends of the other causes have been described.

Figures 4 and 5 show the trends for neoplasms, congenital malformations and external causes of injury for males and females respectively. The trends show very wide fluctuations and very little pattern is evident from both Figures. For males however, the period 1971-1979 show steady increase in the rates due to external causes of injury which is followed by a period of uniform decline. Neoplasms for males rose to a peak in 1981 prior to which the rates had been rising in a fluctuation manner. For neoplasms, the rates for males and females are significantly different. While the male rates exhibit an increasing trend between 1969 and 1981, for females, the rates exhibit a decreasing one. After, 1981, the reverse of this trend was observed for both sexes. Because of these opposing trends observed, the rates at the beginning and the end do not show much change. For males, neoplasms remained the sixth most important group of causes of death for 1969 and 1986 for females, on the other hand, the rank of neoplasms increased from fourth in 1969 to third in 1986.

External causes of injury an poisoning ranked fourth for males in 1969 at 59.2 per

100,000. The rate for this group of causes increased unsteadily to 84.5 in 1979, showing a 43% increase. After this peak, it declined more steadily to 58.9 in 1986 with its rand still unchanged. For females, the rate per 100,000 in 1969 was 22.6, nearly a third of that of males. Over the period, the rates fluctuated between 20.0 and 32.0 per 100,000 and did not show any consistent trend.

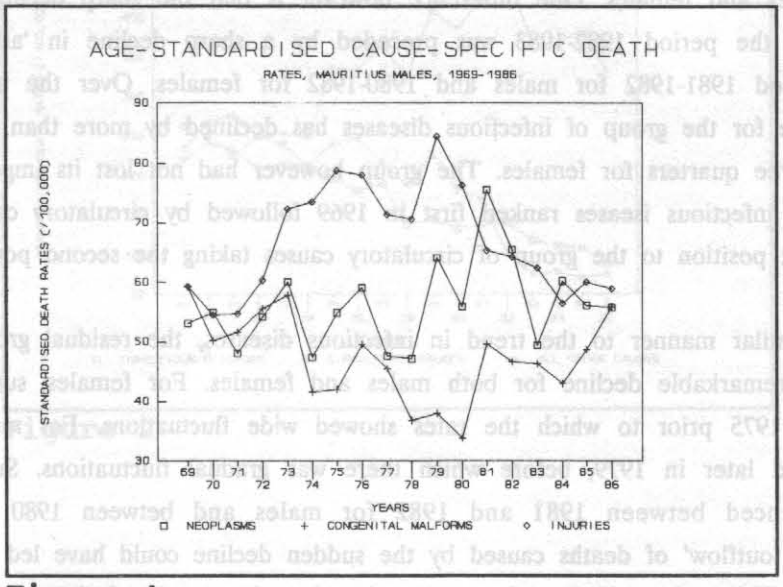

Figure 4

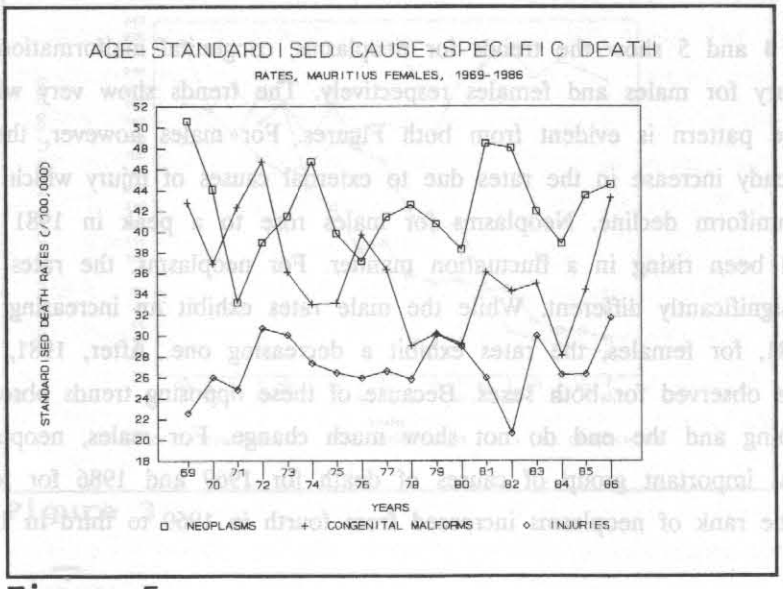

Figure 5

For congenital malformation and diseases of infancy, the change has not been much over the period 1969 to 1986. For males, this group of causes ranked fifth in 1969 at 59.21 per 100,000. Over the period under study, rates for this group had shown only slight decline in the rate but experienced many fluctuations. One can only infer that low levels had already been reached so that further reduction has become very difficult to achieve. For females, the variation has been less.

Figures 6 shows the trend for nutritional causes, respiratory causes and digestive causes for males. For females, Figure 7 includes these same causes in addition to pregnancy realted

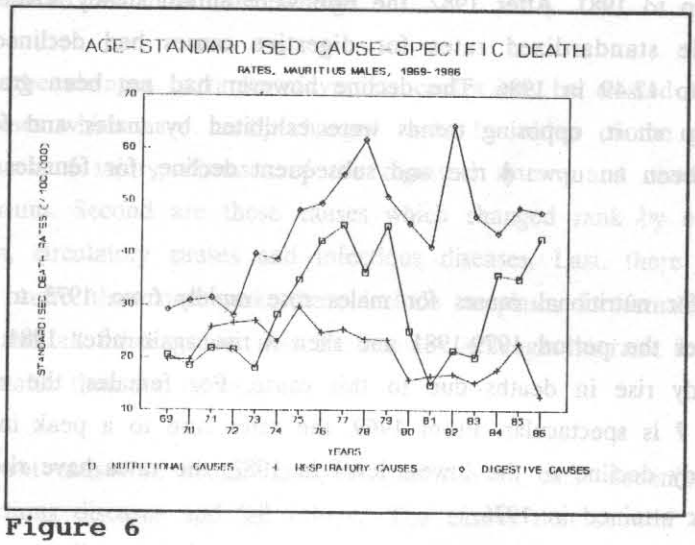

Figure 6

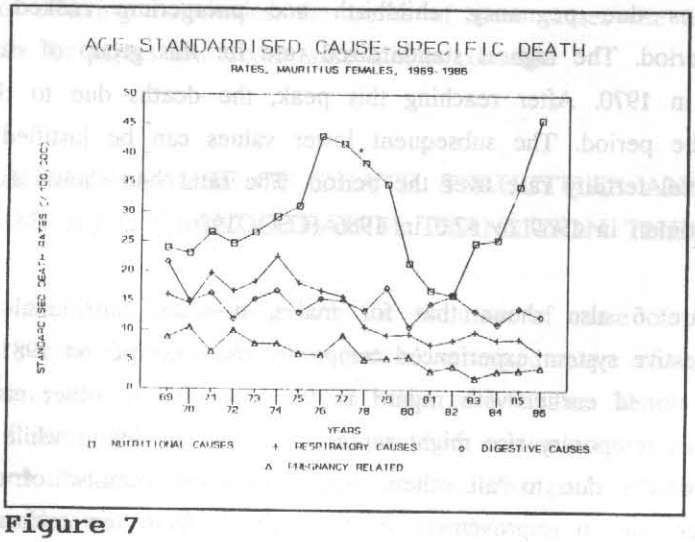

Figure 7

causes. From Figure 6, respiratory causes show almost constant trend except for a sharp decline in 1979-1980 and a sharp peak in 1985. There was a temporary decline between 1980 and 1983 and a slight rise in 1984 and 1985. Respiratory causes have only really declined for females. The decline in rates has been by more than 60% from 16.03 in 1969 to 6.27 per 100,000 in 1986. Between 1971 and 1976, there was a slight increase in rates with the peak attained in 1974. After 1976, the decline had been steadier with only minor fluctuations. For both genders, the causes ranked ninth in 1969 as well as in 1986. Clearly, this is not a leading cause of death in Mauritius.

For digestive causes, the male rates show a rapid rise from 1972 to 1978 followed by a rapid decline up to 1981. After 1982, the rate were almost steady. Over the period under study, the female standardized rates for digestive causes had declined from 21.56 per 100,000 in 1969 to 12.49 in 1986. The decline however had not been gradual but rather a fluctuating one. In short, opposing trends were exhibited by males and females. While for males there has been an upward rise and subsequent decline, for females there has been a general decline.

The trend for nutritional causes for males rose rapidly from 1973 to 1977, a rapid decline followed over the period 1979-1981 and then a rise again after 1981. After 1983, there has been a steady rise in deaths due to this cause. For females, the trend of nutritional causes in Figure 7 is spectacular. From 1969, the rates rose to a peak in 1976 followed by a rapid and steady decline to the lowest level in 1982, the rates have risen to even exceed the previous peak attained in 1976.

Complications due pegnancy, childbirth and puerperium radked last for females throughout the period. The highest standardized rate for this group of causes was 10.5 per 100,000 attained in 1970. After reaching this peak, the deaths due to these had declined unsteadily over the period. The subsequent lower values can be justified by observing the trend in the general fertility rate over the period. The rates had shown a 43% decline from 118.4 per 1000 women in 1969 to 67.0 in 1986 (CSO, 1986).

The Figure 6 also shows that for males, diseases, nutritional disorders and diseases of the digestive system experienced temporary rise over period 1981-1982. Going back to the point mentioned earlier with regard to the trend in 'all other causes,' it cannot be ruled out that such temporary rise might represent 'inflow' of deaths while the corresponding sudden drop in deaths due to 'all others' might represent 'outfolw' of deaths. This might have arisen either due to improvement in diagnosis or from the reclassification of deaths

due to the changeover from one international classification of diseases code to the next. It is noteworthy to point out that the ICD-9 cod was put into effect in 1981. For females, the cause that experienced sudden rise simultaneously with the drop in deaths due to all others were circulatory causes and diseases of the digestive system.

The trend of the age-standardized cause-specific death rates have shown that changes take place in both the magnitudes of the rates as well as in their rankings. Few of the causes like diseases of the circulatory system, nutritional disorders and digestive system showed rise meanwhile others such as infectious diseases, respiratory causes, and 'all others' showed decline. Yet others like neoplasms, external causes of injruy and poisoning and congenital malformation did not show much change.

In summary, the changes in ranks of various causes can be classed into three groups: First are those causes which have hardly changed ranks for either of the genders; these include external causes of injury, diseases of the digestive system and diseases due to pregnancy and puerperium. Second are those causes which changed rank by one; these include respiratory diseases, circulatory causes and infectious diseases. Last, there are those causes which changed by more than one rank; these include neoplasm for females, nutritional disorder for females and all other causes also for females. Changes in rank for more than one occur more for females than for males.

Of the different causes of death, the ones that showed clear declining trend for both genders were infectious diseases and 'all others.' The causes that showed clear rising trend for both genders were diseases of the circulatory system. For the rest of the causes, there were fluctuations of differing magnitudes, the trends of some causes rise to peaks and then decline sharply while for others the tredns were almost constant.

V. MAURITIAN CAUSE OF DEATH STRUCTURE AND THE EPIDEMIOLOGIC AND HEALTH TRANSITION THEOIES

The paper so far has been dealing with the evolution of cause of death structure in Mauritius over the period 1969 to 1986. This period witnessed major changes in the ranks, magnitude and leading causes of death for both males and females. These changes could be better understood if interpreted within the framework of epidemiologic and health transition theories. The aim of this section is to see how best the change in Mauritian mortality fits within the transition theories outlined above. By tentatively using the framework of Omran's

formulations, one can interpret changes in Mauritian mortality as follows: In the 1960's, there was no pandemic in Mauritius and the life expectancy at birth was more than 50 years. Hence, mortality in Mauritius in this period could be described as having already progressed far into the second stage of the epidemiologic transition theory. In the 1980's, with circulatory diseases as the leading causes of death and life expectancy at birth of more than 60 years, it had already entered the third stage. If this is true, when did the transition from the second to the third stage take place?

From the trends in the age-standardized cause-specific death rates described earlier, it could be seen that the change from infectious diseases being the leading causes of death to those of circulatory causes did not come all of a sudden. The trends of infectious diseases and circulatory causes shown in Figure 2 for males reveal one crossover between 1969 and 1970 and a near crossover in 1972. It is only after 1972 that circulatory disease clearly became the leading cause of death. Also, external causes of injuries (other man-made causes of death) started increasing for males in 1971. For females, Figure 3 reveals crossovers in 1971 and again between 1973 and 1974. It is only after 1974 that circulatory causes became the leading cause of death for females. Also, the rates for digestive causes started rising after 1972 and those for nutritional causes after 1973. Furthermore, the female rates for all causes combined were almost stationary between 1970 and 1974.

Based on these evidences, one can tentatively conclude that the transition from the second to the third stages could have taken place in the early 1970's. For females, this was likely to have occurred over the period 1970-1974 and for males, over the period 1969-1975. After 1975, Mauritian mortality was already in the early phase of the third stage.

By 1982-84, life expectancy in Mauritius was around seventy years rather than the late eighties as experienced in countries described as being in the fourth stage. Also, a study of age patterns in cause specific mortality does not show any unexpected shift in the age pattern of mortality for degenerative causes in the advanced ages. On the contrary, it was found that, over time, the proportion of deaths due to neoplasms was shifting toward the middle ages (Bah, 1987). While changes in lifestyle were partly responsible for the rise in degenerative causes in the 1970's, their recent trend shows decrease rather rapid increase. For these reasons, one can easily see that Mauritian mortality has not yet entered the fourth stage of the epidemiologic transition though rapidly progressing towards it.

The application the 'protracted and polarized' model of Frenk et al. to Mauritius poses some problems. The model was developed for describing changes in heterogenous popula-

tions such as those in Latin America. On the other hand, Mauritian population is largely homogenous with respect geographic differentials in health and in access to medical and welfare services. More specifically, overlap of epidemiologic eras as observed in Latin America does not occur in Mauritius. Over the period under study, infectious diseases show continuous decline in importance while circulatory diseases showed gain in importance. Similarly, the countertransitions reported in Latin America did not occur in Mauritius. The transition in Mauritius cannot also be described as being protracted. As described above, the era of predominance of infectious diseases is clearly defined as well as that of degenerative diseases. The period over which the transformation took place could be narrowed to within a span of about five years. Lastly, as Mauritius is a small island with no sharp distinctions between urban and rural areas, the epidemilolgic polarisation experienced in Latin America is absent in Mauritius.

As seen above, the subsequent modifications of Omran's theory cannot adequately describe Mauritian mortality experience. One is left with the original formulation which had been tentatively accepted earlier. The exceptions to the applicability of this formulation are: a)the rise in male mortality in the early 1970's and b)the decline in chronic diseases in the 1980's. To provid explanation for this developments, one looks at the health care transition in Mauritius.

In order to describe the health care transition in Mauritius, the first question one poses is 'What were the health conditions resulting from the epidemiologic transition?' This is followed by the next question, 'What were the organised social responses to these health conditions?' The first part has been answered in the preceding section; the transition brought about immediate disadvantages in mortality for both genders. While for females, the pace of mortality decline was reduced over the period 1970-1974, for males, mortality decline reversed and life expectancy at birth actually decreased between 1972 and 1976. The organized social responses to health changes were manifested on at least two levels; at the government level, in the form of health policy formulation and at the community level in the form of the adoption of medical pluralism.

To answer the question on the organized social response on the political level, one must first look back at the history of population and social concerns in Mauritius. Concerns for improvement of social conditions in Mauritius go back to a century. The first census in Mauritius was taken as far back as 1846. Between 1846 and 1983, fifteen censuses had been taken (UNFPA, 1982). The Mauritian government has put lots of emphasis on education and health. Medical services are free for all and since the mid 1970's, education was free

for all. The result is highly literate population which makes effective use of free medical services. The medical services are accessible to most of the population irrespective of religion, ethnicity or social status. the credit for this equality is partly due to adoption of the spirit of 'Mauritianism' (term used in Mauritius to mean one-nation one-people) with regards to welfare and health care system as opposed to 'communalism' (term used to mean discrimination found on racial and cultural differences). The adoption of this spirit of Mauritianism is rooted in the political system. As Mauritius is a multi-racial multi-ethnic plural society the political system adopted is a 'multiparty parliamentary democracy with guarantees in its electoral system, to ensure that no major group is unrepresented' (Chandrasekar, 1988).

Following independence in 1969, the Mauritian government implemented the first four-year development plan, 1971-1975. The health policy adopted focused on curative services. During that period, the Government set out to expand medical and health training facilities at various levels. Emphasis was also given to hospital-centered services. The slow-down in mortality decline over the period 1970-1976 caused the Government to change its health policy during the following five-year development plan, 1975-1980, to one focusing on preventive services. The Mauritian officials then viewed hospitals as inappropriate institutions to deal with the basic health problems of the country such as the rise in circulatory causes. The Government's health policy then aimed to strengthen health care provision at the level of first contact through a network of rural and urban health centers (UNFPA, 1982). This is a significant move that shows the sensitivity of the Governmnet to health matters and how they respond to unfavorable health changes.

The organized social response on the community level is reflected in the existence of medical pluralism. Sussman (1981) has described the different medical systems available in Mauritius. These incluse biomedicine, Chinese medicine, Ayurvedic medicine, herbal healing, faith healing, spiritualism and sorcery. In Mauritius, the health belief system subscribed to is a multicausal one wherein illness is believed to be caused by many factors so that no one therapeutic system is capable of dealing with all of the factors. This belief accommodates medical pluralism such that patients may easily switch medical systems without ideological conflicts (Sussman, 1981). As already discussed, the late 1970's witnessed rise in nutritional digestive and circulatory causes for both males and females. These are causes for which biomedicine does not have ready cures as it does for many infectious and parasitic diseases. Patients with such ailments increasingly consulted the other non-biomedical health care systems available.

VI. CONCLUSION

In conclusion, Mauritian mortality has undergone both an epidemiologic and a health care transition. Owing to the homogeneity in mortality and health differentials in Mauritius, the change in cause of death structure cannot be described by the protracted and polarised model. As the emergence of degenerative diseases is a recent phenomenon, the era of 'delayed degenerative diseases' which is a characteristic of the fourth stage, has not yet been reached. The mortality change in Mauritius over the study period can best be described as one that has rapidly evolved from the second to the third stage of the epidemiologic transition with some exceptions noted. It was the health care transition that helped reduce chronic diseases. The health care transition is rapidly propelling Mauritian mortality pattern towards the fourth stage of its epidemiologic transition. The health transition in Mauritius is still in progress, for example, the Governmnet still maintains a one-sided emphasis on biomedicine even though there are several other medical system. Medical pluralism is yet to be fully realized and officially pursued.

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APPENDIX A

CAUSES OF DEATH CATEGORIES USED IN THE ANALYSIS

CATEGORY	Abbreviation used	Terms in the ICD-8 A-List(1965)	Terms in the ICD-9 Basic Tabulation List(1975)
1.All Causes	ALLC	A1-A150	01-56
2.Infectious and Parasitic diseases	INF	A1-A44	01-96; 2% of Remainder of 34; 320, 323
3.Neoplasms	NEO	A45-A61	08-17
4.Endocrine and Nutritional Disorders	NU	A62-66	18-19
5.Diseases of the Circulatory System	CIR	A80, A88	25-30
6.Diseases of the Respiratory	RES	A89,A94-86	31-32
7.Diseases of the Digestive System	DIG	A97-104	33-34
8.Complications due to Pregnacny, Childbirth and Puerperium	PRG	A112-118	38-39;41
9.Congenital Malfromation and diseases of Infancy	CON	A126-135	44-45
10.External causes of injury and poisoning	INJ	AE138-AE150	E47-E56
11.Others and unknown	OTH	A68-A80;A106-A112;A120-A126; A137-A138	All the rest

Sources: W.H.O. (1967,1977); Hakulinen et al. (1986). Table 1.

模里西斯的流行病與健康轉型之探討

*Sulaiman M. Bah**

（中文摘要）

本文就模里西斯自 1969 至 1986 年間之十大死因趨勢做一回顧，並以年齡別標準化死因別死亡率作爲指標，探討該國各種死因的變化與趨勢，配以各種健康轉型理論的架構及流行病轉型理論來解釋其變遷的結果。

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