



**The Trends in Diabetes and
Cardiovascular Disease Risk in
Mauritius
The Mauritius
Non Communicable Diseases
Survey 2015**

The Mauritius Non Communicable Diseases Survey 2015

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Executive summary

A non-communicable disease (NCD) survey employing similar methodologies and criteria to surveys undertaken in Mauritius in previous years (1987, 1992, 1999, 2004 and 2009), was carried out in 2015. This report provides a summary of the burden of the key NCDs and their risk factors.

Diabetes mellitus

- The prevalence of type 2 diabetes in the Mauritian population aged 20-74 years was 20.5%: 19.6% in men and 21.3% in women.
- The ratio of known diabetes to newly diagnosed diabetes was approximately 2:1.
- There are an estimated 257,442 people between the ages of 25 and 74 years with diabetes in Mauritius.
- The standardised prevalence of diabetes in adults 25-74 in 2015 was 22.8% compared to that measured in 2009 which was 23.6%.
- The prevalence of pre-diabetes being either impaired glucose tolerance or impaired fasting glycaemia in the population was 19.4%: 20.2% for women and 18.5% for men in Mauritian adults aged 25-74 years.
- Among those people known to have diabetes, metabolic control of their diabetes as judged by blood glucose levels was moderately poor (33% had HbA1c \geq 9.0%); this is indicative of very high risk of developing diabetic complications, although this proportion has improved since the last survey in 2009.

Overweight and obesity

- Using the European body mass index (BMI) cutpoints, the prevalence of obesity was 19.1%: 11.9% for men and 25.6% for women and the prevalence of overweight was 35.2%: 38.2% in men and 32.6% in women.
- Thus, 54.2% of the participants were overweight or obese. The rate for men was 49.4%, and for women, 54.3%.
- Using the ethnic specific BMI cutpoints, the prevalence of obesity was 45.5%: 50.6% for women and 39.4% for men and the prevalence of overweight was 23.1%: 20.9% in women and 26.7% in men.
- Thus, 68.6% of the participants were overweight or obese. The rate for men was 66.0%, and for women, 70.1%.
- There are an estimated 398,417 people between 25 and 74 years of age who are overweight /obese in Mauritius.

Hypertension

- The prevalence of hypertension was 28.4%: 27.0% for women and 30.3% for men.
- Blood pressure lowering medication was being taken by 15.0% of the adult population: 15.2% of women, and 14.6% of men.
- Of those with hypertension, only 52.6% of individuals were currently on medication for hypertension. Thus, for every treated case of hypertension, there was at least one untreated case.
- Among those with treated hypertension, 70.6% continued to have elevated blood pressure (i.e. above 140/90 mmHg).

Lipids (abnormal cholesterol and other blood fats)

- The prevalence of elevated total cholesterol (≥ 5.2 mmol/l) was 44.1%: 41.8% for women and 47.1% for men.
- The prevalence of elevated total cholesterol (≥ 5.5 mmol/l) was 36.2%: 33.9% for women and 39.2% for men.
- The prevalence of elevated triglycerides (≥ 2.0 mmol/l) was 25.0%: 15.1% for women and 37.0% for men.
- Lipid-lowering agents were being taken by 13.3% of the population.

Smoking

- The prevalence of current smoking was 19.3%: 3.9% in women and 38.0% in men.

Physical Activity

- Only 23.7% of Mauritian adults aged 25-74 years reported undertaking sufficient physical activity to meet the National Guidelines of 30 minutes of leisure time activity (moderate to vigorous) per day to maintain good health (30.2% of men and 18.5% of women).

Alcohol Consumption

- 52.8% Mauritian population (41.0% of women and 66.2% of men) were consuming alcohol.

Kidney Disease

- Albuminuria, an index of kidney disease, was detected in 6.8% of the survey population. 7.1% of men and 6.6% of women had micro albumuria.
- The prevalence of impaired glomerular filtration rate (<60 mL/min per 1.73 m²) was 5.9%:4.1% in men and 7.3% in women.
- Over a third (36%) of Mauritian adults have either one of hypertension, albuminuria or diabetes and thus are at increased risk of kidney disease.

Disability

- Physical disability (defined as requiring some assistance with activities of daily life such as washing and dressing) was reported by 9.8% of the survey population aged over 50 years of age: 6.7% in men and 12.5% in women.

Depression

- Symptoms suggestive of depression were detected in 16.7% of the survey population. The prevalence of depressive symptoms was 13.1% in men and 19.6% in women.

Asthma

- The age and gender standardised prevalence of asthma in adults was 8.9%: 8.0% in men and 9.7% in women.

Conclusions

Despite the high prevalence, it is important to note that for the first time in 30 years diabetes prevalence is not increasing and in the 2015, some six years since it was last measured, diabetes prevalence appears to have stabilised.

Apart from the high diabetes prevalence, there is a high prevalence of pre-diabetes, a condition as is diabetes, associated with increased risk of subsequent diabetes and of heart disease. This double burden of the high rates of diabetes and pre-diabetes, coupled with those of obesity, dyslipidaemia and hypertension, constitute a significant threat in terms of the future social and economic burden of heart disease and diabetes complications for Mauritius. This relates to both the direct medical costs and national productivity due to the impact of these diseases on the workforce as discussed below.

Recommendations

The magnitude of the diabetes epidemic in Mauritius, coupled with the significant premature ill health and death due to the enormous burden associated with diabetic complications, including heart and kidney disease, heralds the need for increased attention and resources. The fact that potent environmental and behavioural risk factors for type 2 diabetes such as obesity and exercise are modifiable, points to the case for lifestyle intervention. This involves the incorporation of a healthy diet with an increase in physical activity and less sedentary activity, strategies which also target obesity, as a means of curbing the impact of this epidemic. Since this survey shows evidence that the rise in diabetes has been halted, the measures taken in recent years to prevent diabetes should be reinforced and expanded.

Recent years have seen a great increase in our knowledge of the lifestyle and pharmacological strategies required at both an individual and community level to reduce the risk of developing diabetes. This knowledge should drive intervention strategies. However, it is also essential to consider interventions that have not yet been tested in clinical trials. These should include transport, education, workplace, food supply and labelling, and town-planning interventions. These interventions, which target the whole population are considered to be as important as those directed at individuals.

Furthermore, there is also increasing evidence that the effect of the maternal environment of the foetus *in utero* can have a long term effect in increasing risk of heart disease and

diabetes when the child reaches adult life. In this respect, the importance of optimal maternal and child health must not be underestimated. Maternal health during pregnancy needs to be a vital component of future diabetes prevention activities. It is clear that reinforcement of existing programmes is essential but there is also a need to evaluate new strategies such as those relating to early life development.

A Multi-disciplinary, coordinated approach across health, finance, education, sport, agriculture and the food industry sectors can contribute towards reversing the underlining causes of diabetes. A high level Multi-sectoral NCD Prevention Committee **has to be set up**, if possible under the chairmanship of Hon Minister of Health and Quality of Life. The committee would comprise representatives of the following Ministries and other institutions:

- Ministry of Finance and Economic Development
- Ministry of Youth and Sports
- Ministry of Gender Equality, Child Development and Family Welfare
- Ministry of Social Security, National Solidarity and Reform Institutions
- Ministry of Education and Human Resources, Tertiary Education and Scientific Research
- Ministry of Environment, Sustainable Development and Disaster and Beach Management
- Ministry of Public Infrastructure and Land Transport
- Ministry of Local Government
- Ministry of Agro Industry and Food Security
- Ministry of Industry, Commerce and Consumer Protection
- Ministry of Civil Service Affairs and Administrative Reforms

- Attorney General's Office
- National Transport Authority
- Central Electricity Board
- Open University of Mauritius
- Mauritius Institute of Education
- University of Mauritius
- University of Technology Mauritius (UTM)

- Police Department
- Road Development Authority
- Mauritius Institute of Health
- Joint Economic Council
- Mauritius Export Processing Zone Authority
- Mauritius Employers Federation
- Health Impact studies have also to be carried out for all programmes geared towards health intervention and health promotion activities.

1.0 Introduction

The multi-ethnic population of Mauritius (Asian Indian Hindus, Asian Indian Muslims, Chinese and Creoles) has undergone rapid industrialisation and economic growth over the past several decades, and this has brought in its wake a shift in the disease pattern.

Mauritius has experienced rapid industrialisation and general improvements in living standards over the past five decades. However, through previous surveys in 1987, 1992, 1998, 2004 and 2009 conducted by the Ministry of Health and Quality of Life (MoH&QL), in collaboration with the World Health Organization, Baker IDI Heart and Diabetes Institute (formerly the International Diabetes Institute) and partners, it has been shown that the prevalence of diabetes mellitus was very high and on the increase.

In Mauritius, Mortality due to diseases of the Circulatory system and diabetes significantly increase from 31% of total deaths in 1975 to 46% in 1990 and peaked at 59% in 2007. However, during the recent years, it has oscillated between 56% and 57% indicating a halt in the increasing trend.

Numerous studies of diabetes and other NCDs in Mauritius have been carried out under the leadership of Professor Zimmet (Baker IDI Heart and Diabetes Institute), in collaboration with the MoH&QL since 1987, and have shown the emergence of NCDs in parallel with lifestyle change. Their contribution to the scientific understanding of the causes of NCDs is invaluable and has generated many health promoting initiatives such as the establishment of a NCD and Health Promotion Unit. However, the undiminished rise in NCDs is a cause of great concern to the whole community.

The first study on the prevalence of NCDs carried out in 1987 showed an overall crude prevalence of 14.3% for type 2 diabetes mellitus and 19.3% for impaired glucose tolerance (IGT) (which is a risk marker for both type 2 diabetes and cardiovascular disease such as ischaemic heart disease (IHD)). About 60% of those found to have type 2 diabetes were previously undiagnosed, indicating a large pool of unknown morbidity in the community. IHD was also common in the age group 35–74 years, as probable or possible heart ischaemia was even found in 19% of men and 31% of women with normal glucose tolerance.²

A follow-up survey carried in 1992 showed that the prevalence of type 2 diabetes and IGT had increased moderately, but that there was an increased awareness of NCDs in the community resulting in a fall in the proportion of undiagnosed cases of diabetes. In this

survey, the ratio of newly detected diabetes to known cases of diabetes was high and the proportion of poorly controlled diabetic patients reached 42%.³

In 2009, we showed that diabetes prevalence had steadily increased since 1987. We also showed that the burden of risk factors for NCDs was high. Mauritius has major problems with NCDs (viz. type 2 diabetes mellitus, hypertension and cardiovascular disease and their risk factors).³ Much work needed be done for their prevention and control and several new strategies were developed and implemented to reduce NCDs and their risk factors, and better control of all individuals with established diseases.

In 2015, a new survey was conducted in collaboration with the Baker IDI Heart and Diabetes Institute, the Cardiology Department, Umea University Hospital, Sweden, the National Institute for Health and Welfare, Helsinki, Finland and the Department of Endocrinology and Metabolism, St Marys Hospital, United Kingdom. Within the context of the epidemiological transition, and constraints on resources, the purpose of the collaborative effort is to help strengthen national strategies for the prevention and control of NCDs.

Study Objectives

The 2015 NCD Survey in Mauritius had the following objectives:

- To measure the prevalence of non-communicable diseases (i.e. type 2 diabetes, hypertension and chronic kidney disease);
- To examine complications of diabetes including nephropathy, and peripheral neuropathy;
- To examine risk factors associated with chronic disease (diabetes and cardiovascular disease) including obesity, micro albuminuria, physical inactivity, diet, cigarette smoking and serum lipids, and haemoglobin A1C (HbA1c);
- To measure the incidence of diabetes from 1998 to 2015 and to study the incidence and determinants of impaired glucose tolerance (IGT), type 2 diabetes, hypertension and coronary heart disease, and their risk factors.
- To measure the prevalence of asthma-like symptoms;
- To measure the prevalence of depressive symptoms;
- To measure the prevalence of disability in adults aged 50 years of over;
- To explore the relationship between cognitive impairment and chronic diseases.

This report summarises some of the key findings of the study. At the time this report was prepared, data on electrocardiograms, and cleaning and analysis of other key data were not completed.

2.0 The samples

2.1 Study design

Two different designs were employed during the survey. A cross-sectional survey of a representative sample of the Mauritian adult population was recruited to address the objectives related to prevalence. This sample was known as the Mauritius NCD Survey 2015. Additionally, a sample was recruited from the 1998 survey to measure incidence of diabetes. This is known as the Mauritius 1998 NCD cohort.

2.2 Sampling frame of the Mauritius NCD survey 2015

The target population for the survey comprised of all Mauritian adults aged 18 years and above (according to the Global NCD Framework Indicators). Because of the heterogeneity of the Mauritian population and in order to present reliable estimates of the disease and risk factor distribution, it was necessary that participants should be drawn from all over the island. Mauritius is divided into nine districts. The sample drawn from each district was proportional to the population size of the district. Within each district, a number of primary sampling units (PSUs) was chosen randomly. A total of 11 Primary Sampling Units was randomly selected for the whole island. Two additional PSU's were selected in the district of Port Louis (China town and Plaine Verte) to ensure that all ethnic groups were adequately represented, giving a total of 13 PSUs.

After the selection of the clusters as PSUs, a complete listing of members of households was performed. The details that have been collected at the listing stage included age, sex, ethnicity and occupation. Based on estimated prevalence rates and desired levels of precision, a sample of approximately 4400 participants was chosen.

The characteristics of the survey population are described in Table 2.1.

The final sample size for the prevalence survey was 3829.

Table 2.1 Demographic characteristics of the participants: the Mauritius NCD Survey 2015

	Men	Women
N	2089	1740
Mean (standard deviation)age (years)	48.9 (15.7)	48.8 (14.5)
Age range (years)	17– 81	18 – 81
Education n (%)		
None	53 (3.0)	167 (8.0)
Primary (Up to Std V)	244 (14.0)	344(16.5)
Primary CPE	307(17.6)	413(19.8)
Secondary (Form I – IV)	344 (19.8)	398(19.1)
Secondary SC	442 (25.4)	429(20.5)
Secondary HSC	144 (8.3)	175 (8.4)
Tertiary level	206 (11.8)	162 (7.8)
Ethnicity (%)		
Hindu	50.9	52.5
Muslim	19.9	19.1
Creole	21.4	21.8
Chinese	6.3	5.5
Other	1.5	1.2
District(n)		
Port Louis	344	394
Pamplemousses	160	246
Riviere du Rempart	100	130
Flacq	134	145
Grand Port	157	165
Savanne	154	194
Plaine Wilhelms	456	515
Moka	134	177
Black River	101	123

2.3 Sampling frame of the Mauritius 1998 NCD cohort

The 1998 sample was used as the base population for this sample. For the Mauritius 1998 NCD Follow Survey, participants were recruited from 9 out of 14 clusters used in 1998.

(see Table 2.2). A register list of all participants was obtained and a total of 3570 participants were re-visited. Approximately 2751 individuals were traced and they were all invited to participate in the follow up study. The final sample size was 2069.

Table 2.2 Demographic characteristics of the participants in 2015: the Mauritius 1998 NCD cohort

	Men	Women
N	887	1,182
Mean (standard deviation) age (years)	60.7 (10.8)	61.2(10.9)
Age range (years)	36.9-90.9	37.3-92.4
Education (%)		
None	3.4	17.0
Primary (Up to Std V)	17.0	23.1
Primary CPE	26.3	28.7
Secondary (Form I – IV)	21.0	15.2
Secondary SC	22.0	12.4
Secondary HSC	4.6	1.9
Tertiary level	5.8	1.7
Ethnicity (%)		
Hindu	57.8	57.8
Muslim	26.2	21.7
Creole	15.2	20.0
Chinese	0.1	0.2
Other	0.7	0.4
District (n)		
Port Louis	155	195
Pamplemousses	143	173
Riviere du Rempart	93	142
Flacq	122	149
Grand Port	132	157
Savanne	101	122
Plaine Wilhems	141	245
Moka	0	0
Black River	0	0

2.4 Response rates

A major aim of the survey team leaders was to promote a high participation rate. In line with this strategy, a strong motivation campaign was sustained throughout the field survey.

Table 2.3 Response rates: the Mauritius NCD Survey 2015

SURVEY CLUSTER	INVITED			PARTICIPATED			RESPONSE RATE (%)		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Pamplemouses	168	250	418	160	246	406	95.5	98.4	97.1
PlaineVerte	130	150	280	124	140	264	95.4	93.3	94.3
Vallée des Prêtres	155	166	321	122	147	269	78.7	88.6	83.8
China Town	101	110	211	98	107	205	97.0	97.3	97.2
Goodlands	178	168	346	100	129	229	56.2	77.4	66.5
Bel Air	176	177	353	134	145	279	76.1	81.9	79.0
Mahebourg	167	171	338	157	165	322	94.	96.5	95.3
Rivière des Anguilles	167	200	367	154	194	348	92.2	97.0	94.8
Henrietta	160	170	330	152	154	306	95.0	90.6	92.7
Curepipe	161	220	381	151	209	360	93.8	95.0	94.4
Rose Hill	173	172	345	154	152	306	89.0	88.4	88.7
Petit Paquet	182	185	367	134	177	311	73.6	95.7	84.7
Petite Rivière	150	193	343	101	123	224	67.3	63.7	65.3
TOTAL	2068	2332	4400	1741	2089	3829	84.2	89.6	87.0

Among those invited to participate to the survey (n=4400), 3830 participated and thus the overall response rate was 87.0%. The response rate was 84.2% for men and 89.6% for women.

Table 2.4 Response rates: the Mauritius NCD survey 1998 cohort

SURVEY CLUSTER	INVITED			PARTICIPATED			RESPONSE RATE (%)		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Triplet	208	259	467	143	172	315	68.8	66.4	67.5
Rivière du Poste	135	162	297	101	122	223	74.8	75.3	75.1
Petit Raffray	128	209	337	93	142	235	72.7	67.9	69.7
Phoenix	105	139	244	77	115	192	73.3	82.7	78.7
Cité Vallijee	92	137	229	72	106	178	78.3	77.4	77.7
Rose Belle	153	181	334	132	157	289	86.3	86.7	86.5
Plaine Verte	112	118	230	83	89	172	74.1	75.4	74.8
Mangalkhan	98	160	258	64	130	194	65.0	81.3	75.2
Belvédère	169	186	355	122	149	271	72.2	80.1	76.3
TOTAL	1200	1551	2751	887	1182	2069	73.9	76.2	75.2

Among those invited to participate to the survey (n=2751), 2069 participated and thus the overall response rate was 75.2%. The response rate was 73.9% for men and 76.2% for women (see Table 2.4).

3.0 Diabetes and pre-diabetes

Background

The term diabetes mellitus describes a metabolic disorder with multiple causes, and is characterised by chronically elevated blood glucose levels (hyperglycaemia), with disturbances of carbohydrate, fat and protein metabolism. The effects of diabetes include long-term damage, dysfunction and failure of various organs and tissues. It predisposes those suffering from it to many severe conditions, including cardiovascular disease, as well as visual loss, amputations and renal failure.

Type 2 diabetes constitutes at least 90% of all diabetes. It is now a common and serious global health problem, which, for most countries, has evolved in association with rapid cultural and social changes, ageing populations, increasing urbanization, dietary changes and reduced physical activity leading to obesity and other unhealthy lifestyle and behavioural

patterns. Many of these risk factors for type 2 diabetes are also risk factors for cardiovascular disease and other chronic diseases.

On December 21st 2006, the United Nations General Assembly unanimously passed Resolution 61/225 declaring diabetes an international public health issue and declaring World Diabetes Day as a United Nations Day, only the second disease, after HIV/AIDS, to attain that status. For the first time, governments have acknowledged that a non-infectious disease poses as serious a threat to world health as infectious diseases like HIV/AIDS, tuberculosis and malaria. This United Nations resolution recognises that tackling diabetes is likely to be one of the most important challenges for the global public health community in the 21st century.

Definitions

Diabetes and pre-diabetes

The diagnostic criteria for diabetes, IGT and IFG were based on the values for venous plasma glucose concentration (fasting and two-hour measurements) outlined in the 1999 World Health Organization report on the Diagnosis and Classification of Diabetes⁴ (Table 3.1). People who reported taking oral hypoglycaemic medication and/or insulin were classified as having diabetes regardless of their plasma glucose levels. The term 'pre-diabetes' is used to include all those with either IGT or IFG. In this report, results for type 1 and type 2 diabetes have not been reported separately, as the vast majority of cases were classified as type 2.

Known diabetes

Participants were classified as having known diabetes if they satisfied at least one of the following criteria:

1. receiving glucose-lowering treatment in the form of tablets or insulin (or both) at the time of the study, or;
2. having ever been told by a doctor or nurse that they had diabetes, and had a fasting blood glucose or 2-hr post load glucose levels over the cut-offs for diabetes mellitus (Table 3.1).

Newly Diagnosed Diabetes

Newly diagnosed cases of diabetes consisted of those:

- not previously diagnosed with diabetes, and who had fasting or 2-hour plasma glucose measurements over the diabetes cut-off range (Table 3.1).

Table 3.1 Classification values for the oral glucose tolerance test

Glucose tolerance	Plasma glucose (mmol/l)		
	Fasting glucose		2-hour glucose
Diabetes	≥7.0	or	≥11.1
Impaired glucose tolerance (IGT)	<7.0	and	7.8–11.0
Impaired fasting glucose (IFG)	6.1–6.9	and	<7.8
Normal glucose tolerance (NGT)	<6.1	and	<7.8

Notes: All participants on oral hypoglycaemic medication or insulin were classified as having diabetes.

Results

3.1 Glucose tolerance status

The prevalence of diabetes (age and gender standardised to the national population of Mauritius in 2008) in adults aged 20-74 years was 20.5%: 19.6% in men and 21.3% in women.

Figure 3.1 shows the age-specific prevalence of diabetes for each gender. Applying the age-specific prevalence of diabetes for each gender to the total population of Mauritius in 2014 produces an estimate of 265,000 people aged between 20 and 74 years with diabetes.

The prevalence of diabetes (age- and gender-standardised to the national population of Mauritius) in adults aged 25-74 years was 22.8%: 23.5% for women and 22.0% for men. The prevalence of diabetes in adults aged 30-74 years was 25.8%: 25.3% in men and 26.6% in women.

In line with agreed WHO Global NCD Action Plan Indicators, The age and sex standardised prevalence of type 2 diabetes in the Mauritian Population aged 18 – 74 years was 19.5%: 18.7% in men and 19.5% in women.

The survey found that only about two thirds of the persons found to have diabetes had been previously diagnosed. Table 3.2 shows the prevalence of known and newly diagnosed diabetes according to age. Table 3.3 shows the prevalence of diabetes according to ethnic group. Due to the small numbers of Chinese and those belonging to the 'other' group, these ethnic groups were combined. The prevalence of diabetes in rural and urban areas was 23.6% and 21.7%, respectively.

Table 3.2 Age-specific prevalence (%) of known and newly diagnosed diabetes: the Mauritius 2015NCD survey.

	Age groups (years)						Total*
	18-24	25-34	35-44	45-54	55-64	65+	
Men							
Newly diagnosed	1.0	3.8	7.2	13.0	12.8	13.0	8.0
Known	0	1.0	5.5	16.1	34.0	39.8	11.6
Women							
Newly diagnosed	3.1	4.7	7.8	11.4	11.0	13.6	8.2
Known	0	3.0	7.3	16.6	32.5	42.4	13.9
All persons							
Newly diagnosed	2.1	4.3	7.6	12.0	11.8	13.4	8.1
Known	0	2.0	6.5	16.4	33.2	41.2	12.4

Notes: *Standardised to the 2008 population of Mauritius aged 25-74 years.

Table 3.3 Age and gender standardised prevalence of diabetes according and ethnic group: Mauritius NCD Survey 2015.

	Hindu	Muslim	Creole	Chinese +other*
All persons				
DM	24.6	22.6	21.9	14.1

Notes: *The *other* population includes those who are 'Franco-Mauritian'. Prevalence data were standardised to the 2008 population of Mauritius aged 25-74 years.

The prevalence of IGT (age- and gender-standardised to the national population of Mauritius in 2008) in adults aged 25-74 years was 14.2%: 15.7% for women and 12.4% for men. The prevalence of IGT increased with age for both genders. The prevalence of IGT was higher in women than men. The age- and gender-standardised prevalence of IFG was 5.3%: 4.5% in women and 6.2% in men. The prevalence of IFG was higher in men than women. The age-specific prevalences of IFG and IGT are shown in Table 3.4.

In line with agreed WHO Global NCD Action Plan Indicators, The overall prevalence of pre-diabetes (IGT and IFG combined) in the Mauritian population aged 18–74 years was 19.5%: 20.2% for women and 18.5% for men.

Table 3.4. Age-specific prevalence (%) IGT and IFG according to gender: the Mauritius NCD Survey 2015.

	Age groups (years)						Total*
	18-24	25-34	35-44	45-54	55-64	65+	
Men							
IGT	7.2	16.1	14.0	12.7	12.8	12.6	12.4
IFG	3.8	2.9	7.2	8.6	6.5	7.1	6.2
Women							
IGT	7.8	10.2	19.8	19.4	14.2	14.2	15.7
IFG	3.0	3.4	4.1	5.5	5.4	4.5	4.5
All persons							
IGT	6.0	8.7	18.1	13.6	13.7	13.5	14.2
IFG	3.4	3.2	5.5	6.9	5.9	5.7	5.3

Notes: *Prevalences were standardised to the 2008 population of Mauritius aged 25-74 years.

Figure 3.1: Age-specific prevalence of diabetes according gender: the Mauritius NCD Survey 2015.

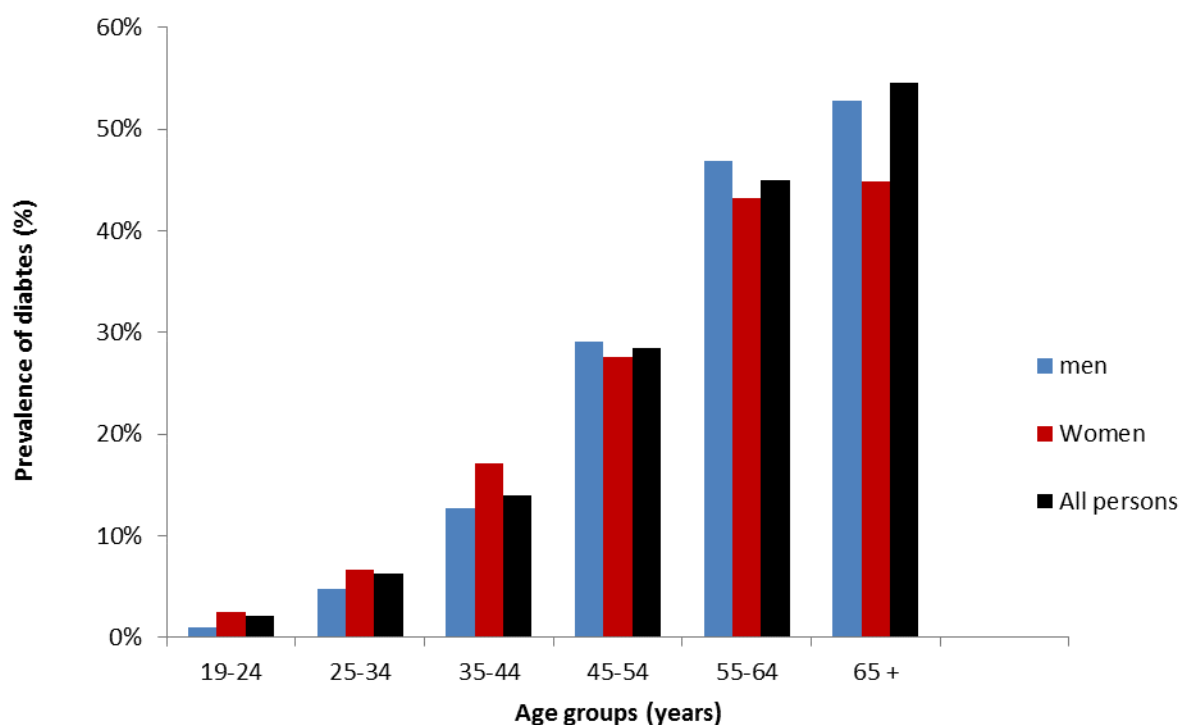


Figure 3.2 shows the prevalence of diabetes in 1987, 1992, 1998, 2004, 2009 and 2015 surveys. All estimates were standardised to the 2008 estimated population of Mauritius. The first three of these surveys were conducted by the Baker IDI with funding from National Institute of Health in conjunction with other collaborators. The 2004 was conducted by the Ministry of Health and Quality of life, while the 2009 and 2015 surveys were conducted by the Ministry of Health and Quality of Life with *in kind* support by Baker IDI. The methodologies of the surveys and age distributions of the samples were similar. It is important to note that the 1992, 1998 and 2004 surveys were predominantly follow-ups of the 1987 survey, while the 1987, 2009 and the 2015 survey samples were entirely independent samples. The prevalence of diabetes has increased steadily over the last 20 years. Since 1987, there has been a 61.5% increase in the prevalence of diabetes, but in 2015 we observed that diabetes prevalence has plateaued.

Figure 3.2: Age-standardised prevalence of diabetes across the six surveys according to gender.

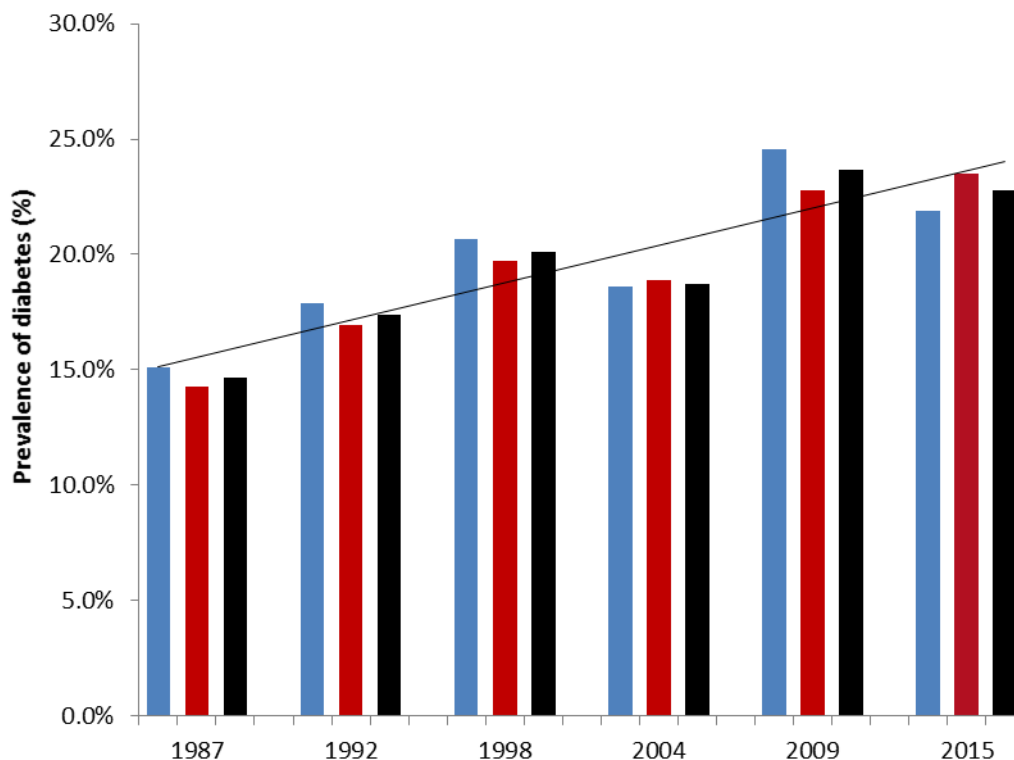


Figure notes: All prevalences were standardised to the 2008 population of Mauritius aged 25-74 years.

Table 3.5 shows the achieved level of glycaemic control (as measured by HbA1c) among people with previously diagnosed diabetes, according to their treatment category. Among those treated with oral hyperglycaemic drugs or insulin treatment, 33.4% had an HbA1c level greater than or equal to 9%.

Table 3.5 Glycaemic control in all participants reporting a diagnosis of diabetes: the Mauritius NCD Survey 2015.

Self reported treatment for diabetes	N	Haemoglobin A1c groups (%)					
		≤5.9%	6-6.9%	7-7.9%	8-8.9%	9-9.9%	≥10%
None	10	0.0	10.0	40.0	10.0	10.0	30.0
Diet only	21	0.0	23.8	42.9	14.3	4.8	14.3
Herbal	1	0.0	0	100.0	0	0.0	0.0
Oral medication	568	4.6	21.0	28.5	19.2	10.9	15.9
Insulin	43	0.0	9.3	4.7	18.6	23.3	44.2
Oral & Insulin	71	1.4	0	12.7	14.1	26.8	45.1
Total	714	3.8	18.1	26.1	18.5	13.0	20.6

4.0 Obesity

Background

Obesity is strongly linked to type 2 diabetes, and is a major risk factor not only for type 2 diabetes, but other chronic conditions such as hypertension, cardiovascular disease, dyslipidaemia, some cancers, sleep disturbances and arthritis. The most serious form of obesity is the central (abdominal) rather than peripheral form, as it is associated with substantially higher risks for diabetes and cardiovascular disease.

Definition

Overweight and obesity were defined using the World Health Organization classification³ based on BMI (weight/height²), and waist circumference. The WHO recommend different cut points depending on ethnicity (see below). While the BMI is used as a measure of overall adiposity (Table 4.1), the waist circumference is a more accurate measure of central adiposity (Table 4.2).

Table 4.1 Body mass index classification of obesity.

	Body mass index (kg/m ²)	
	Europeans (including Creoles)	Asians
Normal	<25.0	<23.0
Overweight	25.0–29.9	23.0–24.9
Obese	≥30.0	≥25.0

Table 4.2 Classification of abdominal obesity by waist circumference

	Waist circumference (cm)	
	Males	Females
Large waist *	≥90.0	≥80.0
Large waist#	≥102.0	≥88.0

Notes: * Asian cut points; # European and African cutpoints

Results

4.1 Obesity

Table 4.3 shows the prevalence of normal weight, overweight and obesity. Using the European body mass index (BMI) cutpoints, the age and gender standardised prevalence of obesity was 19.1%: 11.1% in men and 25.9% in women (Mauritian adult population aged 25-74 years).

In line with agreed WHO Global NCD Action Plan Indicators, Using the European body mass index, the age and gender standardised prevalence of overweight in the Mauritian population aged 18-74 years was 32.3%: 35.0% in men and 30.0% in women.

In line with agreed WHO Global NCD Action Plan Indicators, Using the European body mass index (BMI) cutpoints, the age and gender standardised prevalence of obesity in the Mauritian population aged 18-74 years was 17.6%: 10.2% in men and 23.7% in women.

Table 4.3a The age and gender standardised prevalence of normal weight, overweight and obesity: the Mauritius NCD Survey 2015.

	Men	Women	Total
BMI (cutpoints for European)			
Normal weight	50.1	41.6	45.7
Overweight	38.3	32.6	35.2
Obese	11.1	25.8	19.1

Table 4.3b The age and gender standardised prevalence (18-74) of normal weight, overweight and obesity: the Mauritius NCD Survey 2015.

	Men	Women	Total
BMI (cutpoints for European)			
Normal weight	54.7	46.2	50.1
Overweight	35	30	32.3
Obese	10.2	23.7	17.6

Table 4.4 shows the prevalence of normal weight, overweight and obesity using BMI cutpoints for ethnic specific BMI cutpoints.^{5,6}For BMI, the Asian-specific cutpoints were applied to the Hindu, Muslim and Chinese populations while the European cutpoints were applied to the Creole and *other* (Franco-Mauritian) population. Using ethnic-specific BMI cutpoints, the age and gender standardised prevalence of obesity was 45.5% with more women being obese than men. Using ethnic-specific waist circumference cutpoints, the prevalence of obesity was 55.9%.

In line with agreed WHO Global NCD Action Plan Indicators, Using ethnic-specific waist circumference cutpoints, the prevalence of obesity was 50.7%: 62.6% in men and 36.6% in women.

Applying age-specific prevalence of obesity for each gender to the total population of Mauritius in 2014 produces an estimate of 398,417 Mauritius aged between 25 and 74 who are overweight or obese using ethnic-specific BMI groups.

Table 4.4a Age- and gender-standardised prevalence of normal weight, overweight and obese by BMI and large waist circumference according to gender.

	Men	Women	Total
BMI (cutpoints for Asians and Europeans)			
Normal weight	34.0	29.3	34.0
Overweight	26.7	20.1	23.1
Obese	39.4	50.6	45.5
*Waist Circumference			
Large waist	40.1	68.5	55.9

Notes: Standardised to the 2008 population of Mauritius aged 25-74 years. Ethnic specific cutpoints

Table 4.4b Age- and gender-standardised prevalence (18-74) of normal weight, overweight and obese by BMI and large waist circumference according to gender.

	Men	Women	Total
BMI (cutpoints for Asians and Europeans)			
Normal weight	39.3	34.7	36.8
Overweight	24.5	18.7	21.3
Obese	36.1	46.6	41.8
*Waist Circumference			
Large waist	36.6	62.6	50.7

Notes: Standardised to the 2008 population of Mauritius aged 18-74 years. Ethnic specific cutpoints

5.0 Hypertension and Lipoproteins

Definitions

Hypertension

Participants who reported having hypertension and taking drug treatment or reported hypertension and had a blood pressure of greater or equal to 140/90 mmHg were classified as hypertensive. Participants who had systolic blood pressure or diastolic blood pressure greater or equal to 140/90 mmHg and not on anti-hypertensive medication were defined as *untreated hypertension*.

Lipoproteins

The following thresholds were using to classify participants according to lipid levels.

Table 5.1 Classification of lipid values.

Classification	Blood lipid concentration (mmol/l)			
	Cholesterol	HDL-cholesterol	LDL-cholesterol	Triglycerides
Normal	< 5.2	> 1.0	< 3.5	< 2.0
Abnormal	≥ 5.2	≤ 1.0	≥ 3.5	≥ 2.0

Results

5.1 Hypertension

Table 5.2 show the prevalence of hypertension according to age-group. The age and gender-standardised prevalence of hypertension was 28.5%: 27.0% in women and 30.3% men. The prevalence of hypertension rose steadily with age in both men and women. The age-standardised prevalence of hypertension was higher in men than women.

In line with agreed WHO Global NCD Action Plan Indicators, The age and gender-standardised prevalence of hypertension (18-74 years) was 24.5%: 23.3% in women and 26.1% men.

The diagnostic criteria for hypertension recommended by the WHO include both untreated persons with hypertension and those who have been diagnosed and are on treatment. At all ages, untreated hypertension was more common among men than women. Overall, for every participant being treated for hypertension there was at least another untreated person except for the older age groups.

Medication to control hypertension was being taken by 15.0% of the population: 14.2% of men and 15.7% of women. In both genders the usage of such medication increased with age, from levels of 2-3% or less for the youngest groups, to over 50% for the oldest female group. Of those participants with hypertension, 46.9% of males and over 58.1% of females were taking medication for hypertension, with the remaining 53% of men and 42% of women being untreated cases of hypertension. For those on treatment, even so, 70.6% had elevated blood pressure levels.

Table 5.2 Age-specific classification by treatment status of hypertensive participants according to gender: the Mauritius NCD Survey 2015.

Hypertension Category	Age (years)					
	18-24	25 – 34	35 – 44	45 – 54	55 – 64	65 +
Males						
Untreated ^a	3.1	6.0	14.1	22.3	24.1	27.4
Treated ^b	0.6	0.5	7.4	16.4	35.1	47.7
Total hypertensive	3.7	6.4	21.6	38.6	59.2	75.1
Females						
Untreated ^a	2.9	3.5	9.9	14.1	20.2	18.3
Treated ^b	0.0	1.9	4.2	19.1	36.6	53.7
Total hypertensive	2.9	5.4	14.1	33.2	56.8	74.0
All Persons						
Untreated ^a	2.5	4.6	11.8	17.8	21.9	21.8
Treated ^b	0.3	1.3	5.7	17.8	35.9	51.0
Total hypertensive	2.8	5.9	17.5	35.7	57.9	72.8

Notes: ^aSystolic pressure \geq 140 mmHg, or diastolic pressure \geq 90 mmHg, and not on anti-hypertensive medication. ^bOn anti-hypertensive medication. Totals may not equal sum of the two because of rounding and missing data in the treatment variable. Prevalences are standardised against the 2008 Mauritian population.

5.2 Lipids

The age and gender-standardised prevalences of various lipid abnormalities are shown in table 5.3. Men had a higher prevalence of elevated low density lipoprotein cholesterol (LDL-C), total cholesterol, elevated triglycerides and low high density lipoprotein cholesterol (HDL-C) than women. Almost 66% of Mauritians had at least one abnormality in one of the four lipids.

Table 5.3 Age- gender standardised prevalence of elevated LDL-C, total cholesterol, low HDL-C and triglycerides: the Mauritius NCD Survey 2015.

	Elevated LDL-C	Elevated Total Cholesterol	Low HDL-Cholesterol	Elevated Triglycerides
Men	32.1	47.1	18.9	37.0
Women	28.0	41.8	32.4	15.1
All Persons	29.7	44.1	26.5	25.0

Notes: LDL cholesterol ≥ 3.5 mmol/l; Total cholesterol ≥ 5.2 mmol/l; HDL cholesterol ≤ 1.0 mmol/l; Triglycerides ≥ 2.0 mmol/l. Prevalences are standardised against the 2008 Mauritian population

The age-sex standardised prevalence of elevated total cholesterol (≥ 5.2 mmol/l) was 44.1%.

Lipid-lowering agents were being taken by 13.3% of the population, comprising 11.7% of men and 14.7% of women, respectively.

6.0 Lifestyle behaviours

6.1 Smoking

The age- and gender-standardised prevalence of smoking was 19.3%: 3.9% in women and 38.0% in men. The prevalence of smoking was highest in the younger age-groups with over 50% of men aged 19-24 years of age reporting smoking. Smoking decreased with age in both men and women.

In line with agreed WHO Global NCD Action Plan Indicators, The age- and gender-standardised prevalence of smoking in the Mauritian population aged 18-74 years was 19.7%: 4.1% in women and 38.5% in men.

Table 6.1 Age-specific prevalence (%) of smoking status categories according to gender: the Mauritius NCD Survey 2015.

Smoking status	Age (years)					
	18-24	25 – 34	35 – 44	45 – 54	55 – 64	65 +
Men						
Ex-smoker	6.1	6.4	10.8	14.1	20.8	22.1
Current smoker	44.7	49.5	41.4	32.2	25.4	20.6
Women						
Ex-smoker	0.7	2.7	2.0	2.1	1.9	1.8
Current smoker	7.2	6.9	3.9	2.4	1.7	1.2
All persons						
Ex-smoker	2.8	4.4	6.0	7.6	10.4	11.0
Current smoker	21.6	26.4	21.0	16.0	12.4	10.0

6.2 Physical activity

Self-reported data on physical activity was collected using the Global Physical Activity Questionnaire (GPAQ). This questionnaire asks about moderate and vigorous physical activity during leisure time and walking, and travelling to and from work. The Ministry of Health and Quality of Life recommend that Mauritians should undertake 30 minutes of exercise each day comprising of brisk walking, jogging, swimming, cycling or dancing (aerobic). Table 6.2 shows the crude prevalence of Mauritians who meet these guidelines. These data show that only 23.7% of Mauritians (18.5% of women and 30.2% of men) undertook sufficient vigorous or moderate physical activity to meet the national guidelines.

In line with agreed WHO Global NCD Action Plan Indicators, 22.8% of Mauritians (18 – 74 yrs) undertook sufficient vigorous or moderate physical activity to meet the national guidelines (30.2% of men and 16.9% of women).

Table 6.2 Crude prevalence of Mauritians who meet National guidelines of 30 mins of moderate or vigorous leisure physical activity each day: the Mauritius NCD Survey 2015.

	Age (years)					
	18-24	25 – 34	35 – 44	45 – 54	55 – 64	65 +
Men	34.6	30.6	36.1	29.8	27.8	8.3
Women	8.5	15.1	21.5	23.1	17.0	9.1
All persons	20.0	22.0	28.0	26.1	21.8	8.7

6.3 Alcohol consumption

A total of 52.8% individuals (41.0% of women and 66.2% of men) reported consuming alcohol (Table 6.3). Among those who reported consuming any alcohol, more than 85.4% of the men and almost 90% of the women were light drinkers consuming fewer than two drinks per day (Table 6.4).

Table 6.3 Age-specific prevalence (%) of the frequency of alcohol consumption according to gender: the Mauritius NCD Survey 2015

	18-24	25-34	35-44	45-54	55-64	65+
Men						
Never	34.2	32.6	24.9	26.1	26.7	34.5
Ex drinker	0.6	3.2	5.1	7.9	6.7	7.1
Once per week or less	54.3	42.7	42.8	38.6	39.2	34.5
2-3 days per week	4.9	11.9	15.2	10.5	10.3	6.1
≥4 days per week	6.1	9.6	12.1	16.9	17.2	17.8
Women						
Never	59.1	54.2	54.9	57.6	65.1	65.3
Ex drinker	0.5	1.5	0.6	1.3	1.7	3.0
Once per week or less	38.9	41.2	40.9	39.0	30.3	27.9
2-3 days per week	0.5	2.3	2.3	1.9	2.1	3.0
≥4 days per week	1.0	0.8	1.4	0.2	0.8	0.9
All persons						
Never	47.6	44.4	41.3	43.2	47.8	51.3
Ex drinker	0.6	2.3	2.6	4.3	3.9	4.9
Once per week or less	45.9	41.8	41.7	38.8	34.3	30.9
2-3 days per week	2.5	6.7	8.1	5.8	5.8	4.4
≥4 days per week	3.4	4.8	6.3	7.8	8.2	8.6

Table 6.4 Amount of alcohol consumption according to gender: the Mauritius NCD Survey 2015.

	Men	Women	All persons*
Fewer than 2 drinks per day	85.4	97.7	90.5
3-4 drinks per day	6.2	1.4	4.3
≥5 per day	8.4	0.8	5.3

7.0 Chronic kidney disease

Background

Chronic kidney disease is common in the general community and causes significant morbidity and mortality. Individuals with chronic kidney disease are at risk of experiencing end-stage kidney failure requiring dialysis or organ transplantation and are also predisposed to develop premature cardiovascular disease with an increased risk of death due to heart attack or stroke.

Definitions

Impaired glomerular filtration rate

Chronic kidney disease is defined as present when there is impaired kidney function. The standard measure of kidney function is the glomerular filtration rate (GFR). GFR can be estimated from the results of a blood test (so called 'estimated' GFR or eGFR) and an impaired eGFR is defined as an eGFR of <60 ml/min/1.73m.²⁷ The eGFR has been calculated using the abbreviated Modification of Diet in Renal Disease(MDRD) formula.⁸

Albuminuria

Early kidney disease can manifest as the leakage of protein into the urine. The earliest manifestation of an excessive leakage of protein into the urine can be detected by measuring the urinary albumin levels and is called albuminuria. We considered albuminuria to be present if the spot urine albumin: creatinine ratio was ≥ 2.5 mg/mmol for men and ≥ 3.5 mg/mmol for women. Albuminuria is a recognised early risk factor for the development of chronic kidney disease and additionally, is an important risk factor for cardiovascular disease and mortality.

Results

7.1 Albuminuria and impaired glomerular filtration rate

The age- and gender-standardised prevalence of albuminuria in the Mauritius population was 6.8%: 6.6% in women and 7.1% in men. The age-specific prevalence of albuminuria is shown in Figure 7.1. The age- and gender-standardised prevalence of impaired glomerular filtration rate (<60 ml/min/1.73m²) was 5.9%: 7.3 % in women and 4.1% in men (Figure 7.2).

Figure 7.1 Age-specific prevalence of albuminuria according to gender: the Mauritius NCD Survey 2015.

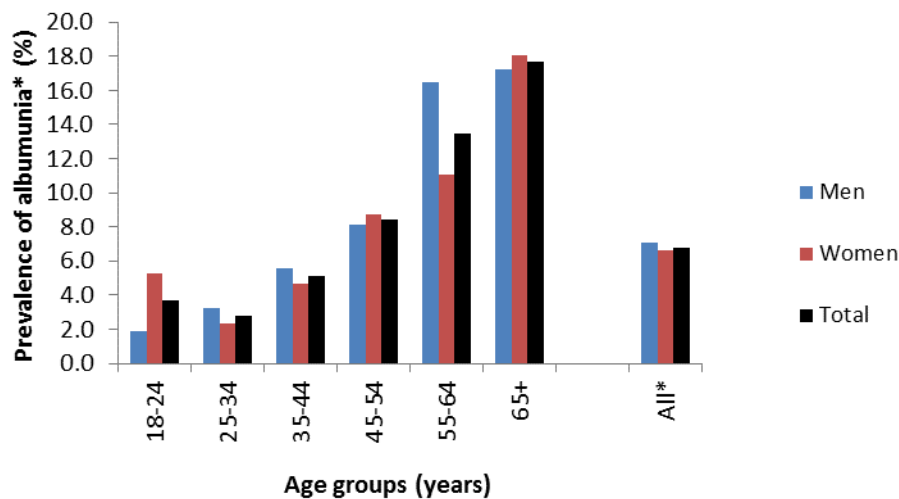


Figure notes: *Age and gender standardised to the Mauritius population of 2008 aged 25-74

Figure 7.2: Gender specific prevalence of impaired glomerular filtration rate (<60 mins/ml/1.73 m²): the Mauritius NCD Survey 2015

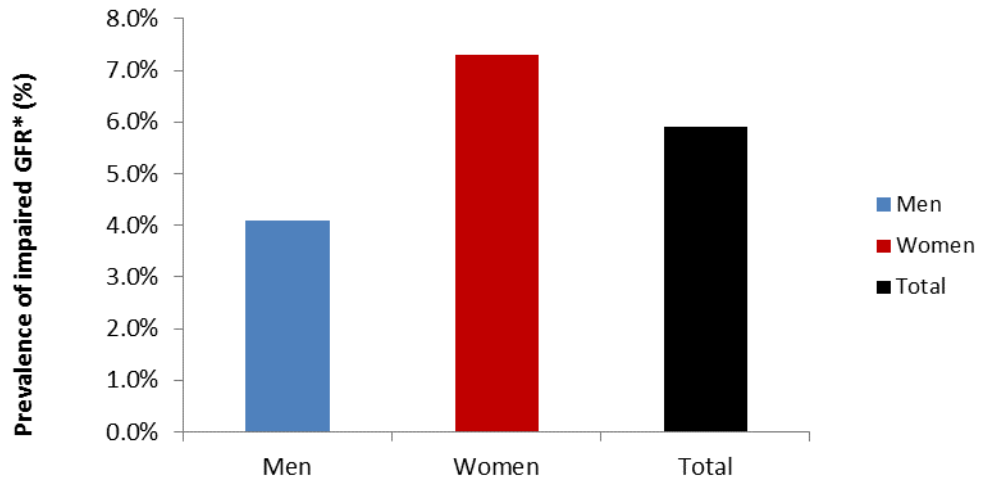


Figure notes: *Standardised to the 2008 Mauritian population.

8.0 Disability

Disability can be described in relation to several aspects of life experience:

- as an impairment in body structure or function (such as significant loss in hearing or vision);
- as an activity limitation (such as needing help with eating or moving around);
- or as are striction in participation (such as attending school, work and social interactions).

These above disability experiences exist in various degrees and combinations among individuals. How people experience and cope with their disability is affected by environmental factors, including opportunities, services and assistance provided for them. Recent gains in life expectancy across developed and developing nations driven mainly by improved medical treatment have been accompanied by an increase in years of life lived with disability.

The prevalence of disability was estimated in adults aged greater than or equal to 50 years of age using the Katz questionnaire. Disability was defined as difficulty with any of the following: walking across a small room; moving in and out of a chair or bed; bathing or showering; dressing yourself; feeding yourself; using the toilet. Disability scores were derived from the answers to the above questions. For each of above 6 activities, the responses were: 1, no difficulty; 2, a little difficulty; 3, some difficulty; 4, a lot of difficulty. For acquiring the prevalence of dichotomized disability, disability was defined as non-limited (response 1) vs. limited (response 2 to 4).

The age and gender standardised prevalence of disability in adults aged ≥ 50 years was 9.8%: 6.7% in men and 12.5% in women.

9.0 Depression

The Center for Epidemiologic Studies Depression Scale (CES-D) is one of the most common screening tests for identifying depressive symptoms in the general population. Major components of depressive symptomology are incorporated into the scale including, depressed mood, feelings of guilt and worthlessness, feelings of helplessness and hopelessness, psychomotor retardation, loss of appetite, and sleep disturbance. The possible range of the 10-item scale is 0 to 30, and a cut off score of ten or higher indicates the presence of significant depressive symptoms.

The age and gender standardised prevalence of significant depressive symptoms in adults aged was 16.7%: 13.1% in men and 19.6% in women.

In line with agreed WHO Global NCD Action Plan Indicators, The age and gender-standardised prevalence of depression standardised 2008 population 18-74 years was 16.0%: 18.7% in women and 12.3% men.

Table 9.1 Age-specific prevalence (%) of depressive symptoms: the Mauritius 2015NCD survey.

	Age groups (years)						Total*
	18-24	25-34	35-44	45-54	55-64	65+	
Men							
Depression	8.1	9.2	18.4	13.9	10.5	13.6	13.1
Women							
Depression	13.8	13.0	21.9	18.7	25.7	27.7	19.6
All persons							
Depression	11.6	11.3	20.3	16.6	19.4	21.6	16.7

Table 9.2 Age- and gender-standardised prevalence of depressive symptoms by weight status.

	Men	Women	Total
BMI groups			
Normal weight	15.6	16.8	16.2
Overweight	18.6	8.0	13.2
Obese	22.2	13.3	19.0

Notes: Standardised to the 2008 population of Mauritius aged 25-74 years. Ethnic specific

Table 9.3 Age- and gender-standardised prevalence of depressive symptoms according to diabetes status

	Men	Women	Total
No Diabetes	11.4	18.5	15.4
Diabetes	29.3	23.9	25.3

10.0 Asthma

The prevalence of asthma-like symptoms was measured using The European Community Respiratory Health Survey (ECRHS) screening questionnaire. Asthma-like symptoms were defined as wheezing or whistling in the chest at any time in the last 12 months (Q1) if which breathlessness occurred during the wheezing episode (Q1a) and these symptoms occurred in the absence of a cold (Q1b). We also included those who reported current medication for asthma (Q6).

Using this definition, the age and gender standardised prevalence of asthma in adults was 8.9%: 8.0% in men and 9.7% in women.

In line with agreed WHO Global NCD Action Plan Indicators, The age and gender-standardised prevalence of asthma standardised 2008 population 18-74 years was 8.9%: 9.6% in women and 8.0% men.

The prevalence of asthma like symptoms increased with age in men and women (Table 10.1) and was highest in ex-smokers. Asthma was more common in those reporting nasal allergy compared to those who did not (21.1% vs 5.1).

Table 10.1 Age-specific prevalence (%) of asthma: the Mauritius 2015NCD survey.

	Age groups (years)					
	18-24	25-34	35-44	45-54	55-64	65+
Men						
Asthma symptoms	8.0	6.4	10.2	5.6	10.3	11.1
Women						
Asthma symptoms	8.8	10.4	9.6	9.4	7.6	13.4
All persons						
Asthma symptoms	8.4	8.6	9.8	7.7	8.8	12.3

Table 10.2 Age- and gender-standardised prevalence of asthma symptoms by smoking status.

	Men	Women	Total
Smoking groups			
Non smoker	6.0	9.0	8.1
Ex smoker	10.9	21.1	13.8
Smoker	8.9	17.7	9.9

Notes: Standardised to the 2008 population of Mauritius aged 25-74 years. Ethnic specific

Table 10.3: Age- and gender-standardised prevalence of asthma symptoms by ethnicity

Ethnicity	Prevalence of asthma
Hindu	9.5
Muslim	10.0
Creole	8.4
Chinese	2.2

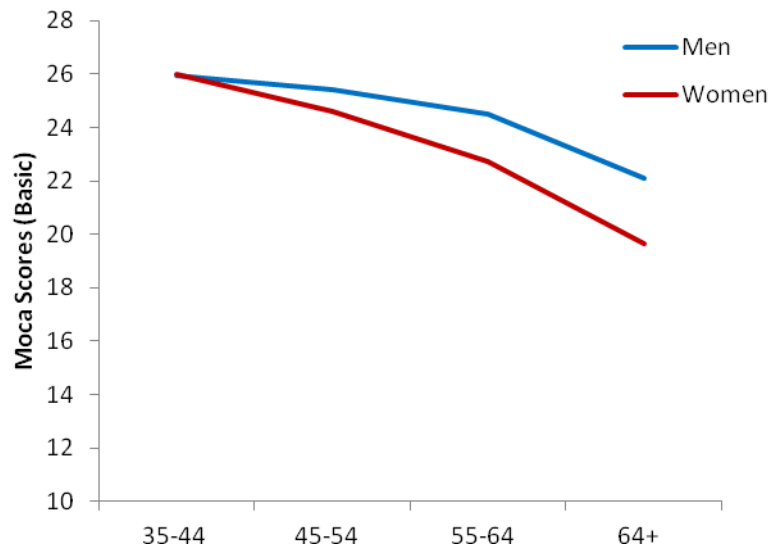
11.0 Cognitive impairment

In 2015, a cognitive assessment was undertaken in those greater than 35 years of age. The instrument used to assess cognitive was the Montreal Cognitive Assessment Tool. Two different forms of this tool were used. The MOCA original was used in those who were literate and the MOCA basic was used for those who were illiterate or did not complete primary school. Scores for both tests range from 0-30. The MOCA test has not been administered in Mauritians before. Given the main aim of this survey was to measure the association of chronic disease with cognitive impairment, raw MOCA scores are not presented.

Among those who completed the MOCA original assessment tool (n=136), mean MOCA scores were not significantly different among with diabetes versus those without. BMI levels and hypertension were also not related to MOCA scores. However, those who undertook sufficient levels of physical activity had significantly higher MOCA scores than those who did not. Total cholesterol, triglycerides, HDL cholesterol and LDL cholesterol were not related to MOCA scores.

Among those who completed the MOCA Basic assessment tool (n=2326), mean MOCA scores were significantly different among with diabetes versus those without (22.13 vs 23.1) after adjusting for age and sex. BMI levels and hypertension were also not related to MOCA scores. Total cholesterol, triglycerides, HDL cholesterol and LDL cholesterol were not related to MOCA scores.

Mean Moca(basic) scores decreased by age in both men and women (Figure 11.1)



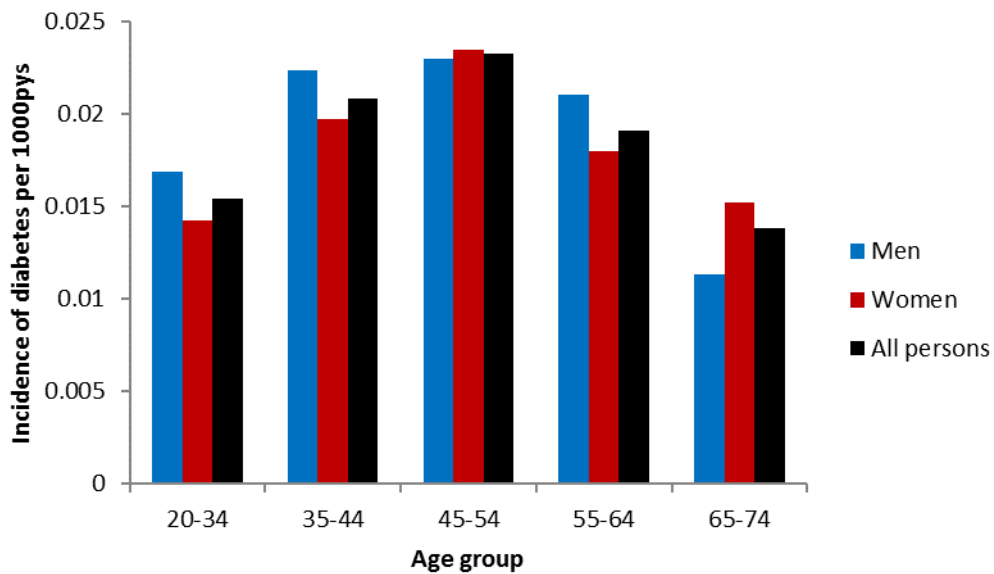
12.0 Incidence of diabetes

The incidence of diabetes was estimated using the 1998 follow-up cohort. The crude incidence of diabetes was 20.0 per 1000 person years in the total population. The incidence of diabetes in men and women was 21.1 and 19.7 per 1000 person-years, respectively. The incidence of diabetes by ethnic group is shown in Table 12.1

Table 12.1 Crude incidence of diabetes according to ethnic group

Ethnicity	Incidence of diabetes per 1000 person years
Hindu	19.7
Muslim	19.8
Creole	23.0
Chinese	19.8

Figure 12.1 Age-specific incidence of diabetes according to gender and age



13.0 Discussion

There were several findings of major importance:

13.1 Diabetes and Pre-diabetes:

- The high prevalence of diabetes- approximately 257,442 Mauritians adults have diabetes. However, the prevalence of diabetes has remained stable i.e from 23.6% to 22.8%.
- The high prevalence of IGT and IFG- The prevalence of pre-diabetes (IFG/IGT), though being still high, have declined from 24.2% to 19.4% compared to the 2009 survey.
- The prevalence of diabetes increased by 62.0% from 1987 to 2009, but in 2015 for the first time in 30 years, diabetes prevalence has stabilised.
- For every two known cases of diabetes, there is one undiagnosed case
- The glycaemic control of people with diagnosed diabetes is poor, with 33% having an HbA1c $\geq 9.0\%$. However, an improvement has been noted compared to the 2009 survey wherein it was 47%.
- The incidence of diabetes was 20 per 1000 persons.

All of these factors have major implications for public health and the national health burden and failure to adequately treat is associated with an increased rapidity of progression to the many complications of diabetes.

13.2 Overweight and Obesity:

- The prevalence of overweight has remained stable (34.9 % v/s 35.2%).
- An increase in the prevalence of obesity has been observed compared to that measured in 2009 i.e. from 16.0% in 2009 to 19.1% in 2015.
- The high prevalence of obesity and overweight which implies that approximately 398,417 Mauritians are overweight or obese.

There is a high likelihood that these levels of obesity have been a significant contributing factor in the escalating prevalence of diabetes. While the prevalence of obesity measured by BMI has stabilised since 2009, obesity rates using waist circumference of 55% still

indicate that obesity must be curtailed in order to reduce the burden of diabetes, as well as other obesity-related conditions.

13.3 Hypertension:

The prevalence of hypertension in Mauritius was 28.0%, which has improved since 2009 when it was 38%. As a major risk factor for both cardiovascular and kidney disease, it is critically important that hypertension should be prevented, recognised and controlled.

13.4 Serum Lipids:

- Despite the availability of lipid-lowering drugs, about a third of Mauritians had elevated total cholesterol levels and almost two thirds of the study population had an abnormality in one of four lipid levels. These levels are similar to those observed in 2009.
- The use of lipid lowering treatment is more prevalent than in 2009 with 13% of Mauritians were taking lipid-lowering medication.
- The importance of nutrition in the control and prevention of dyslipidaemia cannot be underestimated as a first line therapy for the prevention of cardiovascular disease.

13.5 Smoking:

- Smoking prevalence is highest in young people, particularly young men and decreases with age in both genders. However, the prevalence of smoking has decreased from 21.7% to 19.3% in 2015.

13.6 Physical activity

- An improvement in Mauritian population undertaking sufficient physical activity has been noted compared to the 2009 survey i.e. from 16.5% to 23.7%

13.7 Alcohol

- The consumption of alcohol was 52.8%. It was higher in men i.e. 66.2% compared to 41.0% in women. It has increased slightly compared to the NCD Survey 2009 wherein it was 48.5% (33.8% in women and 65.9% in men).

13.8 Kidney disease:

- The prevalence of Albuminuria has decreased from 12.4% to 6.8% compared to Albuminuria rates in 2009. Albuminuria prevalence in Mauritians is high, both in women and men and this indicates a population clearly at risk for whom intervention should be contemplated.
- The use of impaired glomerular filtration rate as indicator of renal disease has not been fully validated in all ethnic groups and thus the figures relating to this should be interpreted with caution
- The proportion of Mauritians with either diabetes, hypertension , or albuminuria (ie at risk of developing kidney disease) is 34%

Other conditions leading to kidney disease such as diabetes and hypertension were present in a large proportion of the study population. Given the plethora of literature demonstrating the adverse relationship between diabetes and hypertension, and subsequent long-term poor renal outcomes, the impact of such high rates on future prevalence of kidney disease in Mauritius, although not known, is expected to be significant.

13.9 Depression and disability:

- Depression rates, especially in Mauritian women, were high at almost 20%.
- Over 10% of Mauritian adults aged 50 years or over reported requiring some help completing their ordinary daily tasks and was higher in women than men. Data on disability prevalence in developing nations is limited but generally ranges from 10-20% of adults aged 65 years or over requiring some assistance. Disability prevalence also depends on the age group studied and the instrument used to measure disability. As the population in Mauritius continues to age and medical treatment improves, disability will increase. High rates of disability are associated with a financial burden for the individuals affected and for the health care system.

13.10 Cognitive Impairment:

- Cognitive screening was undertaken on those aged 35 years and above with the use of Montreal Cognitive Assessment Tool (MOCA). It was observed that BMI levels and hypertension were not related to MOCA scores; however, those who undertook sufficient physical activity had significantly higher MOCA scores than those who did not.
- Given the fact that this is a novel and complicated aspect, data is still being analysed.

13.11 Asthma:

- This is the first survey to measure the prevalence of asthma-like symptoms. The prevalence of adult Mauritians with asthma-like symptoms was around 10% and similar in both sexes.

Notable differences since last survey

Diabetes and NCD risk factors: While the prevalence of diabetes is still high, it is important to recognize that in 2015 we did not see any further increase in diabetes. The prevalence of diabetes has stabilised (23.6% v/s 22.8%). This is likely due to the implementation of various screening and prevention activities over the last 15 years. We also note that there are other signs that the escalation of chronic disease may have decreased somewhat in Mauritius. These signs include lower hypertension prevalence and lower obesity prevalence according to BMI (though the prevalence according to waist circumference continued to rise).

Treatment of people with diabetes: Among people with diagnosed diabetes, the proportion with poor blood glucose control ($HbA1c \geq 9.0\%$) has dropped from 47% to 33%.

Control of risk factors: Furthermore, the proportion of individuals in the general population taking lipid-lowering and anti-hypertensive medication has increased.

Diabetes incidence: The incidence rate of diabetes measured in 2015 (20 per 1000 person – years) is similar to that measured in 1992-1998 or in 1987-1998.

Collectively, these are encouraging signs that chronic diseases in Mauritius are no longer escalating.

14.0 Survey methods

Survey protocol and procedures

14.1 Sample size of survey population

Considering information from past surveys on the prevalence of diabetes, the degree of precision desired around the new prevalence estimate, and the cluster effect, a minimum sample size of 4000 was required for the study.

14.2 Sample design of survey population

Mauritius is divided into nine districts. The total sample size to be drawn from each district was proportional to the population size of the district. For the prevalence survey, a two-stage sampling was used to obtain a representative sample of the population. Eleven clusters previously not used in other surveys were selected using the Sampling Frame of Statistics Mauritius. The 11 clusters were chosen randomly (the number proportional to size) from the 9 districts according to the approximate population size. To ensure that all ethnic groups are adequately represented in the sample, 2 additional clusters namely Plaine Verte and China Town have been included.

14.3 Enumeration of survey population

A complete listing of members of each household aged 18 years and over within the 13 clusters was carried out in May/June 2015. The information collected at this stage, such as age, sex and ethnicity, was used for the selection of respondents to be investigated at the survey sites. Some 11,500 households were finally enumerated and around 36,300 individuals were listed.

After the exercise of data capture, the listed individuals of the 13 clusters have been pooled together to obtain a master file. The potential participants were grouped by ethnic

group and sex and then sorted by age. A systematic sampling was then carried out within the eight sorted lists. A total of 4,400 participants were invited to participate.

14.4 Response Rates

The target population for the NCD survey sample to estimate prevalence of diabetes was adults aged 18 - 80 years.

Of those invited to participate in the survey (n=4,400), 3,830 attended the survey sites and thus the overall response rate was 87.0% (84.2% for men and 89.6% for women)(see Table 2.2).

The 1998 NCD sample was used as the base population for the follow-up (cohort study). Participants were recruited from 9 from 14 clusters used in 1998. (see Table 2.2). Approximately, 2751 individuals from those who participated in NCD Survey in 1998 were chosen for follow up to measure diabetes incidence with no age limit. Response rates, among those still alive, for this sample are listed in Table 2.4. The final sample size was 2069 and the response rate was 75.2%(73.9% for men and 76.2% for women).

14.5 Invitation and recruitment

In each household selected, the randomly chosen person was invited, in writing, to attend the survey at a given date. They were asked to arrive at 7 am and were asked to fast for at least 12 hours and bring along any medications.

Participants were tested at each of the sites. On-site testing commenced on 20 July 2015 and finished on 24 August 2015. The lists of sites for both samples are shown in Table 14.1 and Table 14.2.

14.6 Training

Two teams of survey staff were recruited to administer the survey. All staff attended a three-day training workshop, which was conducted by the project manager, staff from the Ministry of Health and Quality of Life and Dr Magliano and Professor Soderberg. Staff were briefed on the survey's background, objectives and methodology to ensure accurate and consistent data collection.

14.7 Physical examination

The physical examination procedures closely follow the study protocol recommended by the World Health Organization for the study of diabetes and other non-communicable diseases. The physical examination was conducted on both weekdays and weekends. Local survey sites included community halls, scout halls, sporting halls, church halls and schools. Survey activities at the testing site commenced at 7am and typically finished at 1pm. On average, approximately 90 participants attended daily.

All participants gave written informed consent to participate in the survey upon arrival at the testing site. Participants were moved through the physical examination procedures in a circuit-like manner that took approximately 3–3.5 hours to complete. Participants were asked to remain on site until all tests were performed. Central to the physical examination was the standard two-hour oral glucose tolerance test (OGTT), during which time all other procedures were performed.

14.8 Blood sampling, oral glucose tolerance test and laboratory procedures

Blood was collected by venepuncture after an overnight fast (nine hours or more). Specimens were collected into separate tubes in the following order: two plain tubes for measurement of total cholesterol, high-density lipoprotein cholesterol, triglycerides, creatinine, and urea, uric acid and insulin, a fluoride/oxalate tube for plasma glucose and an EDTA tube for HbA1c. All the blood specimens were stored in a cold box and transported to the laboratory within 2 hours of collection. All analyses were conducted at the Central Health Laboratory, Candos. Glucose was measured by Glucose Oxidase method. Serum triglycerides, total cholesterol and HDL-C, urea and uric acid were measured by enzymatic methods and creatinine measured by the kinetic alkaline picrate method. All these assays were performed on an Abbott Architect C8000. HbA1c was assayed using the HPLC cation exchange method on the Tosoh G8 analyzer. Low-density lipoprotein cholesterol was derived by calculation using the Friedewald formula. A 75 g OGTT was performed on all participants, except those on insulin or oral hypoglycaemic drugs, those who were pregnant or those who failed to fast.

Serum insulin was measured on the Abbott Architect i2000 Immunoassay System. The assay is based on the chemiluminescent microparticle immunoassay (CMIA).

14.9 Urine collection and laboratory procedures

A morning spot urine sample was taken. Each sample was screened for presence of protein using the Medi-test protein 2 strips (Macherey-Nagel, Germany). Urine Creatinine was measured by the modified kinetic Jaffe reaction adapted on the Abbott Architect C8000 automated system. Urine albumin was measured by an immunoturbidimetric assay adapted on the Roche Cobas Mira Plus analyser: Creatinine ratio was calculated and reported.

14.10 Anthropometry

Height was measured to the nearest 0.5 cm without shoes using a stadiometer. Weight was measured without shoes and excess clothing to the nearest 0.1 kg using weighing scales. Body mass index (BMI: kg/m²) was calculated. Waist circumference and hip circumference were measured using a dress-maker's measuring tape applied horizontally. Waist girth was measured at the mid-point between the iliac crest and the lower margin of the ribs. Hip girth was recorded as the maximum circumference around the buttocks. Waist and hip circumference were measured to the nearest 0.5 cm.

14.11 Blood pressure

Blood pressure measurements were performed in a seated position after resting for five minutes or more using an automated blood pressure monitor that was regularly calibrated (Omron Blood pressure machine M7). A cuff of suitable size was applied on the participant's exposed upper arm (the arm not used for blood collection), which was supported on a table at heart level. An 'obese' cuff was available. Three measurements were taken, with a 1 minute interval between them, and the mean of the closest two measurements was calculated.

14.12 Questionnaires

A series of interviewer-administered questionnaires was used to ascertain a range of health and social information including, previous diagnosis of diabetes and cardiovascular disease, exercise, and smoking. The Montreal Cognitive Assessment Tool (MOCA) tool was used to measure cognitive impairment. This tool was translated into Creole. For those who had low education attainment, the MOCA basic was administered. The Centre for studies Depression (CES-D) tool was used to measure depressive symptoms and the KATZ activities of daily living questionnaire was used to measure disability. Asthma-like symptoms were assessed using the European Asthma screening tool.

Table 14.1 List of clusters used in the Mauritius NCD survey 2015

SN	District Name	Clusters
1.	Port Louis	Vallée des Prêtres
		China town
		Plaine Verte
2.	Pamplemousses	Pamplemousses
3.	Riviere Du Rempart	Goodlands
4.	Flacq	Bel air
5.	Grand Port	Mahebourg
6.	Savanne	Rivière des Anguilles
7.	Plaine Wilhems	Curepipe
		Rose Hill
		Henrietta
8.	Moka	Petit Paquet/Montagne Blanche
9.	Black River	Petite Rivière

Table 14.2 List of clusters used in the 1998 Mauritius NCD follow up sample

SN	District Name	Clusters
1.	Port Louis	Cité Vallijee Plaine Verte
2.	Pamplemouses	Triolet
3.	Riviere Du Rempart	Petit Raffray
4.	Flacq	Belvedere/Bon Accueil
5.	Grand Port	Rose Belle
6.	Savanne	Rivière du Poste
7.	Plaine Wilhems	Mangalkhan/Floreal Phoenix

Table 14.3 List of staff who worked on the study

Survey Officers	Name	Survey Officers	Name	Survey Officers	Name
Chief Investigator	Dr K. Pauvaday	General Administrator	Mrs I. Rugjee	Laboratory Coordinator	Dr (Mrs) S. Hunma
Principal Investigator	Dr A. Deelchand	Laboratory Manager	Dr (Ms) N. Joonas	Survey Site Administrators	Mr M. Bahadoor Mrs S. D. Heecharan Mrs J. Jhoomuck Mr R. Beezmohun Ms O. Gaonjur Mrs M.D. Jeetunsiv Mrs L.D. Mohit Mrs L. S. A. Sampatee Mrs A. Fazullah Mr M. Caremben Mrs P. Jhowry Mrs B. Purmessur Mr V. Sookeerah Mr S. Borthosow Mr A. Ramooah Ms R. Lallbahadoor Mr S. Utchanah
Survey Project Manager/Investigator	Mr S. Kowlessur				Mr Y. Seeruttun
Co-Investigators	Dr (Mrs) A. Sorefan Dr S. Mudoo Mr P. Gayan				
Enumeration Supervisor	Mr S.K Sobee Mrs S. Kalasopatan-Chellen	Survey Operational Officers	Mrs A. Ramkhelawon Mr R. Bookal Mr I. Neetye Ms P. Chekhor	Senior Survey Officer	
Principal Survey Coordinator	Mr J. Heecharan	Data Editors	Mr S. Lallmohamed Mr A. Jeetoo	Survey Officers	Mrs A. Fazullah Mrs T. Dinrary Mrs J. Canaye
Human Resources Survey Officer	Mr S. Utchanah	Data Entry Officers	Mrs B. Doorgah Mrs B.N. Hosene Mrs L. Audit Mrs S. Konayernkunowdu Mrs S. Soukhy Mrs S. Dulloye Ms R. Limbeea Ms T. Seegum Mrs B. Pem Mrs T. Rozbully	Interview Supervisors	Mrs L. Mootoosamy Mrs V. Vythilingum
Data Manager	Mr N. Jeeanody				

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Survey Officers	Name	Survey Officers	Name	Survey Officers	Name
Survey Bleeding Supervisor	Mr R. Mannaram	Survey Procurement Officer	Mr P. Ghallu	Finance Survey Officer	Mr J. Jeewoath
Survey Word Processing Operator	Mrs P. Dindoyal	Officers for Measuring Blood Pressure	Mrs P. Kallooa Mrs O. Gopee Mr A. Fowdar Mrs Z. Choychoo Mrs R. Gaonjur Mr C. Monty Mrs R. Bundhoo Mrs D. Choolan Mrs P. Sowaruth Mr A. D.Summun	Officers for taking blood specimen	Mrs T. Appalasawmy Mr K. Fowdar Mr N. Manick Mrs A. Kurmoo Ms T. Jeenally Mrs R. Kishto Doyal Mr O. Ernest Mrs P. Arnachellum
Survey Transport Officer	Mr S. Rengasamy	Blood Specimen Assistants	Mr M. Sumrah Mr B. Sukhai	Survey Officers for Diabetes Complication	Mr I. Southenah Mrs V. Coopen
Data Coordinators	Mrs D. Gangaram Ms K. Cunthen	Registration Officers	Mr J. Gaonjur Mrs A. Chellapen Ms R. Burthun Mrs Y. Gunness Mrs S. Bissoon Mrs V.D. Appiah	Interviewers	Mrs S. Seeboruth Mrs A. MaudhooBeeharry Ms S. Issobe Mrs R. Punchoory Mrs D. Prayag Mrs D. Goodary Mrs A. FoolessurJaulim Mrs B. Moonesamy Mrs H. Narsimooloo Mrs S. Mudhoo Mrs R. Domah Mrs D. Persand Mrs P. Raghoobur Mrs S. Sobrun Mrs R. Booputh Mr P. Neamuth Mrs S. Lotun Mrs S. Cowlessur MrsB.R. Ramjaune Mrs U. Dinaully Mrs S. Boodhoo Mrs S. Sreekeesoon
Medical and Health Officers	Dr Y. Jheenguth Dr (Mrs) Jannoo Bhewa Dr (Mrs) S. Moti Dr R. Bachonee Dr (Mrs) F. Heerah Dr (Mrs) S. Goburdhone Dr R. Ragnath Dr (Mrs) V. Rambhojan Dr (Mrs) V. Sohatee Canye	Officers for measuring height, weight, waist Hip	Mr K. Raghoonath Mrs N. Meetooah Mrs L. Bhoyroo Msr L. Hanzary Mr S.K. Koonjooah Mrs M. Bholah	Urine Collection Officer	Mrs D. Sooknah Mrs B. Sonoo

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Survey Officers	Name	Survey Officers	Name	Survey Officers	Name
Staff for administering oral glucose	Mr B. Calcutteeah Mrs T. Shanker Mrs P. Jhungeer Mrs I. Goolaub	Officers for Hemocue	Mr H. Keesoondoyal Mrs L. Ramashire	Interviewers for Depression Scale	Mrs A. Butan Mrs R. Doomah
Labelling Identification Officers	Mr N. Prayag Mrs U. Jowaheer	ECG Technicians	Mrs L. D. Maistry Mr K. Boodhoo Mrs B.A.K. Kheerdali Mr G. Gaoneadry	Attendants (HQ)	Mr M. Murugassa Pillai Mr G. Pauhalawon
Staff for administering oral glucose	Mr B. Calcutteeah Mrs T. Shanker Mrs P. Jhungeer Mrs I. Goolaub	Interviewers for Cognitive Decline	Mrs M. Purlackee Mrs S. Budruddeen Ms S. Ramful Mr V. Seethiah Mrs R. Sobrun Mr P. Daby Mr D. Paryag Mrs P. Lallmohamed Mrs P. Patel Mrs R. Soobroyen	Survey Site Assistants	Mr S. Tohul Mr S. Emmamally Mr P. Jeetun Mr O. Dussoye
Urine Collection Assistants	Mr R. Bundhun Mr B. Sanahi	Officers for Guest Participants	Mr R. Mohun Mrs D. Poonuth Mrs B. Baurhoo Mrs L. Pydegadu	Chasers	Mr V. Mungroo Mr S. Moongah
Laboratories Staff	Mr N. Gopaul Mrs A. Dayal Beedassy Mr K. Bokhoree Mr H. Ramuth Mr V. Ramessar Mr I. Chutoo Mr K. Futloo Mrs R. Bhagalee Mr A. Bonarien Mrs S. Cheeneebash Mrs S. Moraby	Laboratories Staff	Mrs N.P. Kanaksabee Mr S. Gookool Mr H. Simhadri Mr P. Gunnoo Mrs N. Mandary Mr S. Padaruth Mr S. Peerty Mr H. Seeruttun Mrs D.S. Jaynauth Mrs M. Dhurowa Mr F. Oodian	Laboratories Staff	Mr S. Brojolall Mrs R. Callichurn Mrs B. Seetaram Mrs N. Ramessur Mr D. Tupsee Mr P. Lafresire Mr N. Eydatoulah

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