

Assessing health system challenges and opportunities for better noncommunicable disease outcomes: the case of Mauritius

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Abstract

Background This study provides an overview of NCD mortality, morbidity and risk factors; rates coverage of core population NCD interventions and individual NCD services in Mauritius; assesses health systems challenges and opportunities for better NCD outcomes; and recommends priority action areas to accelerate gains in NCD outcomes in Mauritius.

Methods The Mauritius country assessment applied the guidelines developed by the World Health Organization Regional Office for Europe for systematically assessing health system challenges and opportunities for improving NCD outcomes. The assessment used mixed approaches to provide a fuller picture of the health system.

Results In 2016, Mauritius sustained a total of 10 022 deaths from all causes. About 8,893 (88.7%) were from NCDs. Of the deaths due to NCDs, 6,935 (78%) were caused by cardiovascular diseases (CVD), diabetes and malignant neoplasms (cancers). Majority of NCDs are attributed to alcohol abuse, tobacco use, physical inactivity, and unhealthy diet. Of the 24-core population-based interventions for addressing these risk factors, 16.7% were rated extensive, 37.5% moderate and 45.8% limited. Three (20%), 8 (53%) and 4 (27%) of the 15 individual/personal CVD, diabetes and cancer services were rated extensive, moderate and limited respectively. Some of the challenges hindering NCD intervention scale-up include: lack of a government-led coordination mechanism; limited community empowerment for behavioural change; inefficient primary health care; insufficiently integrated health management information system; lack of explicit processes for prioritizing public health expenditures; and weak health workforce management.

Conclusion There is urgent need to establish a high-level multisectoral/multistakeholder committee to oversee implementation of multisectoral activities for strengthening national health systems and other systems that address NCD risk factors and social determinants of health.

Background

Mauritius is an island state in the Indian Ocean located within the continent of Africa; and had an estimated population of 1 274 000 in 2018 [1]. It is an upper-middle-income economy and in 2018 had a gross domestic product (GDP) of US\$ 13 297 billion and per capita GDP of US\$ 10 437 [1].

Noncommunicable diseases (NCDs) were the leading cause of premature mortality and disability in Mauritius. In 2016, the country lost 413 536 disability-adjusted life-years (DALY), of which 340 551 (82%) were from NCD; 43 977 (11%) from communicable, maternal, perinatal and nutritional conditions; and 29 008 (7%) from intentional and unintentional injuries [2]. As shown in Figure 1, five categories of diseases (malignant neoplasms, diabetes mellitus, mental and substance use disorders, cardiovascular diseases and respiratory diseases) accounted for 70.7% of NCD-related DALY loss in 2016.

The Mauritius health system infrastructure consists of 124 public health-care facilities. Of these, 88.7% are health posts, 1.61% health centres, 1.61% district hospitals, 4.03% provincial hospitals and 4.03% regional hospitals. The health post density is 8.840 per 100 000 population; 0.161 health centres per 100 000 population; 0.161 district hospitals per 100 000 population; 0.402 provincial hospitals per 100 000 population; and 0.402 regional hospitals per 100 000 population [3]. Table 1 shows the priority medical device density per million population [4]. The Mauritius radiotherapy unit's density of 2.411 per million population is higher than the average of 1.2 per 1000 000 population for upper-middle-income countries but lower than the WHO European Region average of 3.9 per 1000 000 population.

[Insert Table 1 here]

As shown in Table 2, the Mauritius health system is run by 2,550 physicians, 4,261 nursing and midwifery personnel, 380 dentistry personnel, 497 pharmaceutical personnel, 324 laboratory health workers, 238 environment and public health workers, 236 community and traditional health workers, 145 other health workers, and 2,027 health management and support workers [5]. The Mauritius densities of health workers are lower than global averages for upper-middle-income countries [6].

[Insert Table 2 here]

In 2016, per capita total current health expenditure on health (CHE) in Mauritius was US\$ 553 (Int\$) [7]. About US\$ 244 per capita came from domestic general government health expenditure; US\$ 308 per capita from domestic private health expenditure; and US\$ 1 per capita from external health expenditure. Mauritius CHE was within the range of US\$ 297 (minimum) and US\$ 984 (maximum) per person per year health systems investment recommended for achieving health sustainable development goal (SDG) 3 [8]. However, it is of concern that out-of-pocket spending (OOPS) of US\$ 266 per capita, which was equivalent to 86% of private health expenditure and 48% of the total CHE. According to the WHO World Health Report 2010 [9], when direct payments (OOPS) are above 15–20% of CHE, incidence of financial catastrophe and impoverishment increases substantially. Therefore, the OOPS in Mauritius is far much higher than the WHO threshold.

Treatment of NCDs exerts a significant burden on Mauritius health system and economy. According to Mauritius National Health Accounts 2017, of the Rs 25.3 billion spent on health care in 2016, Rs 16.50 billion (65.2%) was spent on treatment of NCDs. Of the total spending on NCDs, Rs 3.6 billion (21.8%) was on cardiovascular diseases, Rs 2 billion (12.1%) on respiratory diseases, Rs 1.7 billion (10.3%) on diseases of the genitourinary system, Rs 1.2 billion (7.3%) on diabetes, Rs 1.2 billion (7.3%) on mental and behavioural disorders (and neurological conditions) [10]. In addition to health system cost of managing NCDs, productivity losses associated with NCDs are significant. Stuckler, Basu and McKee [11] estimated that for every 10% increase in NCD mortality, economic growth is reduced by 0.5%. Kirigia *et al.* [12] estimated that NCD deaths that occurred in Mauritius in 2012 would be expected to have reduced future non-health GDP by Int\$ 1 143 857 025.

The NCD-associated health and economic losses could be attributed to lack of comprehensive multi-sectoral action and suboptimal health services coverage to reduce the NCD. For instance, the UHC service coverage index—which encompasses general and the most disadvantaged population access to reproductive, maternal, new-born and child health, infectious diseases, NCD services—was 64% [6]. This implies a service coverage gap of 34%. Prior to the assessment reported in this paper, no study had attempted to comprehensively evaluate health system challenges and opportunities for increasing effective coverage of NCD interventions in Mauritius.

The objectives of the study reported in this paper were to provide an overview of NCD mortality, morbidity and risk factors; rate coverage of core population NCD interventions and individual NCD services in Mauritius; assess health system opportunities for better NCD outcomes in Mauritius; and assess health system challenges and recommend priority action areas to accelerate gains in NCD outcomes.

Methods

The current study used guidelines developed by the World Health Organization Regional Office for Europe (EURO) to systematically assess health system challenges and opportunities for improving NCD outcomes [13]. Following the guidelines, the Mauritius country assessment was done in five steps. First, appraisal of health system performance in relation to NCD outcomes and probability of attaining global target of a 25% reduction in premature mortality from NCD (cardiovascular diseases, cancer, diabetes and chronic respiratory diseases) by 2025 [14,15].

Second, development of score evaluating coverage of core population and individual interventions and link to health behaviour and outcomes. Third, analysis of the presence and extent of 15 common health system challenges (and opportunities) that impede (or facilitate) the delivery of core NCD services. The 15 health system features are contained in Table 3 below. Detailed explanation of each feature is contained in the WHO/EURO assessment guide [13].

[Insert Table 3 here]

Fourth, documentation of impact of health system good practices and innovations on NCD-related core services and outcome. Fifth, making of contextualized and implementable recommendations to Mauritius for addressing the health system barriers to prevention and control of NCD.

Data collection methods and sources

The assessment methodology uses a flexible participatory approach. All key stakeholders (Ministry of Health and Quality of Life, WHO, other government ministries, academic and research institutions, private health institutions, nongovernmental organizations, professional associations and councils, and representatives of the civil society and religious/sociocultural organizations) were involved at multiple

points in the process including planning, conducting the assessment, and disseminating and validating the findings and recommendations.

The assessment combined both quantitative and qualitative (mixed) approaches to provide a fuller picture of the health system. Data collection was primarily based on desk review of printed and electronically stored information. The key documents consulted included policy papers [16,17], legislation [18,19], strategic frameworks/plan [20,21], action plans [22], health statistics [23,24,25], annual reports [26–32], monitoring and evaluation reports [33,34,35], research studies and survey reports [36], national health accounts (NHA) reports [10,37], peer-reviewed articles, World Bank website [38], WHO NCD-related publications [39,40,41,42], WHO website [43] and Global Health Observatory [44].

Desk review was complemented with key informant interviews, focus group discussions and observations. The WHO publication entitled “Better non-communicable disease outcomes: challenges and opportunities for health systems—Assessment Guide” [13] was used as the interview guide. No primary quantitative data was collected for the assessment. Among the key informants were the Ministry of Health and Quality of Life (MOHQL) senior officials, government officials from other ministries, heads of units/sections, service providers, representatives from the private sector, nongovernmental organizations, health training institutions and professional organizations.

Wherever possible, data triangulation was used to check and establish regularities in the data through cross-verification from two or more sources.

The 15 health system features were assigned to five working groups (WGs) of five to six members indicated below:

- WG1—political commitment to NCDs, explicit priority-setting approaches and interagency cooperation;
- WG2—effective model of service delivery, coordination across providers, effective management;
- WG3—regionalization, integration of evidence into practice, access to quality medicines;
- WG4—distribution and mix of human resources, adequate information solutions, incentive systems, managing change; and
- WG5—population empowerment and ensuring access and financial protection.

The WGs were guided by the respective set of questions and matrices in the WHO/EURO assessment guide when reviewing and evaluating available information related to NCD outcomes, interventions and services for assigned features to determine how they affect the performance of health systems in delivering primary prevention, secondary prevention and disease management, and treatment of acute events. Each WG led by an expert group chair and under the guidance of the assessment team members had at least eight working sessions (characterized by debate, dialogue and deliberation), each lasting two to three hours. Each WG prepared a short report on each feature assessed summarizing their main findings, highlighting the key challenges, and making some initial recommendations. WG chairpersons

presented their reports at a one-day stakeholder workshop held on 16 November 2017, and subsequently revised their reports incorporating suggestions and filling any information gaps. The WGs made final presentations of their findings and recommendations to a high-level panel of the MOHQL which was chaired by the Acting Director-General of Health Services.

After the high-level panel, WG findings were integrated and synthesized across 15 features by a WHO national consultant, and then reviewed by the assessment team. The latter also reviewed WG core interventions and individual services coverage evaluations; health system features coverage; analysed the linkages between coverage evaluation and health system features assessment; identified good practices and innovations worth emulating; prioritized health system features that most significantly undermine coverage of core NCD interventions; prepared an initial draft of strategies and recommendations; and prepared the draft assessment report under coordination of the Mauritius WHO Country Office and the MOHQL.

A stakeholder validation workshop was held in November 2018 to validate and finalize the report, enhance dialogue around health system strengthening and NCD for policy development and implementation, and provide orientation for initiating a “Stakeholders’ Dialogue Forum” for the prevention and control of NCDs in Mauritius.

Results

NCD mortality

In 2016 Mauritius sustained a total of 10 022 deaths from all causes [2]. About 8,893 (88.7%) were from NCDs; 647 (6.5%) from communicable, maternal, perinatal and nutritional conditions; and 481 (4.8%) from injuries [2]. Figure 2 shows number of deaths caused by various NCDs in 2016. About 37.5% of NCD deaths resulted from cardiovascular diseases; 26.7% from diabetes mellitus; 13.8% from malignant neoplasms (cancers); 10% from respiratory diseases; 4.1% from digestive diseases; 2.4% from genitourinary diseases; 1.8% from neurological conditions; 0.9% from endocrine, blood, immune disorders; 0.7% from mental and substance use disorders; 0.7% from congenital anomalies; 0.7% from other neoplasms; 0.6% from skin disease; 0.2% from musculoskeletal diseases; 0.03% from oral conditions; and 0.01% from sudden infant death syndrome. Thus, cardiovascular diseases, diabetes mellitus, malignant neoplasms (cancers) and respiratory diseases accounted for 88% of NCD-related deaths.

Figure 3 depicts trend of age-standardized death rate per 100 000 by cause in Mauritius. Between 2005 and 2016 mortality rates due to cardiovascular diseases, diabetes, malignant neoplasms and respiratory diseases increased by 9.58%, 31.54%, 40.54% and 16.13% respectively. The probability of dying between ages 30 and 70 years from any of the 4 main NCDs (cardiovascular diseases, cancer, diabetes, chronic respiratory diseases) was 22.5% in Mauritius in 2015 compared to around 10% in developed countries like Australia, France, Singapore and UK [54].

NCD morbidity and risk factors

In 2015, the standardized prevalence of type 2 diabetes in Mauritian population aged 20–74 years was 20.5% with a slightly higher proportion among women (21.3%) compared to men (19.6%). New cases of cancer increased from 1,800 (729 males and 1,071 females) in 2011 to 2,607 (1,058 males and 1,549 females) in 2016, representing an increase of 44.8% in 5 years. The prevalence of asthma in adults was 8.9%, that is 8.0% in men and 9.7% in women. Albuminuria, an index of kidney disease, was detected in 6.8% (7.1% of men and 6.6% of women) of the 2015 population survey compared to 12.4% in 2009 [55,56].

Risk factors

According to WHO [42] majority of NCDs emanate from four specific behaviours (harmful use of alcohol, tobacco use, physical inactivity, and unhealthy diet) that lead to four key metabolic/physiological changes (raised cholesterol, raised blood pressure, overweight/obesity and raised blood glucose). Figure 4 shows the trends of raised blood pressure (SBP \geq 140 OR DBP \geq 90), raised fasting blood glucose (\geq 7.0 mmol/L or on medication), overweight (BMI = \geq 25) among adults aged 18 years and above, and overweight (BMI = \geq 25) among children and adolescents aged five to nine years.

Metabolic/physiological factors

Hypertension: The percentage of people aged 18 years and above with raised blood pressure decreased slightly from 26.4% in 2000 to 25% in 2015 [57].

Lipids: In 2015, the overall prevalence of elevated serum total cholesterol (\geq 5.2 mmol/L) was 44.1 % (47.1% for men and 41.8% for women), compared to 34.7% in 2009 [55].

Fasting blood glucose: The population of adults aged 18 years and above with raised fasting blood glucose increased from 11.4% in 2000 to 13% in 2014 [58–61].

Overweight: The World Health Organization defines overweight in adults as a body mass index (BMI) greater than or equal to 25, and obesity as a BMI greater than or equal to 30. In 2016, 32.3% (24.3% male and 39.8 % female) aged 18 years and above were overweight compared to 26% (19.9% male and 31.5% female) in 2000 [59]. A study conducted among 841 school children aged 9–10 years found 17.4% were overweight, 5.0% obese, and 12.7% thin [60]. The prevalence of overweight (BMI $>$ +1 standard deviations above the median) among children and adolescents increased from 8.1% in 2000 to 14.6% in 2016, accounting for an 80.2% increase [61].

Behavioural risk factors

Harmful use of alcohol: In 2016 total pure alcohol consumption per person aged 15 years and older was equal to 3.6 litres (male 6.3 litres and female 1 litre) compared to 3.8 litres (male 6.6 litres and female 1.1 litre) in 2010. About 54% of persons aged 15 years and older consume beer, 31% spirits and 15% wine. Drinkers only consumed an average of 11.5 litres of pure alcohol in 2016 [62].

Tobacco use: Figure 5 shows trends in tobacco smoking among persons aged 15 years and above in Mauritius. Age-standardized prevalence of current tobacco smoking among persons aged 15 years and older in 2015 was 21.2% in Mauritius compared to African Region average of 13.9% [63,64]. The current tobacco smoking among males aged 15 years and over was 12.5 fold that of females in 2015. The current tobacco smoking for both sexes decreased by 17.8% between 2000 and 2015.

Salt/Sodium Intake: The age-standardized mean population salt intake (sodium chloride) was 14 grams per day in Mauritians aged 18 years and older in 2010 [65]. This is almost three times the WHO recommended daily salt intake of 5 grams per person [42]. A high level of salt intake is associated with high blood pressure and a greater risk of cardiovascular diseases [66].

Physical inactivity: In 2016, 29.8% (male = 27.6% and female = 31.8%) of adults aged 18 years and above were insufficiently physically active in Mauritius compared to African Region average of 22.1% (male = 18.4% and female = 25.6%) and European Region average of 29.4% (male = 26.2% and female = 32.4%) [67].

Coverage of core population and individual NCD interventions and services in Mauritius

Table 4 summarizes the assessment team's evaluation (on a three-point scale, extensive, moderate or limited as per criteria given in the WHO assessment guide) of 24 core population-based interventions geared towards tackling the four main risk factors for NCDs, that is tobacco smoking, harmful alcohol use, unhealthy diet and physical inactivity.

[Insert Table 4 here]

About 4 (16.7%) of the interventions were rated extensive, 9 (37.5%) moderate and 11 (45.8%) limited. Out of the six antismoking interventions, two were rated extensive and four moderate. Out of the six interventions to prevent harmful alcohol use, one was rated extensive, one moderate and four limited. Of the six interventions to improve diet, one was rated extensive, two moderate and three limited. Of the six interventions to promote physical activity, none was rated extensive, two were rated moderate and four were rated limited. According to the assessment team's rating Mauritius still needs to invest more in scaling up the coverage of population NCD control interventions to the extensive level.

Table 5 encapsulates the assessment team's evaluation (on a three-point scale, as extensive, moderate or limited based on criteria given in the WHO Assessment guide) of the 15 core individual services for controlling cardiovascular diseases (CVD), diabetes and cancer.

[Insert Table 5 here]

Three (20%), eight (53%) and four (27%) of the 15 individual NCD services were rated extensive, moderate and limited respectively. With regard to CVD, effective primary prevention in high-risk groups and secondary prevention after AMI (including acetylsalicylic acid) were rated extensive; effective detection and management of hypertension, and rapid response and secondary care after AMI and stroke were rated moderate; and risk stratification in primary health care was rated limited. All the individual services for diabetes (detection and general follow-up, patient education, hypertension management and prevention of complications) were rated moderate. In the case of cancer first line services, prevention of liver cancer through hepatitis B immunization was rated extensive, and screening for cervical cancer and treatment of precancerous lesions were rated moderate. About the four cancer second line services, only vaccination against human papilloma virus was rated extensive; with the early case-finding for breast cancer and timely treatment of all stages, population-based colorectal cancer screening, and oral cancer screening coverage rated limited.

Health system opportunities to scale up core NCD interventions and services

In this subsection we present an analysis of the 15 health system features contained in Table 3.

Political commitment to NCDs, explicit priority-setting approaches and interagency cooperation: The Mauritius Government's political commitment to continually improve the level and distribution of health is clearly expressed in Mauritius Vision 2030 [16], Government Programme 2015–2019 [68], MOHQL vision and mission statement [69] and health sector strategy 2017–2021 [20]. The MOHQL mission is to create a modern high-performing quality health system that is patient centred, accessible, equitable, efficient (uses available human, financial and physical resources without waste) and innovative (using the full potential of information and communications technology) [20].

The main objective of the health sector strategy is “to ensure the enhancement of health sector development in the Republic of Mauritius, including Rodrigues and the Outer Islands, in order to attain positive health outcomes for the individual, the family, the community and the economy at large” (p.21) [20]. In relation to NCDs and health promotion, Mauritius strategic objective is to reduce the burden of premature morbidity, mortality and disability associated with NCDs and their risk factors [20].

The Government has enacted various public health legislations targeting various NCD risk factors. For instance, the 2008 public health regulations which prohibit advertisement, sponsorship and sale and consumption of alcoholic drinks in public places [70]. Another set of public health regulations that came into force in March 2009 imposed restrictions on tobacco products; and was reinforced by the June 2018 Mauritius accession to the WHO FCTC Protocol to Eliminate Illicit Trade in Tobacco Products [71]. The Minister of Health and Quality of Life published the Government Gazette of Mauritius No. 74 of 15 August 2009 entitled “Food (Sale of Food on Premises of Educational Institutions) Regulations 2009”,

which specifies the types of food which may be sold on the premises of educational institutions (pre-school, primary school, secondary school or pre-vocational school) [72].

In terms of priority-setting, current budget allocation to the MOHQL is divided into five major subheads: general, curative services, primary health care and public health, treatment and prevention of HIV and AIDS, and prevention of noncommunicable diseases and promotion of quality of life (see Table 6). Budget allocation is based on the proposal estimates from the MOHQL through an existing Committee chaired by the focal point of the Ministry of Finance and Economic Development in the MOHQL.

[Insert Table 6 here]

Between 2016/17 and 2019/20 total government expenditure increased from Rs 10.9 to 12.3 billion, representing a 13% increase. During the same period expenditure on prevention of NCDs and promotion of quality of life grew from Rs 106.8 million to Rs 137.3 million, accounting for a 29% increase. The country has undertaken a number of national health accounts (NHA) studies [10,37] and is currently institutionalizing NHA to facilitate tracking of health expenditures over time. The information is useful in determining whether allocation of financial resources reflects the stated health priorities.

The MOHQL recognizes that multi-sectoral action and partnerships are crucial for core interventions and services to have the greatest impact on NCD outcomes; the MOHQL is forming close partnerships with other sectoral ministries and national institutions; and with UN agencies, diplomatic missions, and civil society organizations including NGOs, the media and other relevant stakeholders [20]. For example, the Ministry of Education and Human Resources, Tertiary Education and Scientific Research has been an important partner in the prevention strategies which include health education, screenings and referrals, sale of healthy food items in school canteens, human papilloma virus (HPV) vaccination, etc.; the Ministry of Social Security, National Solidarity and Environment and Sustainable Development has been a partner particularly in providing preventive, promotive, curative and rehabilitative services to older people and people with disabilities; the Ministry of Agro Industry and Food Security is also collaborating with the MOHQL to ensure food security and safety and to encourage consumers to change their eating habits; the Ministry of Youth and Sports is promoting physical activities by providing incentives for purchase of sports equipment, increasing accessibility of sports infrastructure to the general public and allocation of grants to sports clubs; the Ministry of Gender Equality, Child Development and Family Welfare is organizing regular talks and sensitization campaigns on healthy eating habits, physical activities and cancer through the network of women centres in the island.

Regarding civil participation, several NGOs active in the health sector wish to have closer cooperation, better communication and more exchange with the MOHQL and create more synergy through joint government/NGO efforts. Furthermore, the MOHQL holds consultations with UN agencies on effective policy development, implementation, and service delivery regarding NCDs.

Coordination across providers, effective model of service delivery and effective management: The coordination across providers at the different levels of care in Mauritius such as home care, primary

health care, and emergency care, regional and specialized hospitals is patient-focused with a referral system addressing the needs of NCD patients. Multidisciplinary cooperation is good and effective at facility level, and patients attending primary health-care (PHC) centres are seen by a multidisciplinary team of health professionals which includes community physicians, medical and health officers, nutritionists, diabetes specialized nurses and health-care assistants, amongst others. In principle, patients visit a primary health-care provider at a community health centre/area health centre for non-emergencies, and if necessary, are referred for specialist care. It is the responsibility of the community physician to make the link between PHC and hospital settings. These cases are referred back to primary care for follow-up once the conditions of the patients are stabilized and each patient has an NCD case sheet whereby the personal data, family history, personal history and life style such as smoking and alcohol habits are recorded. In terms of effective management, a performance management system is the only performance-based system for promotional and incremental incentives and a scoring system focusing on various key tasks which is filled out every year.

Regionalization and access to quality medicines: The overall public health-care system is well structured with three distinct levels of care, namely primary, secondary and tertiary. Effective regionalization of care has been achieved with a regional hospital and an extensive PHC network in each of the five health regions with a defined catchment population [73]. There are no wide variations in availability and quality of services within regions [74]. Tertiary care hospitals are accessible within reasonable driving distance. There is also a 24-hour free public emergency ambulance service manned by doctors and nurses with specialized training in emergency medicine. Concerning access to quality of medicines, based on the WHO concept of Essential Drugs [75], the MOHQL has developed its own medicine list covering all pharmacological classes including specialized items [76]. The list is reviewed every two to three years by the Drug Formulary Committee to assess its adequacy and the list approved serves as a guide for medical officers at public health facilities for prescription of medicines using their generic names and for drugs that are not on the essential list on a case-by-case basis. The Hospital Drugs Committee set up at regional level evaluates such requests and advises on the purchase of drugs needed for specific cases. In addition, monitoring of prices of pharmaceutical products is carried out by relevant authorities. So far, no cases of malpractices have been found in this respect and a national pharmacovigilance committee has been set up under the aegis of MOHQL to collect and analyze data on any adverse drug reactions in relation to the prescription and use of drugs in the treatment and control of disease and reporting of suspected quality issues. Finally, public procurement of medicines is highly efficient in terms of procuring medicine at competitive prices and is able to reap the benefits of economies of scale.

Integration of evidence into practice and adequate information solutions

Research, surveys [55,56] and other databases on NCDs have been useful in providing local evidence for identifying more effective actions for combating NCDs. For example, the vaccination strategy against cervical cancer for young girls which started in 2016 was finalized after studies on HPV subtype prevalence done by the Central Health Laboratory and the Mauritius National Cancer Registry (MNCR)

[77,78]. The Virtual Health Library (VHL) in Mauritius which was set up in 2015 by the MIH provides all public health professionals electronic access to scientific knowledge on health [79].

Research is complemented by other adequate information solutions, for instance, the civil registration systems. Morbidity conditions and mortality causes are coded according to the 10th Revision of the WHO International Classification of Diseases [80]. The Health Statistics Report published annually also contains information on population and vital statistics, infrastructure and personnel, morbidity, mortality and the activities of almost all health services pertaining to the Republic of Mauritius. Most importantly, NCD Surveys that have been regularly carried out during the last 30 years provide trends in the prevalence of NCDs and their risk factors and measure impact of actions taken previously [55,56]. Other surveys conducted periodically or on an ad hoc basis such as surveys on nutrition [81], salt intake [66,82], tobacco control [40,63,65,83,84], household out-of-pocket expenditure [36], risky behaviours in children [85] and adolescents [86,87] also provide key information that cannot be obtained from routine sources. Annual and four-year reports are published regularly from the National Cancer Registry [78]. Since 2015, Mauritius has been conducting NHA and it has since been institutionalized [10,37].

Distribution and mix of human resources, incentive systems and managing change: The key roles of the health workforce have been recognized by the MOHQL and recruitment and retention of qualified health personnel have always been a priority. The numbers in all categories of health professionals per 100 000 people, such as doctors, dentists, pharmacists, nurses have increased over time and human resources for health remunerations account for a high proportion of the budget (73%) assigned to the health sector [10]. To improve the skills of health workers, continuing professional development (CPD) has become mandatory for doctors; and creation of the Mauritius Institute of Health (MIH) has availed opportunities for continuing education for other health workforce cadres. In terms of incentives, health professionals receive their salaries and allowances based on recommendations—guided by position levels, years of service and complexity of responsibilities assigned—from the Pay Research Bureau (PRB), an institution responsible for reviewing the pay and grading structures and conditions of service in the public sector [88]. Mauritius is also promoting innovative and comprehensive reforms, for example several changes have been introduced successfully at PHC and hospital levels with a view to improving health services delivery, including the introduction of preventive measures for modifying behaviour and mitigating health risks.

Population empowerment and financial access and protection provision: Increasing health literacy is one of the priorities of the MOHQL for community empowerment and it has gone up over the last decade as reflected in increased awareness of potential health risks associated with smoking, alcohol consumption, unhealthy diet and physical inactivity. A Health Literacy Framework was developed by MOHQL in 2013; it incorporated the strengthening of the health literacy components of the different national action plans being implemented to reduce risk factors and premature mortality as well as a strategy to guide actions to improve health literacy across the life course [89]. In relation to access to health services and financial protection, all government health-care services including medicines and laboratory tests are free to users and are fully tax-funded. Given that public health services are provided free of charge to all, there are no

formal or informal payments which deter utilization of core NCD services in government health institutions including diagnostics and follow-up. Financial burden does not currently constitute any barrier to scaling up core NCD interventions. However, according to the WHO World Health Statistics 2018, Mauritius has a universal coverage index of 64%, implying that there are other factors at play that account for suboptimal coverage of essential health services (including reproductive, maternal, newborn and child health, infectious diseases, and NCD health services) [6].

Discussion

The study has reviewed trends in NCD mortality, morbidity and risk factors; rated coverage of core population and individual NCD interventions; assessed health system opportunities and challenges for better NCD outcomes; and recommended priority action areas to accelerate gains in NCD outcomes. Only four (16.7%) out of the 24 core population NCD interventions and three of the 15 individual NCD services coverage was rated extensive in Mauritius. Therefore, there still remains substantial gaps in coverage of interventions aimed at reducing tobacco use, harmful alcohol use, consumption of unhealthy diet, and physical inactivity. Likewise, the individual NCD services coverage was found to be sub-optimal in the country.

Coverage of core population NCD interventions and individual services: a comparison between Mauritius and European region countries scores

Additional File 1 provides a comparison of Mauritius scorecards for core population-based interventions with those of ten European region countries, namely Belarus [90], Croatia [91], Estonia [92], Hungary [93], Kyrgyzstan [94], The former Yugoslav Republic of Macedonia [95], Moldova [96], Tajikistan [97], Turkey [98] and Serbia [99]. The European country assessments did not contain ratings for interventions to promote physical activity. Thus, comparisons are for ratings of six antismoking interventions, six interventions to prevent harmful alcohol use, and six interventions to improve diet.

Antismoking interventions: (a) Mauritius's efforts to raise tobacco taxes were rated moderate; Belarus, Croatia, Macedonia, and Serbia obtained similar ratings. Only Estonia and Turkey had an extensive rating. (b) Mauritius's efforts to combat smoking through provision of smoke-free environments were rated moderate as in Croatia, Macedonia and Tajikistan. Only Turkey had an extensive rating. (c) Issuance of warnings on the dangers of tobacco and tobacco smoke was rated extensive in Mauritius, Macedonia, Turkey, and the remaining countries had lower ratings. (d) Banning of tobacco advertising, promotion and sponsorship was rated extensive in Mauritius, Macedonia and Turkey. (e) Provision of service for tobacco cessation to all those who want to quit (nicotine replacement therapy) was assessed to be moderate in Mauritius and Estonia, and extensive in Turkey. It was only in Turkey where five of the antismoking interventions were rated extensive. There is need for WHO to undertake detailed study in Turkey with a view to documenting best practice aspects that other countries, like Mauritius, can potentially emulate to

improve implementation of antismoking interventions related to raising tobacco taxes, provision of smoke-free environments, and provision of service for tobacco cessation to all those who want to quit, that is nicotine replacement therapy.

Interventions to prevent harmful alcohol use: (a) Use pricing policies on alcohol including taxes on alcohol was rated moderate in Kyrgyzstan and Macedonia. (b) Restriction or banning of alcohol advertising and promotion was rated extensive in Mauritius, Tajikistan and Turkey. (c) Restriction of availability of alcohol in the retail sector was rated extensive in Croatia and Turkey; and moderate in Kyrgyzstan, Macedonia and Moldova compared to limited rating in Mauritius. (d) Enactment and enforcement of minimum alcohol purchase age regulation was rated extensive in Macedonia and Turkey compared to limited rating in Mauritius. (e). Implementation of a blood alcohol limit for driving was rated extensive in Estonia and Tajikistan compared to limited rating in Mauritius.

Interventions to improve diet: (a) Reduction of salt intake and the salt content of foods was rated moderate/extensive only in Turkey and limited in Mauritius and all other European countries in Additional File 1. (b) Replacement of trans fats with unsaturated fats was rated moderate only in Hungary and Turkey compared to limited in Mauritius and all other European countries. (c) Reduction of free sugar intake was rated extensive in Hungary compared to moderate in Mauritius and limited in all other European countries. (d) Increased consumption of fruit and vegetables was rated limited in Mauritius compared to moderate in Belarus, Hungary, Tajikistan and Turkey. (e) Moderate rating of reduction in marketing pressure of food and non-alcoholic beverages to children in Mauritius was similar to that of Moldova and Turkey. The intervention was rated limited in other European region countries. (f) Awareness raising on diet was rated extensive in Mauritius compared to moderate in Belarus, Macedonia, Tajikistan, Turkey and Serbia.

Interventions to promote physical activity: (a) Implementation of communitywide public education and awareness campaigns for physical activity was similarly rated moderate in Mauritius as in Belarus, Macedonia, Tajikistan, Turkey and Serbia. (b) Provision of physical activity counselling and referral as part of routine primary health-care services through the use of a brief intervention was rated limited in Mauritius compared to moderate in Belarus. Comparison of ratings for the other interventions for promoting physical activity was not possible since information was missing for European region countries.

Coverage of individual services: a comparison between Mauritius and European region countries scores

Additional File 2 compares Mauritius scoring for coverage of individual services with those of ten European region countries. The scoring information on individual cancer interventions for majority of European region countries is missing in their reports. Thus, comparisons are made only for cardiovascular diseases and diabetes individual interventions.

Cardiovascular diseases (CVD) Interventions

Risk stratification in primary health care: CVD risk stratification in primary health care was rated limited in Mauritius compared to moderate rating in Croatia, Kyrgyzstan, Moldova, Turkey and Serbia.

Effective detection and management of hypertension: Effective detection and management of hypertension was similarly rated moderate in Mauritius, Turkey and Serbia.

Effective primary prevention in high-risk groups: Effective CVD primary prevention in high-risk groups was rated extensive in Mauritius compared to limited/moderate in European region countries.

Effective secondary prevention after acute myocardial infarction (AMI) including acetylsalicylic acid: Effective secondary prevention after AMI (including acetylsalicylic acid) was similarly rated extensive in Mauritius, Macedonia, Tajikistan, Turkey and Serbia.

Rapid response and secondary care after AMI and stroke: Rapid response and secondary care after AMI and stroke was rated moderate in Mauritius compared to extensive in Macedonia.

Diabetes

Effective detection and general follow-up: Effective detection and general follow-up for diabetes was rated moderate in Mauritius, Macedonia and Serbia.

Patient education on nutrition, physical activity and glucose management: Patient education on nutrition, physical activity and glucose management was rated moderate in Mauritius, Macedonia, Moldova and Serbia.

Hypertension management among diabetic patients: Hypertension management among people with diabetes was rated moderate in Mauritius compared to limited in Hungary, Macedonia and Serbia.

Prevention of complications (such as eye and foot examinations): Prevention of diabetes complications (such as eye and foot examinations) was similarly rated moderate in Mauritius, Hungary and Serbia.

Health system challenges and priority policy recommendations

The following recommendations are made for further development of policies, programmes and interventions to reduce exposure to NCD risk factors, improve diagnosis and treatment of NCDs, strengthen the health system and aim towards UHC in Mauritius. They can also be used as a basis for policy dialogue between the different stakeholders in the development of the Health Sector Strategic Plan and an integrated NCD action plan.

Based on the assessment of features as well as the challenges identified and discussions with key stakeholders, a number of policy recommendations emerged [100].

First, it was noted that current interagency cooperation is not fully functional despite a new mechanism for more effective coordination and a little synergy through joint government/NGO efforts [100]. In order to keep all stakeholders engaged in health systems strengthening for NCD outcomes, a proposal was made to establish a high-level committee (consisting of relevant ministries, the private sector, academia, NGOs and the civil society) chaired at the highest level of government that oversees and coordinates the implementation of multi-sectoral activities to better address the social determinants of health and enhance a coherent approach to Health-in-All Policies (HiAP). In addition, recommendation was made to specify mandates of each sector explicitly linked with outcomes and resources to ensure accountability; build institutional capacity; and expand health workforce competencies to address inter-sectoral agenda of NCDs and to implement core population-based interventions through whole-of-government approaches.

Second, the population (especially older people) is not adequately empowered to change behaviour towards taking responsibility for their own health and engage actively in decision-making processes both around policy issues as well as individual treatment options/plans [100]. Recommendation was made to invest in community empowerment, through health promotion approaches, to strengthen community mobilization and participation to promote health literacy for behavioural and lifestyle change; to develop incentives for disease prevention, early detection and treatment; to engage and support NGOs and patients' groups working actively on NCDs; and to set up structured peer-to-peer support groups within different stakeholders.

Third, primary health care (PHC) in the country is inefficient contributing to weaknesses in provision of preventive services, early diagnosis and treatment for those living with NCDs [100]. In order to address this issue, it will require improving quality of health care with people-centred health services. It will entail review, update and dissemination of treatment guidelines and standards, and monitoring of compliance; shift from an acute care model to a chronic care model; auditing of clinical services at all levels of care with explicit criteria for evaluating process and outcomes; introduction of incentives for health workers to boost requisite capabilities for controlling NCDs; consolidating National Pharmacovigilance Committee. Furthermore, proposal was made to consolidate and scale up the role of primary health care as the centre of care for NCDs to respond to the ageing population and increasing rates of multi-morbidity. This will require strengthening PHC gatekeeping function and reducing duplication of services at PHC and hospital levels, as well as, reinforcement of the role of PHC in improving coordination between primary, secondary and tertiary care levels, implementing a more systematic screening and management of chronic conditions in PHC including improving links with NCD mobile clinics and risk stratification of patients with assessment of CVD risk factors using CVD risk scores.

Fourth, the assessment revealed issues of inadequate access, sharing and analysis of data generated by the health system, unavailability of modern information and technology solutions, and non-institutionalization of national NCD registries [100]. Recommendation was made to implement strong integrated health management information system. It will entail introducing e-health, whereby, all health information systems are integrated into an effective interoperable patient data transfer system,

considering the use of a smart health card concerning all personal health information as well as setting up strong monitoring and evaluation systems.

Fifth, the assessment identified lack of explicit processes for prioritizing public health expenditures, leading to very low primary health care budgetary allocations [10]. Recommendation was made to develop and implement rational priority-setting mechanism for use in allocation of public health budget; appropriate budgeting and financing for addressing NCDs; increase substantially the allocation of funds for preventive and primary health care; earmark a fair share of the annual sin taxes collected on alcohol, tobacco and sugar for scaling up cost-effective population interventions for tackling NCD risk factors, for instance smoking, alcohol and substance abuse, unhealthy diets and low physical activity [100].

Finally, the assessment uncovered weaknesses in human resources for health (HRH) management such as the dearth of HRH planning and assessment, and inadequate NCD-related in-service training for service providers [100]. In order to improve the distribution and mix of human resources, recommendation was made to formulate a comprehensive policy and plan for HRH; improving training of HRH, especially in controlling NCDs; improving recruitment; efficient allocation of HRH; optimizing the performance of current workers via establishing clear-cut responsibilities for all grades of staff, competitive remunerations, capacity-building, performance contracts, and performance assessment; and reduction in attrition of HRH [100,101].

Conclusion

The study contributes to understanding of the health system challenges and opportunities in Mauritius and makes it possible to use evidence relevant to the local context and to the national health-care system and priorities in order to develop the most appropriate responses for improving NCD outcomes and reducing premature mortality from NCDs by 2030.

The assessment also identifies areas in national health systems where significant changes through stronger policy implementation are required. The greatest challenge identified is the weak inter-sectoral action and an absence of a comprehensive NCD action plan with cross-sectoral engagement. It is therefore imperative to initiate several actions for an effective and sustainable multi-sectoral commitment to strengthen health systems for better NCD outcomes.

Abbreviations

AMI: acute myocardial infarction

BMI: body mass index

CHE: current health expenditure

CVD: cardiovascular diseases

DALY: disability-adjusted life-year

DBP: diastolic blood pressure

FCTC: WHO Framework Convention for Tobacco Control

GDP: gross domestic product

HiAP: Health-in-All Policies

HRH: Human Resources for Health

IMF: International Monetary Fund

Int\$: International dollar or purchasing power parity

MIH: Mauritius Institute of Health

MOHQL: Ministry of Health and Quality of Life

NCD: Noncommunicable diseases

NHA: National health accounts

NGO: Nongovernmental organization

OOPS: Out-of-pocket spending

PHC: Primary health care

PRB: Pay Research Bureau

Rs: Mauritius Rupees

SBP: systolic blood pressure

SDG: UN Sustainable Development Goals

UN: United Nations

US\$: United States Dollar

VHL: Virtual Health Library

WHO: World Health Organization

WHO/EURO: WHO Regional Office for Europe

WG: working group

Declarations

Ethics approval

The Republic of Mauritius Ministry of Health and Quality of Life (MOHQL) in a memorandum reference number MHO/WHONAHS approved the “National Assessment of Health Systems Challenges and Opportunities for better non communicable disease outcomes” on 8th September 2017. The MOHQL approval letter also covered the composition and names of project coordinator, assessment team, and multi-sectoral members of the five working groups. Therefore, the assessment did not require further formal ethical approval since its work undertaken by the MOHQL. The MOHQL in a memorandum reference number MHO/WHO/NAHS/V3 also gave approval on 27 February 2019 for publication.

Consent to participate

The key informants were members of the multi-sectoral working groups constituted by the MOHQL (Reference No. MHO/WHONAHS). In the process of constituting the working groups the MOHQL checked their availability and obtained their verbal consent to participate in the entire assessment according to national procedures. Thus, being a MOHQL activity, it was deemed unnecessary to obtain formal written consent.

Availability of data and materials

The NCD morbidity and mortality datasets used and/or analysed during the current study are available in the publicly accessible WHO Global Health Observatory [<https://www.who.int/gho/en>], the MOHQL website [<http://health.govmu.org/>], and MOHQL published and grey literature included in references. The data on ratings of NCD interventions and services coverage are included in this paper.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

LM, MT, PB, FS and JMK contributed equally in the design of the study, literature review, collecting and analysis of the data/information and writing of the manuscript. PD provided technical advice and quality control during the entire study process and reviewed the manuscript. All authors read and approved the final manuscript.

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This article is dedicated to all health workers in Mauritius who continue to relentlessly wage the fight against NCDs.

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Tables

Due to technical limitations, tables are only available as a download in the supplemental files section.

Figures

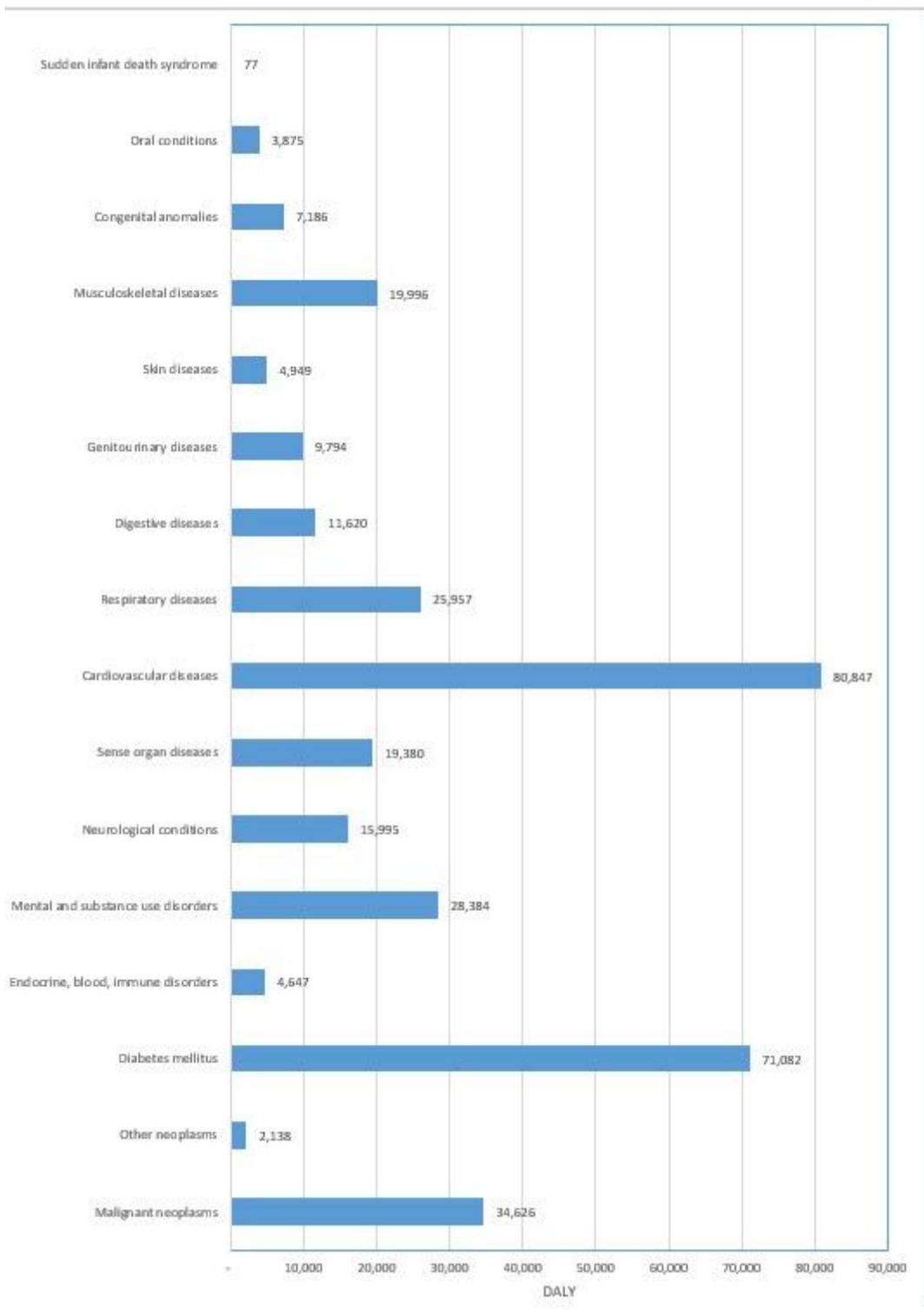


Figure 1

Disability-adjusted life-years (DALYs) lost in Mauritius from noncommunicable diseases in 2016

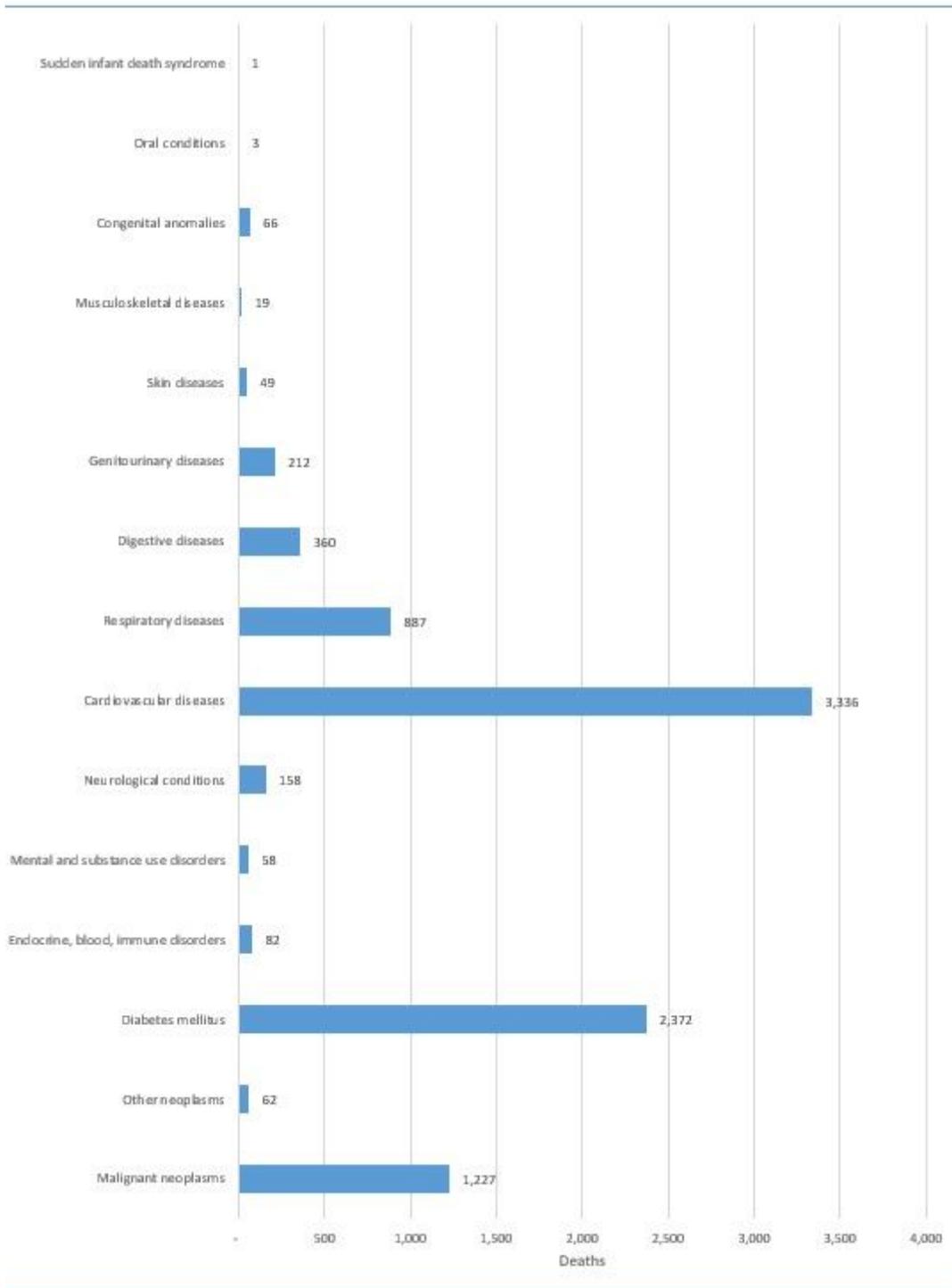


Figure 2

NCD deaths by cause in Mauritius in 2016

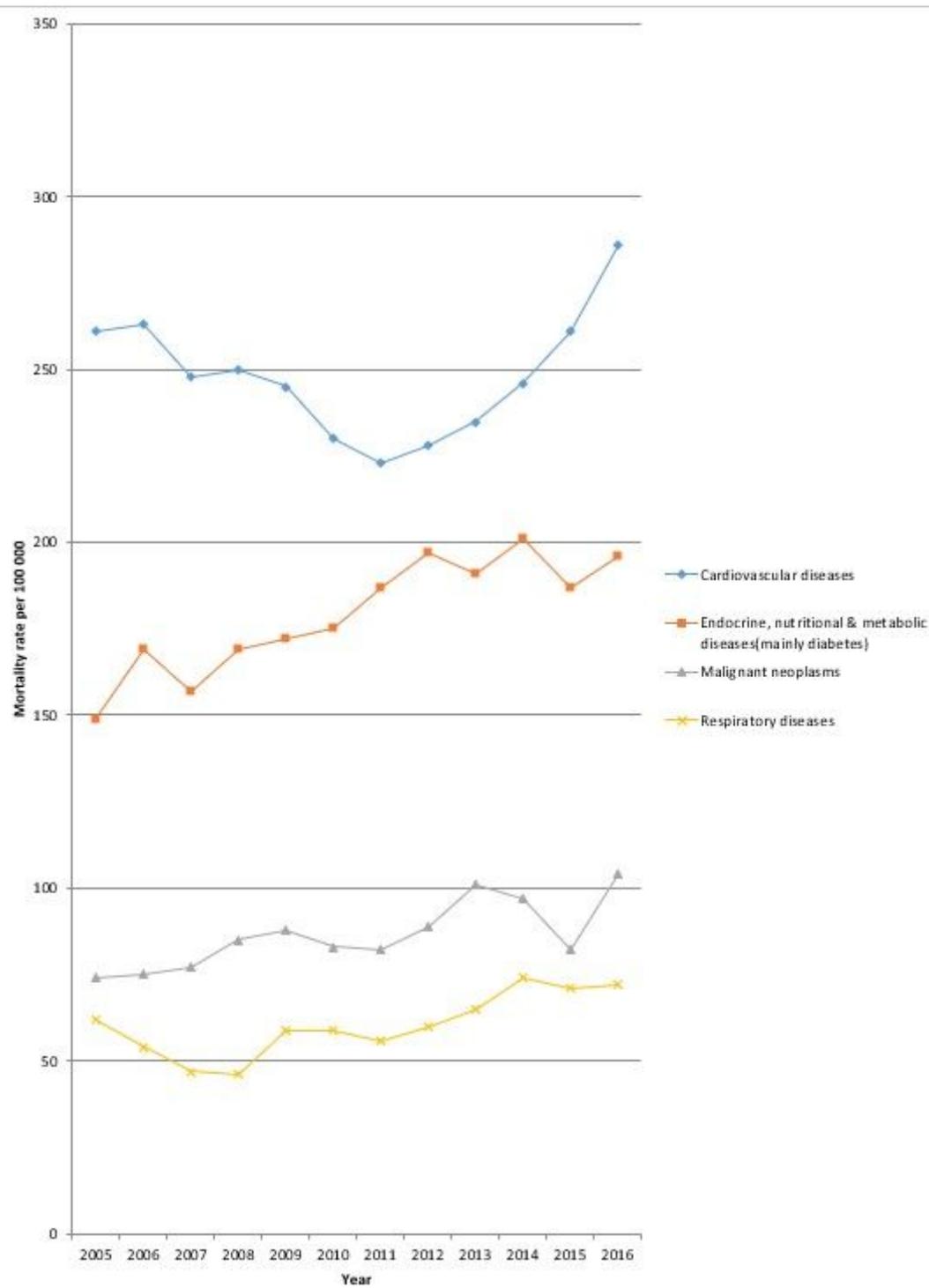


Figure 3

Trends in NCD mortality rates in Mauritius

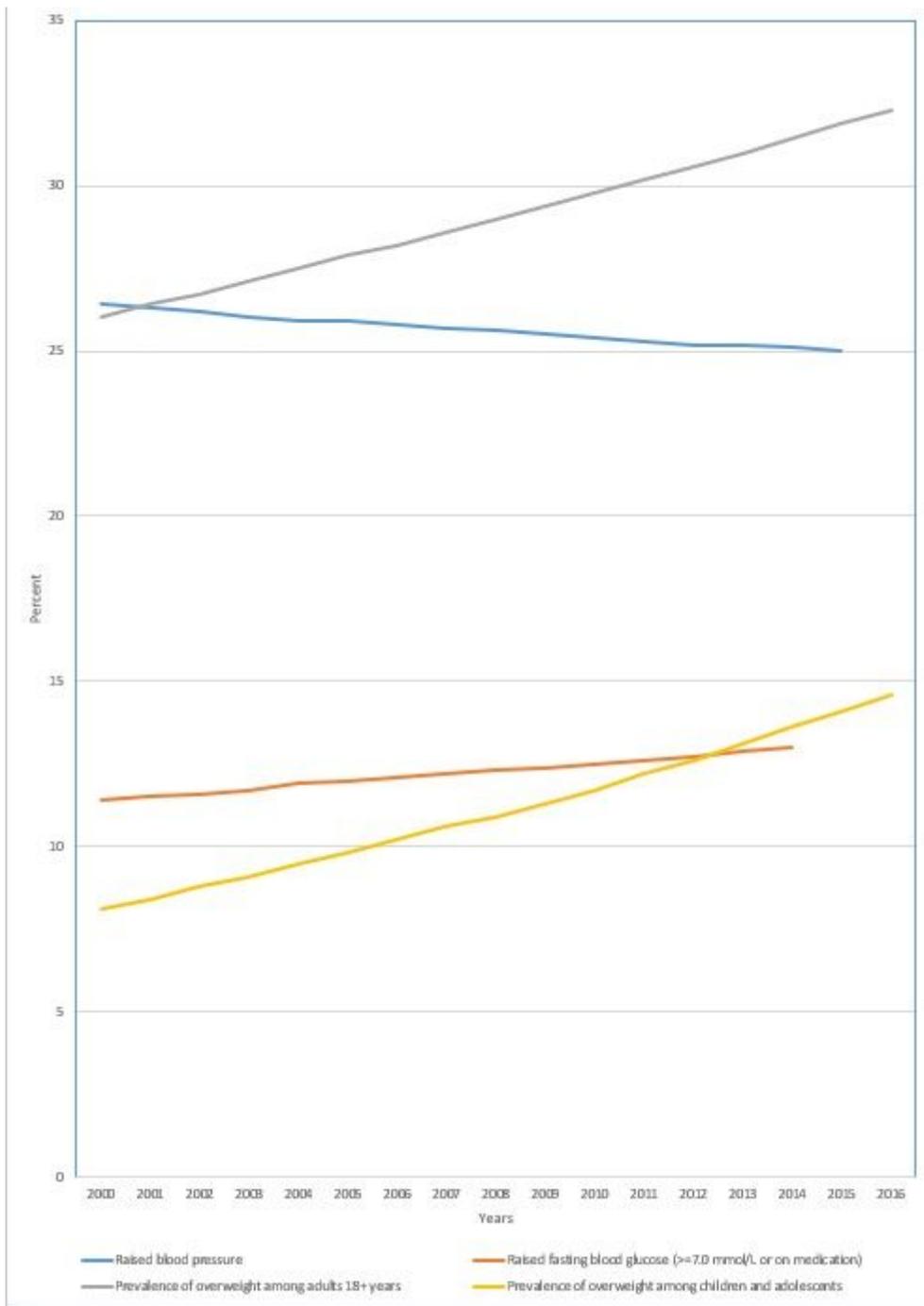


Figure 4

Prevalence of overweight, raised blood pressure and raised fasting blood glucose in Mauritius

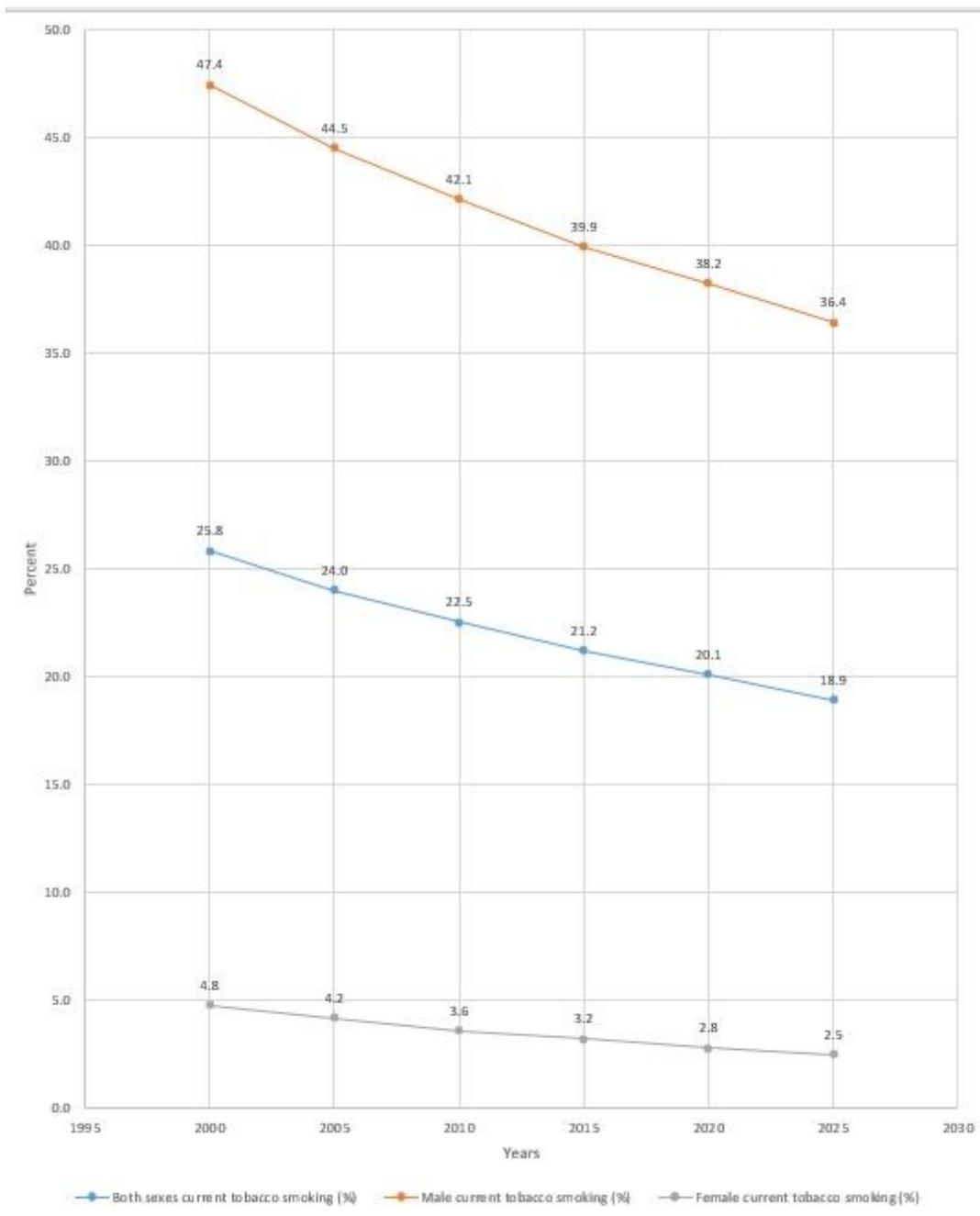


Figure 5

Trends in tobacco smoking among persons aged 15 years and over in Mauritius

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