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ISSN No: 2319-5886

International Journal of Medical Research & Health Sciences, 2019, 8(3): 179-187

The Contributions of the Leading Causes of Death to the Life Expectancy Gap in Mauritius from 2005 to 2015

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ABSTRACT

The Mauritian population has the highest life expectancy in Africa. However, diabetes, ischemic heart disease, stroke, influenza and pneumonia, and lung, breast and colon-rectum cancers are countering the health success of the country. Males, unlike females, are burdened by these diseases. The study assessed the contribution age and cause-specific mortality to the gap in life expectancy among males and females in Mauritius from 2005 to 2015. The role of the age and cause-specific mortality to life expectancy among males and females in Mauritius was decomposed using the Andreev decomposition approach. The study revealed that recorded mortality rates from diabetes, ischemic heart disease, stroke, influenza, and pneumonia were higher among males than females. Health promotion activities will need to be scaled for these causes of death especially among males to achieve national and international health goals.

Keywords: Mortality, Diseases, Life expectancy, Males, Females, Mauritius

INTRODUCTION

In all countries, life expectancy at birth for women is higher than men mainly because the risk of mortality is higher among males than among females [1]. This pattern of gender variation in life expectancy prevails in Mauritius even though it is the country with the highest life expectancy in Africa [2-5]. The gains in life expectancy in Mauritius have a long history of reduction in mortality from certain infectious and parasitic diseases. Again, the rapid reduction in deaths from these diseases especially in the infant years contributes to the success. However, the reductions within years and specific age groups further widened the gender gap in life expectancy in the country [4,6]. In 1968, life expectancy in Mauritius was 59 years [4]. However, by 2005, life expectancy in Mauritius increased to 76.7 years for females and 69.5 years for males [5]. In 2011, the life expectancy in Mauritius was estimated to be 75 years [2,7]. These changes correspond to the global increase in the gap between female and male life expectancy and average life expectancy for both sexes [8]. Consequently, there has been a reduction in the life expectancy gap between Mauritius and countries with the highest life expectancy in the world. It is expected that the average life expectancy of Mauritius will increase at the country's annual growth rate of about 0.35% [9].

Although Mauritius has the highest life expectancy in Africa, the country faces challenges from diseases. Common among these diseases are diabetes, ischemic heart disease (IHD), stroke, influenza and pneumonia, and lung, breast and colon-rectum cancers [4,7,10-13]. Diabetes is the leading cause of death in Mauritius. The susceptibility of developing and dying from diabetes is intense among Mauritians depending on the decent and age of such population group. About 70% of the population of Mauritius has Indian descent. Such Mauritians are the most vulnerable group with respect to deaths caused by diabetes and IHD [4,9]. Again, almost 20% of the Mauritians are diabetic. The intensity of the conditions is even heightened at specific ages. In that after the age of 30 years, 20% of the Mauritians were living with pre-diabetic conditions. The prevalence of diabetes and pre-diabetic conditions increased by more than 60% in 2009 [14-16]. Diabetes has been found to be associated with IHD among the Europid population of Mauritius. Consequently, mortality from IHD among these groups of Mauritians is likely when such Mauritians become diabetic. In fact, it is estimated to increase the risk of dying from IHD by approximately two to three-fold [4,11,17-19]. Between 1992 and 2008, cancer cases and its related mortality increased by 41% among males and 40% among females. Mauvais-Jarvis pointed out that the prevalence of diabetes differs by sex [20]. In that after

menopausal ages, women were prone to diabetic conditions than males. At the ages of 56 years and above, deaths from stroke increases in the Mauritian population [10]. In 2014, Mauritius incurred the highest cumulative risk of breast cancer among women in Africa. Similarly, case mortality from lung cancer is high in the Mauritian population. Like other African countries, over 70% of the cases of lung cancer and its related mortality were recorded among males [13]. Magliano, et al., identified 58% of the causes of death of the Mauritians they employed in their study as cardiovascular disease (CVD) [11]. About 65% of the CVD was qualified as IHD. The risk of death from IHD at ages 31 to 69 years is higher among males than females [17]. In Mauritius, the incidence of influenza and pneumonia is high. However, treatment is categorical and not universal as pregnant women, health care workers, the elderly, young children and persons with certain medical conditions are the targets. Hence, it augments the vulnerability of mortality among Mauritians who are not part of the target population [4,21].

General factors which are behavioral, biological, economic changes and structural issues coincide with these diseases [2,4,7,22-25]. Specifically, smoking, which is prevalent in the adult years of Mauritians, was in 2008, estimated to be practiced by 40.3% of men and 3.7% of women [26]. Besides, the growth of the preference for sedentary lives instead of physical activity prone lifestyle arouses the obesity epidemic trigger diabetes and other causes of death [4,27-29]. Onen pointed out that obesity and overweight, defining conditions for diabetes are common among females than among males in Mauritius. Poor dietary habits of Mauritians allow for the onset of excess weight gain and therefore obesity [30]. Thus, the economic prowess of the country accompanied by cheap access to food and surfeit protein filled diets is paving way for many Mauritians to be obese [19]. The lack of health personnel and inadequate health services and facilities in the country is a challenge to the health and life expectancy in the country. The deficiency promotes the vulnerability of deaths of Mauritians these death defining diseases [30]. The diverse backgrounds of Mauritians are a determinant of the onset of diseases and mortality in the country. Offspring of families with a vulnerability to certain diseases (causes of mortality) such as diabetes inherit the cause of death [4,19,22,25].

The study aimed at assessing the contribution of the leading causes of mortality among males and females, particularly diabetes, IHD, stroke, influenza and pneumonia, and lung, breast and colon-rectum cancers in order to explain the observed life expectancy gap in Mauritius from 2005 to 2015. The study examined the contribution of all other causes of mortality in the gap and quantified the changes in the age and cause-specific pattern of mortality in the country.

MATERIALS AND METHODS

Data

The United Nations Population Division, World Bank Gender Statistics Database, and the World Health Organisation (WHO) Mortality Database were the data sources for the study. Sex and age categories, causes of mortality and population size were the constituents of the WHO Mortality Database for Mauritius. However, the population size for each sex and age category for the year 2009 was extracted from the World Bank Gender Statistics Database and the United Nations Population Division Database. It served as a replacement for the missing population size values for Mauritius in 2009. The primary variables of the study were mortality from neoplasms (C00-D49), endocrine, nutritional and metabolic diseases (E00-E88), diseases of the circulatory system (I00-I99), diseases of the respiratory system (J00-J98), and other causes from 2005 to 2015. These classes of diseases were defined by the International Statistical Classification of Diseases and Related Health Problems 10th revision (ICD 10) (Bots, Peters, and Woodward, 2017; Canudas-Romo, et al., 2015; Martins and Buchalla, 2015). Hence, breast, lung and colon-rectum cancers (C18, C20, C34, C50, D05, D12, D24) were selected from neoplasms. IHD and stroke (I24-I25, I64) were subsection categories of circulatory diseases selected for the study. Diabetes (E10-E14) was selected from endocrine diseases. Influenza and pneumonia (J09-J18) were selected from respiratory diseases.

Statistical Analysis

The study quantified the age and cause-specific mortality among males and female Mauritians. A description of the pattern of the age-and cause-specific mortality among the population was deduced. Further, a method of decomposition was applied to the data to assess the possible role of all the causes of mortality understudy to the observed variance in the life expectancy among males and females in Mauritius, 2005-2015. Ages were aggregated into 5 years for males and females and the respective causes of mortality. However, the 5-year interval begun at age 5 and ended with age 84 years. Age “0”, “1-4” and 85 and above years had different intervals. Age 85 years and above was introduced to provide a meaningful statistic. The age cause-specific death proportion,

$$\frac{{}_nD_x}{{}_nP_x} \tag{1}$$

and age cause-specific death rate was estimated for males and females.

$$\frac{{}_nD_x}{{}_nP_x}\times 100000 \tag{2}$$

${}_nD_x$ represents the number of deaths from a particular cause of death among males or females within a certain age group. ${}_nP_x$ is the total population of Mauritians in an age group and sex category exposed to the causes of death. The study applied the indirect standardization method to the estimated age-specific mortality rate for the causes of death understudy. In effect, the study used the WHO standard population for the standardization. It assisted with the elimination of the influence of age composition on the causes of mortality among males and females [31-34]. Thus, the standardized mortality rate for males and females was estimated using:

$$\sum_{i=1}^{\infty} M_i^j.C_i^s \tag{3}$$

where M_i^j is the age and cause-specific mortality rate for males and females from the first to the last age interval, respectively and C_i^s is the WHO standard population in a particular age interval.

Standard life tables were constructed using life table construction techniques. The age and cause-specific mortality proportions estimated for each year and the individual sex were summed to produce the age-specific probability of dying ${}_nq_x$

$$\frac{n*{}_nM_x}{1+(\mathrm{n}-{}_\mathrm{n}\mathrm{a}_\mathrm{x})*{}_nM_x} \tag{4}$$

Age 85 years and above, was apportioned 1 as the probability of dying. At that particular age, the likelihood of dying is highest than any other age group [35]. The mean number of person-years lived in the interval by those dying in the age interval ${}_\mathrm{n}\mathrm{a}_\mathrm{x}$, was estimated.

$$\frac{({}_\mathrm{n}\mathrm{L}_\mathrm{x})-\mathrm{n}*(l_x)}{l_x-l_{x+n}} \tag{5}$$

Similar averages were allotted to all age intervals but not the "0", "1-4" and "85+" age groups. Again, males and females at ages 0 and 1-4 were apportioned different scales (Preston, et al.,). The probability of surviving l_x , persons left alive in the age interval l_x, number of deaths within the age interval ${}_nD_x$, person-years lived in the age group ${}_nT$, number of people alive above a certain age ${}_nT$ and the life expectancy at a particular age interval e_x were computed [35,36]. Total 11 life tables were constructed for males and females.

The age and cause-specific of mortality contribution to the gender gap in life expectancy were decomposed using standard techniques [28,37-40]. The constructed life tables were used for the decomposition of the cause-specific mortality contributions to life expectancy. Correctly, the Andreev method of decomposition in 1982 was used (cited by Andreev, et al., [37]; Bergeron-Boucher, et al., [39]; Romo, et al., [38]). Hence, the decomposition formula for the study became:

$$\delta_x^{F-M}=\left(l_x^F\right)\left(e_x^{0(F)}-\left(e_x^{0(M)}\right)-\left(l_x^F\right)\left(e_{x+n}^{0(F)}\right)-e_{x+n}^{0(M)}\right) \tag{6}$$

where e_x^0 are persons left alive in an age interval for females, e_x^0 is the life expectancy for the elementary age interval (x,x+ within a specific year n) and M presents males. This method of decomposition interprets the contribution of cause-specific mortality to the gender differences in life expectancy at various age interval [37,38]. The study employed R Studio version 1.1.456 for the analyses.

Limitations of the Study

The study relied on population figures from sources other than WHO mortality database, thus there might exist over or underestimations of some mortality analyses. The study focused on the leading causes of mortality, and therefore, the influence of other causes of death on life expectancy in the country is overlooked. Hence, studies regarding the role of the other causes of mortality on life expectancy in Mauritius is needed.

RESULTS

The pattern of Standardized Death Rates

Figure 1 shows the standardized death rates for diabetes, IHD and stroke, influenza and pneumonia, selected cancers and all other causes of mortality among males and females in Mauritius, 2005 to 2015. Mauritian males experienced more deaths than females. The males recorded more deaths from diabetes, IHD and stroke, influenza and pneumonia and other causes as compared to females who recorded more deaths from selected cancers. Among males and females, mortality from diabetes and influenza and pneumonia was the highest and lowest, respectively. Mortality from diabetes was highest in 2012 and the lowest 2015 among males and highest in 2006 and the lowest in 2015 among females. IHD and stroke declined from 2005 to 2015, but females recorded a smooth decay as compared to males. Selected cancers have been relatively stable although, from 2011to 2015, females but not males experienced a rise in these cancers. In 2007 and 2008, mortality from influenza and pneumonia declined among males than females.

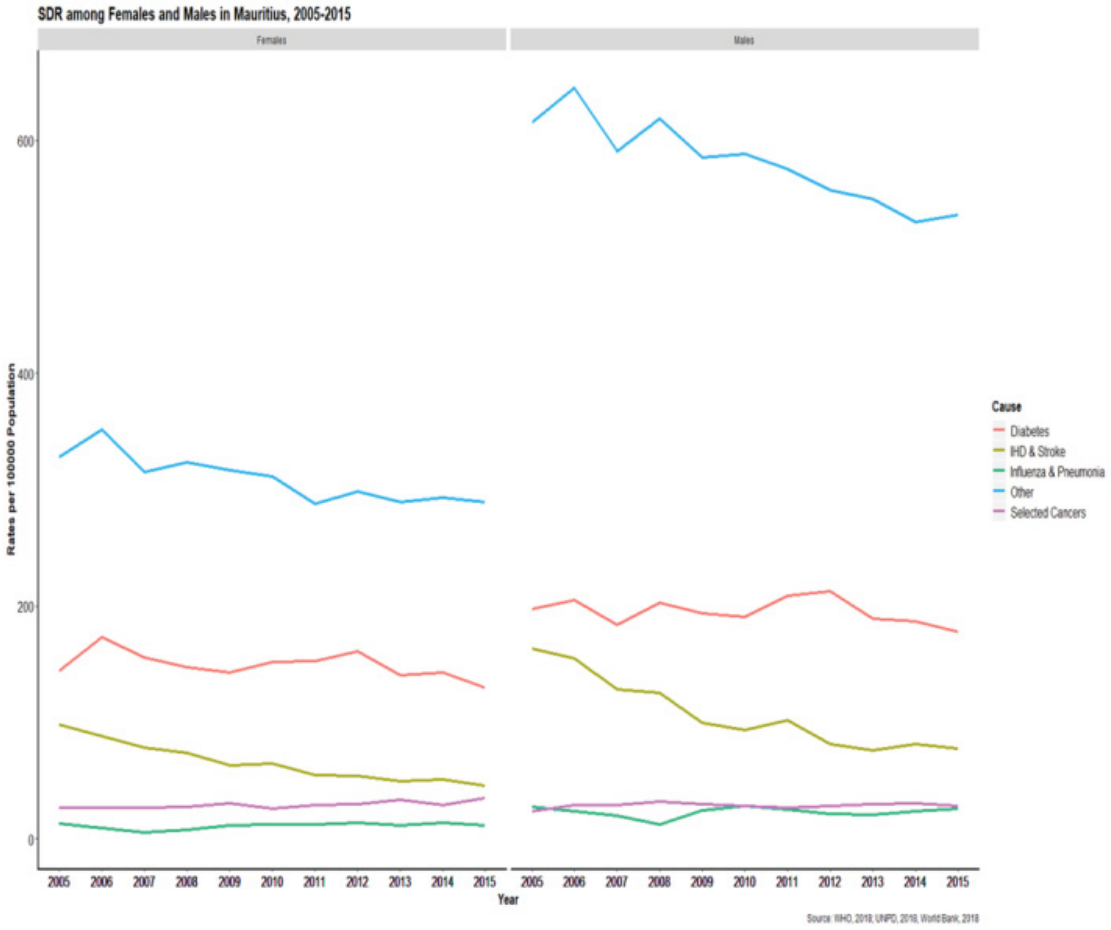

Figure 1 Standardized death rates (SDR) for diabetes, IHD and stroke, influenza and pneumonia, selected cancers and other causes of death among males and females in Mauritius, 2005-2015

Age Pattern Analysis of Standardised Death Rates

Figure 2 shows the age group contribution to the age-standardized death rates for diabetes, IHD and stroke, influenza

and pneumonia, and selected cancers and other causes of mortality in males and females in Mauritius from 2005 to 2015. Generally, males and females at age groups 30 years and more recorded more deaths from all these main causes of death in Mauritius. However, females experienced deaths from diabetes in younger age groups than females. Females experienced deaths from the selected cancers at a younger age than males. Besides, these mortality rates were fairly stable among females. Among males, mortality from these selected cancers was highest in the age group 70-79 years. Mortality from all other causes of death was higher among males than females in all age group.

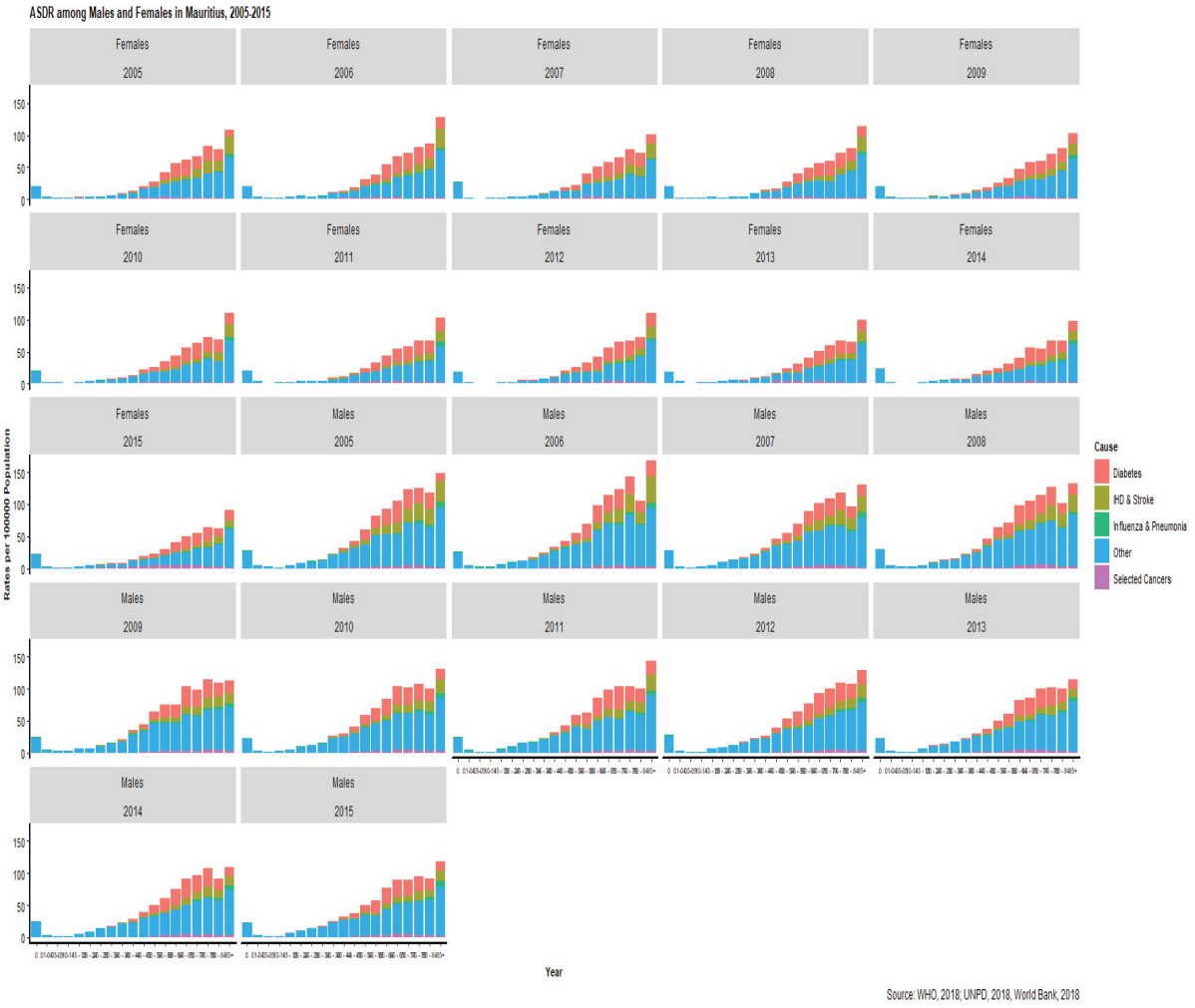

Figure 2 Age-standardized death rates for the main causes of death among males and females in Mauritius, 2005-2015

Decomposition of Contribution of Cause-Specific Mortality Analysis

Figure 3 shows the contribution of age and cause-specific mortality to changes in life expectancy in the Mauritian population from 2005-2015. The gap between the contributions to life expectancy for males and females varied from 7.59 years in 2011 to 6.51 years in 2014. Females experienced more gains in life expectancy than males, especially at ages 15 and beyond. Females recorded lower gains in life expectancy from selected cancers while males experienced lower gains in life expectancy from diabetes, IHD, and stroke, influenza, and pneumonia. In contrast, the peak of the females' lower gains in life expectancy was at the end of the reproductive years (44-54 years). However, in the first decade of the pension years (65-74 years), females observed the highest gains in life expectancy.

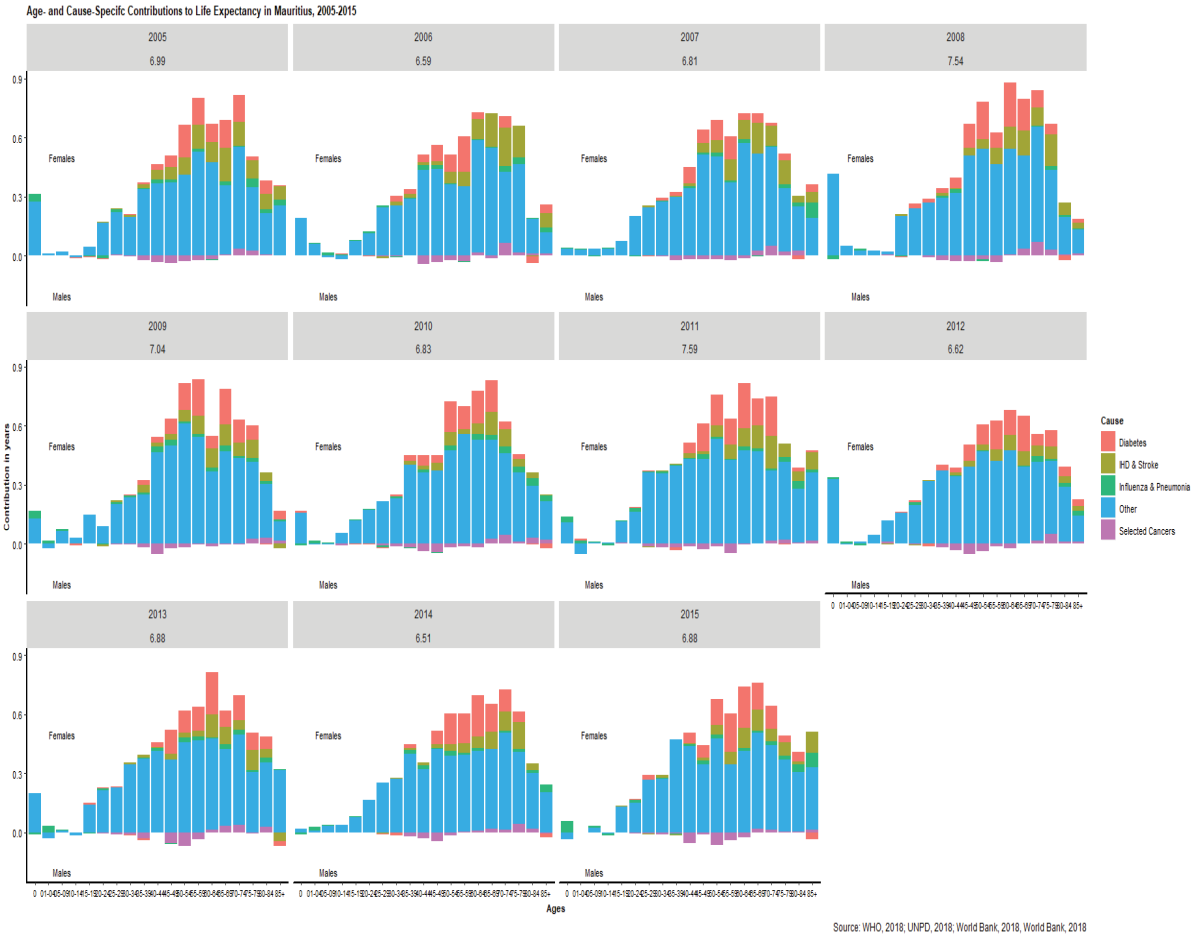

Figure 3 Decomposition of the contribution of the main causes of death to life expectancy for males and females in Mauritius, 2005-2015

DISCUSSION

The study quantified and decomposed the contributions of age and cause-specific mortality from the leading causes of death to life expectancy in Mauritius, 2005 to 2015. The study measured the trends of diabetes, IHD and stroke, influenza and pneumonia, selected cancers and all other causes of mortality among females and males in Mauritius. The contributions of these primary causes of death to life expectancy in Mauritius were dissected from 2005 to 2015. Hence, the study adds to the evidence needed to identify the population and age category of Mauritians who are spending their periods of life under risk of death from diabetes, IHD and stroke, influenza and pneumonia, selected cancers and all other causes of mortality.

The study revealed that diabetes was the leading cause of death in Mauritius. Moreover, the recorded death rates from diabetes were tangible after the young ages. This finding affirms Devi, the postulation that diabetes is endemic at ages 30 years and above in Mauritius [4]. Furthermore, males as compared to females experienced more deaths from diabetes. This finding confirms Mauvais-Jarvis, diabetes and its related mortality varied per gender [20]. The mortality from diabetes among females was higher even before the menopausal ages. This finding opposes Mauvais-Jarvis, assertion that women are susceptible to diabetes and mortality in the menopausal ages than men in the same group [20]. Again, there were more deaths from diabetes among males than females, a finding that counters Onen postulation that as much as defining conditions of diabetes are predominant among females than males, mortality from diabetes will be likely among females than among males [30]. Females experienced more deaths from selected cancers than males. It corroborates the postulation that cancer especially breast mortality is higher among females than males. Given that 40.3% of men as compared to 3.7% of women in Mauritius smoke, the findings of the study

revealed that mortality from IHD and stroke were higher among males than females as pointed out in Azagba, et al., research [26].

The differences in gains in life expectancy for Mauritians was higher among females than males although life expectancy for both sexes has increased [2,4,5,8,9]. The most significant increase and the decrease in female life expectancy were recorded at age 60-69 years and 44-54 years, respectively. The former was due to the reduction in mortality from diabetes, IHD, and stroke, influenza, and pneumonia whereas the latter was due to the increase in mortality from selected cancers. Thus, poor dietary behavior and less physical activities among females increased the risk of mortality and influenced the life expectancy of females [4,13,27-29,41].

The highest increase and decrease in life expectancy among males these causes of death were within the age group 44-54 years and 60-69 years. The former was due to the reduction in the mortality from cancers while the latter was due to the increase in mortality from diabetes, IHD, and stroke, influenza, and pneumonia. It relates to the finding that the risk of death from IHD at ages 31 to 69 years is higher among males than females [17]. In another way, the study affirms Kalkonde, et al., finding that at 56 years and more susceptibility to stroke and its related mortality is higher [10,42]. Also, confirms the fact that the categorical nature of the treatment of influenza and pneumonia increased the risk of death from these diseases among males who are at and above pension years [4,21]. Besides, the decrease in life expectancy among males explains zenith smoking among males than among females [26,43].

CONCLUSION

Mortality from diabetes, IHD and stroke, influenza and pneumonia, selected cancers and other causes among males and females in Mauritius have declined in Mauritius. However, the reductions in mortality experiences of females were higher than males. Almost all these causes of death increased the life expectancy of females than males. One aspect is the variance in the life expectancy which was intense after age 30 years and above. In the pension years, diabetes, IHD, and stroke, influenza, and pneumonia decreased mortality among females. If diabetes, IHD, and stroke, influenza, and pneumonia remain the leading causes of death in Mauritius, males at age 30 years and above, in particular, would live with the risk of mortality diabetes, IHD, and stroke, influenza, and pneumonia. Females in the same age group would live with vulnerability to morbidity and mortality from selected cancers. Thus, policies and health promotion activities will need to be scaled for these causes of death, particularly among males, to achieve national and international health goals as according to the indicators of the sustainable development goals.

DECLARATIONS

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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