Commission for Health & Others
Rodrigues Regional Assembly

Ministry of Health and Wellness
Republic of Mauritius

Rodrigues Non Communicable Diseases Survey 2022

The Trends in Non Communicable Diseases and their Risk Factors in Rodrigues

November 2023

Rodrigues Non-Communicable Diseases Survey 2022

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November 2023

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Abbreviations

BMI	Body Mass Index
COPD	Chronic obstructive pulmonary disease
CVD	Cardiovascular Diseases
ECG	electrocardiogram
ECRHS	European Community Respiratory Health Survey
GPAQ	Global Physical Activity Questionnaire
HDL	High-Density Lipoprotein
IFG	Impaired Fasting Glucose
IGT	Impaired Glucose Tolerance
KDM	Known diabetes Mellitus
LDL	Low-Density Lipoprotein
MET	metabolic equivalents
NCD	non-communicable disease
NDM	Newly diagnosed Diabetes Mellitus
NGT	normal glucose tolerance
OGTT	oral glucose tolerance test
PA	physical activity
TC	Total serum cholesterol
TG	Triglycerides
WHO	World Health Organization

EXECUTIVE SUMMARY

A non-communicable disease (NCD) survey employing similar methodologies and criteria to surveys undertaken in Rodrigues in previous years (1992, 1999, 2004, 2009 and 2016), was carried out in 2022. This report provides a summary of the burden of the key NCDs and their risk factors. The data presented here are standardized for age and sex.

Diabetes Mellitus

- The standardized prevalence of Type 2 Diabetes in the Rodriguan population aged 25-74 years was **15.3%**: 13.6% in men and 16.2% in women.

- The prevalence of pre-diabetes, being either impaired glucose tolerance or impaired fasting glycaemia, in the population of the same age group was **19.5%**: 18.7% for men and 19.3% for women.

- Among those persons known to have diabetes, the poor control of diabetes, judged by glycaemia levels of HbA1c equal to or higher than 9.0%, was 43.0%.

Hypertension

- The standardized prevalence of hypertension in Rodriguan adults aged 25-74 years was **37.0%**: 36.7% in men and 36.5% in women.

- Of those with hypertension, only 57.4% of individuals were currently on medication for hypertension: 47.2% in men and 66.1% in women.

- Among those treated for hypertension, 35.9% continued to have an elevated blood pressure (i.e. above 140/90 mmHg): 28.9% in men and 41.9% in women.

- Most persons with known diabetes had hypertension irrespective of sex, 83.5%: 76.6% in men and 88.7% in women.

Overweight and Obesity

- Using the Body Mass Index (BMI) with ethnic specific cut-off points,

    - the standardized prevalence of obesity was **37.7**%: 22.4% in men and 49.6% in women

    - the standardized prevalence of overweight was 31.7%: 34.6% in men and 29.0% in women.

- Thus, 69.4% of the participants were classified as overweight or obese. The rate for men was 57% and for women was 78.6%.

Lipids

- The age and sex adjusted prevalence of high cholesterol (≥ 5.2 mmol/L) was **21.5**%: 27.6% in men and 16.9% in women.

- Lipid-lowering agents were being taken by 19.0% of the study population.

Smoking

- The standardized prevalence of current smoking was **22.2**%: 43.1% in men and 6.5% in women.

- The prevalence of smoking was highest in young adults with 55.6% of men aged 35–44 years reporting smoking.

- Smoking was also found in known diabetes participants, 24% of men and 5.6% of women.

Physical Activity

- **75.4**% reported Physical Activity (PA) corresponding to 600 MET (Metabolic Equivalents) or more: 79.8% in men and 72.0% in women.

  MET is defined as the energy cost of sitting quietly and is equivalent to a caloric consumption of 1 kcal/kg/hour.

- 50.0% reported PA during leisure time or during transport equal or more than 30 minutes per day: 54.6% in men and 46.7% in women.

- 14.2% and 41.5% of the study population respectively, reported vigorous and moderate intensive physical activity at work.

Alcohol Consumption

The standardized prevalence of harmful consumption of alcohol was **27.7%**: 51.4% in men and 9.6% in women.

Chronic Kidney Disease

- The standardized prevalence of reduced kidney function (<60 ml/min) was **2.7**% in 2022: 1.7% in men and 3.3% in women.

- Albuminuria (ACR ≥3 mg/mmol), an index of kidney disease, was detected in 5.5% of the survey population in 2022: 4.9% of men and 6.0% of women had micro-albuminuria.

Asthma

- The age and gender standardized prevalence of asthma in adults was **8.0%**: 8.7% in men and 7.4% in women.

Conclusions

The Rodrigues NCD Survey 2022 showed a decrease in the prevalence of diabetes as well as pre-diabetes since last measured, some six years back. However, the prevalence of hypertension has increased.

The prevalence of obesity in both men and women has increased and it is more significant among younger age groups. However, the prevalence of overweight has decreased. It may be possible that the overweight persons have become obese.

Consequently, the high prevalence of obesity coupled with that of hypertension may contribute to a significant threat in terms of the future social and economic burden of heart disease and diabetes complications in Rodrigues.

The findings show that the prevalence of smoking has remained stable. An increase in the percentage of persons with airway system indicating asthma or Chronic Obstructive Pulmonary Disease has been noted. A decrease in the prevalence of high cholesterol has been observed. However, many individuals with known diabetes have unsatisfactory LDL-cholesterol levels despite taking lipid lowering medication.

It has also been observed that Rodriguans have a high prevalence of harmful consumption of alcohol and it is mostly consumed by men. On the other hand, percentage of persons in Rodrigues undertaking physically activity has increased as compared to Rodrigues NCD Survey 2016.

In addition, low prevalence of cardiovascular disease and impaired renal function was also noted. CVD risk factors tend to occur simultaneously due to the combined effect of genetic susceptibility and lifestyle factors. This highlights that future interventions must address several key risk factors together.

Improvement in terms of public awareness of Non-Communicable Diseases is observed as shown by a decrease in the proportion of newly diagnosed diabetes.

Overall, improvements in the status of NCDs and their risk factors have been observed. However, NCDs remain a major public health problem in Rodrigues. Pre-diabetes and obesity

are major precursors of diabetes and cardiovascular disease. Hypertension was very common in individuals with diabetes and most of them are badly controlled.

Recommendations

The magnitude of the diabetes epidemic in Rodrigues, 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. Lifestyle interventions are fundamental given the fact that potent environmental and behavioural risk factors for type 2 diabetes such as obesity and physical activity are modifiable. 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 there is a decrease in the prevalence of diabetes, the measures taken in recent years to prevent diabetes should be reinforced and expanded.

Hypertension is one of the risk factors for stroke, heart attack and heart failure and a leading cause of chronic renal failure. The fact that the prevalence of hypertension is very high in Rodrigues, there should be a relatively sustained assessment for the early detection of the disease followed by lifestyle advice and non-pharmacological options prior to any initiation of drug therapy. The process of managing hypertension according to the set the guidelines suggest that non-pharmacological options should be explored in all patients who are hypertensive or pre-hypertensive and these measures include weight reduction and regular physical activity. Discontinuing tobacco use and alcohol consumption may lower blood pressure.

Only one fifth of those with high blood pressure has adequate treatment with normalised blood pressure whereas the remaining had either no treatment at all or badly controlled blood pressure despite treatment. These findings call for better discovery of hypertension, use of modern effective medicine for better adherence to treatment effective follow-up. And all health personals should be trained to treat hypertension according to modern guidelines and targets in order to prevent future serious health problems like kidney failure, heart failure and stroke.

It is recommended to **reduce salt intake** in the mean population as salt reduction helps to decrease blood pressure and the incidence of hypertension and it is also associated with a

reduction in morbidity and mortality from cardiovascular diseases. The **Salt Intake Survey needs to be done again** in Rodrigues as the last one was done in 2013 and it has become outdated. This survey will enable the establishment of the current baseline average consumption of salt (sodium), potassium and iodine through 24-hr urinary excretion testing and to assess the knowledge, attitudes, practices and behaviour around dietary salt in order to devise more effective salt reduction strategies in Rodrigues.

Recent years have seen a great increase in our knowledge of the lifestyle and pharmacological strategies required at both individual and community level to reduce the risk of developing diabetes and hypertension. 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.

Obesity is a serious public health challenge and a major determinant of disability as well as main driver for elevated blood pressure which is associated with increased risk of death from all causes, most notably non-communicable diseases. People with obesity are at higher risks of multiple comorbidities, including cardiovascular disease. Vulnerability to unhealthy body weight can develop in early life, and therefore preventative measures must start early. Obesity has significantly increased in Rodrigues since 2016, thus it is recommended to prepare an Action Plan on Obesity for Rodrigues to cater for first-line clinical management of obesity typically consisting of multi-component, intensive lifestyle interventions that combine nutrition, physical activity, environmental change interventions and behaviour change.

The Action Plan should emphasize on restrictions on marketing unhealthy products, improvement in school food standards and options, taxation on sugar sweetened beverages, reformulation of ultra-processed foods to improve nutrient content. Hence, provision of an enabling environment so that people can more easily access healthy food choices and physical activity opportunities is highly recommended.

The health promotion programmes / activities of the **NCD and Health Promotion Unit** should be re-engineered and sustained to scale up effective interventions and programme delivery to prevent and manage the problem of non-communicable diseases, their risk factors related to

health conditions such as weight management, hypertension, and diabetes among others. Targeted NCD screening programme at community level, worksites and secondary schools as well as promotion of healthy lifestyle should be sustained. Sessions of NCD clinic should be increased at Primary Health Care Level. Fulltime Retinal Screening as well as Foot Care Services have to be set up. Dedicated staff should form part of the NCD and Health Promotion Unit and a coordinated approach using multi-disciplinary team should be set up to support the programmes. Digital database for NCDs should be introduced.

Interpretative nutrition labelling like traffic lights should be supported to decrease sugar sweetened beverages/food and unhealthy snacks. The nutrition labelling (listing nutritional information on menus and menu boards) should be extended to grocery stores and restaurants where it will act as a health education tool, to help consumers achieve healthier diets and better overall health. Offer (tax) subsidies to companies who actively support their employees' health and support companies to develop and implement measures of operational health management. Advertisement of unhealthy food choices across the media spectrum should be restricted.

Introduction and Implementation of TeleMedicine between Rodrigues Island and Mauritius. Its implementation will allow healthcare providers from Mauritius to evaluate, diagnose, inform and treat patients without an in-person visit. Patients can communicate with physicians from their homes using their own personal technology or by visiting a dedicated telehealth kiosk situated in Rodrigues.

Considering the very high prevalence of smoking now and in previous surveys, and the increase in the prevalence airway problem symptoms, it is recommended to include **spirometry** in future studies to better evaluate the disease burden caused by obstructive airway disease in Rodrigues.

Set up of a Multi-Sectoral Approach in combatting NCDs, given the magnitude of the burden, can prevent and manage non-communicable diseases effectively. The Multi-disciplinary, coordinated approach across health, finance, education, sports, agriculture and the food industry sectors can contribute towards reversing the underlying causes of diabetes, hypertension and obesity. The setting up of a High Level Multi-sectoral NCD Prevention Committee under the chairmanship of the Commissioner for Health is recommended. The committee would include representatives of the following:

- Ministry of Health and Wellness
- Rodrigues Regional Assembly
- Commission for Health, Community Development, Fire Services, Meteorological Services, Judicial Services and Civil Status
- Commission for Women's Affairs, Family Welfare, Child Development, Industrial Development, Information and Communication Technology, Vocational Training, Cooperatives, Trade, Commerce and Licensing and Prisons and Reforms Institutions;
- Commission for Social Security, Housing, Labour and Industrial Relations, Employment and Consumer Protection;
- Commission for Agriculture, Environment, Fisheries, Marine Parks and Forestry
- Commission for Youth and Sports, Arts and Culture, Library Services, Museum, Archives, Historical Sites and Buildings
- Commission for Tourism and others
- World Health Organization
- Non-Governmental Organisation

1.0 Introduction

Rodrigues is an autonomous outer island of the Republic of Rodrigues in the Indian Ocean. It is situated about 560 km north east of Mauritius and has regular air links with the main island. It has a land surface of 108 square kilometres and 200 square kilometres of lagoon. The island's population as at 31st December 2022 was 44,783. It is governed by the Rodrigues Regional Assembly. In general, the population is scattered over the island and there are no dominant towns except the administrative centre, Port Mathurin. Its economy is built mainly on fishing, farming, handicraft, and a developing tourism sector.

The population of Rodrigues has undergone rapid economic growth, and general improvements in living standards over the past decades. This has brought a shift in the disease pattern in its wake.

Because of routine statistics showing high rates of hypertension in Rodrigues in the 1980s and the general lack of information on non-communicable diseases and their lifestyle related risk factors, a population survey of disease and risk factor prevalence in Rodrigues became a priority project of the Ministry of Health in 1990. The first NCD Survey was conducted in 1992 to document the prevalence of NCDs and their risk factors. A follow-up survey was carried out in 1999 followed by the NCD Survey in 2004, 2009 and 2016.

The 1992 Survey confirmed that Rodrigues had a high prevalence of hypertension and that obesity and overweight were common, particularly among women. There was also, a moderate-high prevalence of diabetes and impaired glucose tolerance.

Findings of survey 1999 showed a 31.0% rise in diabetes and a 5.0% rise in hypertension. Following the 1999 NCD Survey, a number of measures for the reinforcement of prevention and control of NCDs and their risk factors were undertaken. These included the setting up of NCD clinics and the introduction of mass screening of the population.

In 2004, a new survey was carried out to assess the trends in NCDs, their risk factors and the impact of the intervention measures. The findings of the 2004 Rodrigues NCD Survey revealed that there were a number of noticeable changes in the evolution of diabetes, hypertension and other risk factors in the population during the previous 12 years, that is, from 1992 to 2004.

The survey carried out in 2009 revealed that the prevalence of diabetes in the adult Rodriguan population aged 25- 74 years was 16.5%. The survey also confirmed that over 1 in 3 Rodriguans aged 25-74 years has either diabetes or impaired glucose metabolism (pre-diabetes). Impaired glucose metabolism is associated with substantially increased risk of developing heart diseases as well as of developing diabetes. The findings of the NCD surveys between 1992 and 2009 show a high prevalence of Type 2 diabetes, hypertension and its associated risk factors, poor levels of control and high levels of complications.

The findings of the Rodrigues NCD Survey 2016 showed that the standardised prevalence of diabetes in adults aged 25-74 years in 2016 was 17.2%. The prevalence of pre-diabetes being either impaired glucose tolerance and/or impaired fasting glycaemia in the Rodriguan adults aged 25-74 years was 24.2%. The prevalence of hypertension was 30.5%. 64.8% of the participants were overweight or obese. 31.1% of Rodriguan adults aged 25-74 years reported undertaking sufficient physical activity.

These studies have shown the emergence of NCDs in parallel with lifestyle changes. Their contribution to the scientific and public health understanding of the causes of NCDs is invaluable and has generated many health promoting initiatives such as the establishment of an NCD and Health Promotion Unit. However, the undiminished rise in NCDs is a cause of great concern to the whole community. The early detection of this condition in the young population may help in the prevention of NCDs in the adult population.

In 2022, a new NCD survey was conducted in collaboration with the Monash University, Australia; University of Helsinki, Finland; Umea University, Sweden; Baker Heart and Diabetes Institute, Australia; and Imperial College, UK with the aim to strengthen national strategies for the prevention and control of NCDs.

2.0 Study Objectives

2.1 Overall

To determine the prevalence and study the trends in diabetes, pre-diabetes, hypertension, cardiovascular diseases, obesity and their associated risk factors in the Rodriguan population.

2.2 Specific

- To measure the prevalence of diabetes mellitus and pre-diabetes (Impaired Glucose Tolerance and Impaired Fasting Glucose).
- To examine complications of diabetes including retinopathy and nephropathy.
- To measure the prevalence of cardiovascular risk factors including general and abdominal obesity, hypertension, blood cholesterol levels, cigarette smoking, alcohol consumption and physical inactivity.
- Assess public awareness of diabetes mellitus, and the importance of its metabolic control (levels of haemoglobin A1C).
- To measure the public awareness of hypertension, and its control.
- To measure the prevalence of asthma-like symptoms.
- To measure the prevalence of ischemic heart disease according to resting electrocardiogram (ECG).
- To measure vascular health by pulse wave velocity.
- To validate the physical activity questionnaire (Accelerometer).

3.0 Study Design and Methodology

3.1 Study design

The Rodrigues NCD Survey 2022 is a cross-sectional study based on a representative sample of the Rodriguan adult population.

Since 1992, the methodologies of the surveys and age distributions of the samples were generally similar.

The design of the survey, the variables of which data were collected and the instruments aimed to meet the highest possible standards in terms of statistics validity and reliability.

3.2 Sampling frame

The target population comprised Rodriguan adults aged 20 to 74 years. In order to obtain reliable estimates of the prevalence of the diseases as well as their risk factors being studied, participants were drawn from all over the island to represent all socio-economic groups. Based on known prevalence rates and desired level of precision, a sample size of 1,250 individuals was randomly selected from 5 clusters (Table 1) distributed geographically across the island of Rodrigues. Age distribution and gender were also considered to ensure representatives of the population being studied.

Table 1. List of Clusters

SN	Locality / Cluster
1	Port Mathurin
2	Grande Montagne
3	Riviere Coco
4	Petit Gabriel
5	La Ferme

Listing of members of households in the randomly selected localities was carried out. The details of each person within each of the enumerated households during the listing exercise included names, contact details, address, date of birth and gender. Some 1,500 households were visited and overall, 3000 persons were enumerated.

The inclusion/exclusion criteria for the survey are as follows:

- Only Rodriguan residents aged 20 to 74 years were included.
- Those unable to provide written informed consent were excluded

Households within the identified localities were visited by enumerators in an orderly manner and all persons aged 20 to 74 years within each household was registered. An enumeration form was used to record all relevant details required for the final selection of persons to be invited to participate in the study.

A systemic sampling was then carried out within each age group. Considering the non-response factor, a total of 1,250 participants was invited to participate. To obtain reliable national estimates of the parameters under study, the main findings was standardized using the population of Rodrigues distributed by aged-group and sex.

4.0 Response Rate

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. Site-names, number of selected participants and attendance rates are given in Table 2.

Table 2. Response Rate by Survey Site

SITE	PARTICIPANTS SELECTED	PARTICIPANTS ATTENDED (N 20 ≤ 75)	% ATTENDANCE
Port Mathurin	250	163	65.2
Grande Montagne	250	187	74.8
Riviere Coco	250	198	79.2
Petit Gabriel	250	227	90.8
La Ferme	250	197	78.8
Total	**1250**	**972**	**77.8**

Among those invited to participate in the survey (n=1,250), 972 responded, making the overall response rate of 77.8%.

Altogether 37% of all participants were chosen from an urban setting. The characteristics of the survey population are described in Table 3.

Table 3. Demographic characteristics of the participants of NCD Survey 2022

	SURVEY 2022
No	**972**
Sex (%)	
Female	55.5
Male	44.5
Age (mean)	49
Age group (%):	
<25	10.3
25 - 34	17.4
35 - 44	19.9
45 - 54	19.0
55 - 64	19.2
65 - 74	14.2

The NCD Survey in Rodrigues was carried out in October-November 2022. Altogether 972 individuals participated (age range 20 to 74 years). To make the age-standardised results comparable with previous surveys in Rodrigues, the age range 25 to 74 years was used in this present report resulting 872 participants remained. This age interval has also been used in previous reports from Rodrigues enabling comparison backwards

Prevalence data are reported as age-standardised means with 95% confidence intervals (95% CL) and using the male distribution from the 2008 Mauritius census as standard for both sexes.

The mean age in the cohort aged 25 to 75 years was 49 years (men 50 years and women 48 years). Most of the participants reported Creole ethnicity (96%) with similar distribution in

men and in women (96% in both). Stratification for ethnicity was thus not done due to the very small numbers for other ethnicities (25 Indian Asians and 4 Chinese participants).

5.0 Diabetes and Pre-diabetes

5.1 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 the person to many severe health 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. These include ageing populations, increasing urbanization, dietary changes, reduced physical activity, sleep disorders 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. This is the second only disease, after HIV/AIDS, to attain that status. For the first time, governments 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 recognised that diabetes would likely be one of the most important health challenges for the global public health community in the 21st century.

5.2 Definitions

5.2.1 Diabetes and pre-diabetes

The diagnostic criteria for diabetes and pre-diabetes [Impaired Glucose Tolerance (IGT) and Impaired Fasting Glucose (IFG)] were based on the values for venous plasma glucose concentration (fasting and two-hour measurements) outlined in the 1999 WHO report on the Diagnosis and Classification of Diabetes (Table 4). People who reported taking oral glucose-lowering drugs 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 and/or IFG. In this report, results for type 1 and type 2 diabetes have not been reported separately, as most people with diabetes were presumably type 2.

5.2.2 Known diabetes

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

1. Receiving glucose-lowering drug 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 at the current survey examination had a fasting plasma glucose or 2-hr post-load glucose over the cut-off levels for diabetes mellitus (Table 4).

Newly diagnosed (NDM) cases of diabetes were those who at the current survey examination had a fasting or 2-hour plasma glucose measurement over the diabetes cut-off range, but were not aware of the diagnosis and did not receive any glucose lowering drugs.

Table 4. Classification of glucose values based on the results of oral glucose tolerance test (OGTT)

	FASTING GLUCOSE (mmol/L)		2-HOUR POST GLUCOSE LOAD (mmol/L)
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

Those who fulfil the criteria for both IFG and IGT are labelled as pre-diabetes in this report.

Fasting plasma glucose was also measured at site using Hemocue® and the results determined if the participant was suitable for the OGTT; people with high fasting glucose were excluded. Altogether 85% had an OGTT, and the correlation between fasting glucose levels at site and at the laboratory in Mauritius (performed on the same day) was high (r=0.95).

5.3 Results

The crude prevalence of diabetes by 10-year age group and stratified for sex are shown in Table 5. The age standardised prevalence in adults aged 25 -74 years was **15.3%: 13.6% for men and 16.2% for women**. If HbA1c was used for diagnosis, the prevalence was significantly higher [21.9% (19.2–24.7)].

Table 5. Diabetes prevalence by age-group

Age-group, years	All (%)	Men (%)	Women (%)
<25	2	–	3.4
25 – 34	2.5	4.4	1.1
35 – 44	7	8.8	5.6
45 – 54	18	11.8	23.5
55 – 64	36	32.1	39
65 – 74	44.4	40	49.2
Prevalence OGTT %	**15.3**	**13.6**	**16.2**
Prevalence HbA1c %	**21.9**	**20.1**	**23**

Two women below the age of 25 had diabetes, one NDM with high BMI and one KDM on insulin therapy and low BMI.

In 2016, the prevalence of diabetes based on the OGTT and glucose-lowering drug treatment in adults aged 25-74 years was 17.2%: 18.6% for women and 15.6% for men.

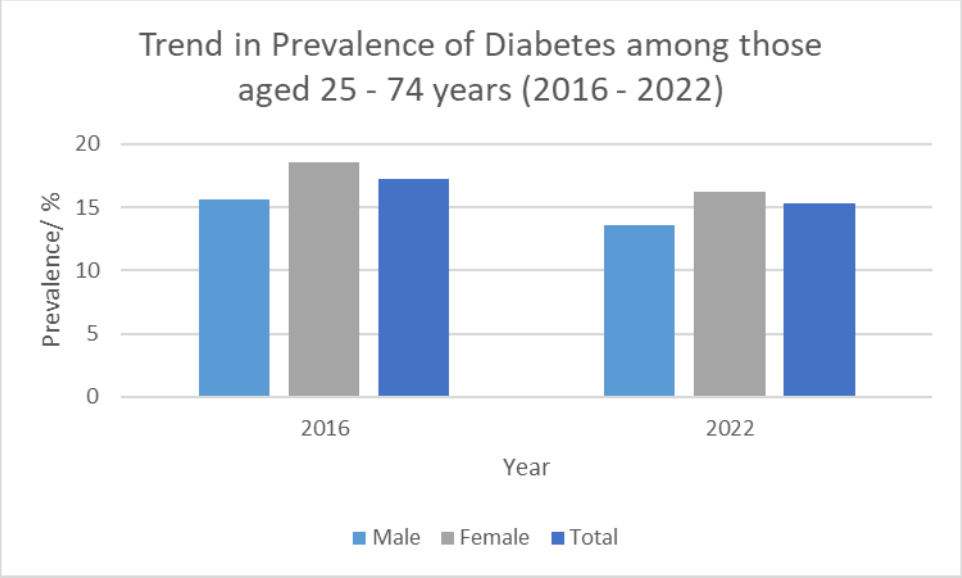

Figure 1: Trend in Prevalence of Diabetes in Rodrigues since 2016

Figure 1 shows the trend for the prevalence of diabetes in Rodrigues since 2016, the overall prevalence denotes that women had a higher prevalence of diabetes as compared to men. The prevalence of diabetes has decreased from 2016 to 2022 for both women and men.

DM denoted total diabetes, KDM previously known diabetes, and NDM newly diagnosed diabetes.

Of people with diabetes, 68.0% had been already diagnosed prior to the survey (known diabetes mellitus - KDM), whereas 32.0% were identified for the first time at the survey (NDM)

The distribution of KDM and NDM per 10-year age-group and stratified for sex is shown in Table 6. The prevalence of KDM was higher than the prevalence of NDM in all age-groups except in women aged <45 years. For every two individuals with known diabetes, there was one individual whose diabetes was previously unknown. Thus, the ratio unknown/known was 1:2 and it had improved from 1:1 ratio found in 2016. In the oldest age group 65 -74 years only 18% of all people with diabetes were previously unknown. Overall, the awareness of diabetes was similar in men and women.

Table 6. Age specific prevalence of diabetes in 2022 for all participants, and after stratification for age and sex.

KDM and NDM by age-group						
	All		Men		Women	
Age group	**KDM (%)**	**NDM (%)**	**KDM (%)**	**NDM (%)**	**KDM (%)**	**NDM (%)**
25 – 34	1,2	1,2	1,5	2,9	1,1	–
35 – 44	3,7	3,2	6,3	2,5	1,9	3,7
45 – 54	9,8	8,2	4,7	7,1	14,3	9,2
55 – 64	23,1	12,9	19,8	12,3	25,7	13,3
65 – 74	37,8	6,7	34,3	5,7	41,5	7,7
Age standardised prevalence	**9.8**	**5.5**	**8.3**	**5.4**	**10.6**	**5.6**

The proportion of persons with a HbA1c level equal to 6.5% or higher by the glucose tolerance category is shown in Table 7. Elevated levels of HbA1c were seen in all categories. As expected in people with diabetes HbA1c levels were high. The findings that high values were seen also in 8.1% of people who had normal glucose levels could indicate ethnicity-related alterations of the haemoglobin molecule.

Table 7: Elevated HbA1c

	NGT (%)	IFG (%)	IGT (%)	NDM (%)	KDM (%)
6.5% or higher	8.1	25.5	28.1	78.6	90.1

The metabolic control was estimated by calculating the proportion of persons with diabetes having a HbA1c level equal or higher that 9%, 43% of those with KDM had HbA1c 9% or more (46% in men and 41% in women) and 14.3% of those with NDM (8% in men and 19% in women) had HbA1c 9% or more.

Pre-diabetes in this report is referring to the glucose intolerance categories IFG and IGT. The crude prevalence of pre-diabetes by 10-year age-group for all and stratified for sex is shown in Table 8. The age-standardized prevalence was 19.5% with no statistical difference between men and women.

Table 8. Pre-diabetes (IFG and/or IGT) by age-group

Age-group	All (%)	Men (%)	Women (%)
<25	4.1	2.4	5.4
25 – 34	9.4	6.2	11.7
35 – 44	13.2	8.2	16.8
45 – 54	22.0	26.7	17.3
55 – 64	37.8	41.8	34.4
65 – 74	36.0	35.7	36.4
Age-standardised prevalence	**19.5**	**18.7**	**19.3**

In 2016, the prevalence of pre-diabetes (IGT and/or IFG) was 24.2 and similar for women and men.

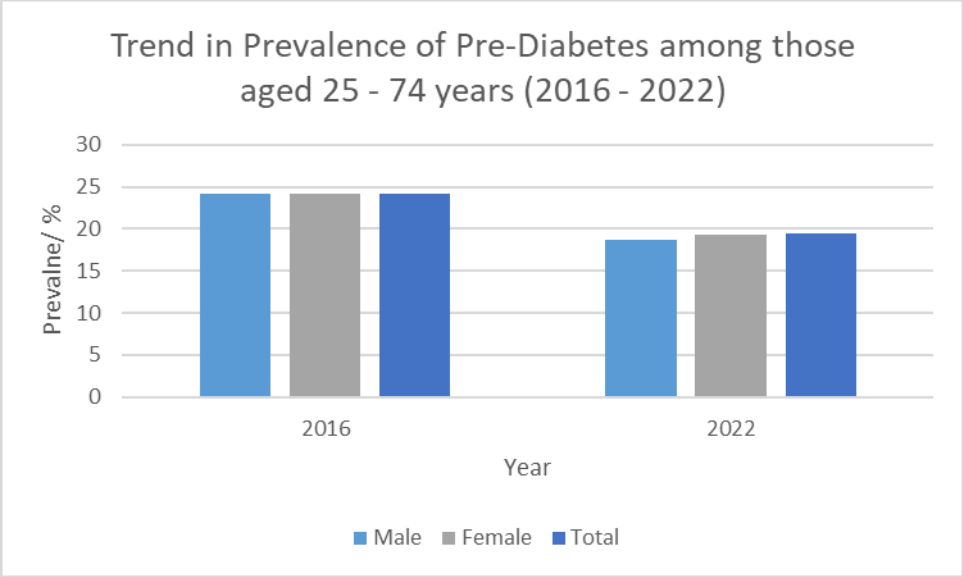

Figure 2: Trend in Prevalence of Pre-Diabetes in Rodrigues since 2016

As depicted in figure 2, the prevalence of pre-diabetes (IGT and/or IFG) has decreased from 2016.

6.0 Hypertension

6.1 Background

Hypertension or high blood pressure was defined as systolic blood pressure equal to or more than 140 mmHg and/or diastolic blood pressure equal to or more than 90 mmHg and/or person taking antihypertensive medication. Three blood pressure measurements were taken and the mean of the two last was used after data cleaning.

6.2 Results

The crude prevalence of hypertension by 10-year age-group for all and stratified for sex is shown in Table 9. The age standardised prevalence of hypertension was 37.0% with no statistical difference between men and women. No hypertension was detected in people aged 25 years or under.

In 2016, the age and sex-standardised prevalence of hypertension was 30.5%: 29.5% men and 31.5% in women.

Table 9. Hypertension by age-group

Age-group	All (%)	Men (%)	Women (%)
<25	–	–	–
25 – 34	12.4	17.1	9.1
35 – 44	23.8	27.2	21.4
45 – 54	47.6	41.9	52.5
55 – 64	68.4	64.6	71.4
65 – 74	81.9	80.6	83.3
Age-standardised prevalence	**37.0**	**36.7**	**36.5**

Table 10. Treatment and hypertension

	All (%)	Men (%)	Women (%)
Treatment and BP OK	21.5	18.3	24.2
No treatment and high BP	42.5	52.8	34.0
Treatment and high BP	35.9	28.9	41.9

Table 10 shows the proportion of individuals with hypertension who had antihypertensive drug treatment, and the proportion of those in whom treatment had resulted in normalized blood pressure (<140/90 mmHg). Most men with hypertension did not have any drug treatment (52.8%) and most women who had drug treatment but with poor control of blood pressure (41.9%).

Table 11. Hypertension by glucose tolerance category

		NGT (%)	IFG (%)	IGT (%)	NDM (%)	KDM (%)
All	Hypertension	30.6	57.4	67.7	62.5	83.5
	Treatment and high BP	25.8	22.2	40.0	31.4	56.4
Men	Hypertension	32.8	66.7	71.1	58.3	76.0
	Treatment and high BP	17.7	20.0	33.3	21.4	57.9
Women	Hypertension	28.8	41.2	65.5	65.6	88.7
	Treatment and high BP	33.3	28.6	44.7	38.1	55.6

Hypertension was common in those with abnormal reduced glucose regulation (Table 11). The prevalence of hypertension increased in all categories with impaired glucose regulation compared with those with normal glucose tolerance (NGT). Most persons with KDM had

hypertension in both sexes, and the majority of those treated with drugs had poorly controlled blood pressure. Among people who had NGT, most did not have hypertension (69.4%) and among those who were treated for hypertension had well-controlled blood pressure (74.2%).

Altogether 83.5% of those with known diabetes had hypertension: 76.0% in men and 88.7% in women. The corresponding numbers for IGT were 67.7%: 71.1% in men and 65.5% in women, and for IFG 57.4%: 66.7% in men and 41.2% in women.

Compared with the results from the 2016 survey, blood pressure levels, treatment status and efficacy of blood pressure-lowering drug treatment had not changed by 2022.

Approximately one third of the adult Rodriguan population have hypertension and a large proportion of them are not aware that they have the disease. Hypertension affects all age groups, and the prevalence increases steadily in both men and women above 55 years of age, more than every second person is affected by high blood pressure. Unfortunately, one third of people on blood pressure-lowering drug treatment still have elevated blood pressure. Hypertension is common in subjects with glucose intolerance.

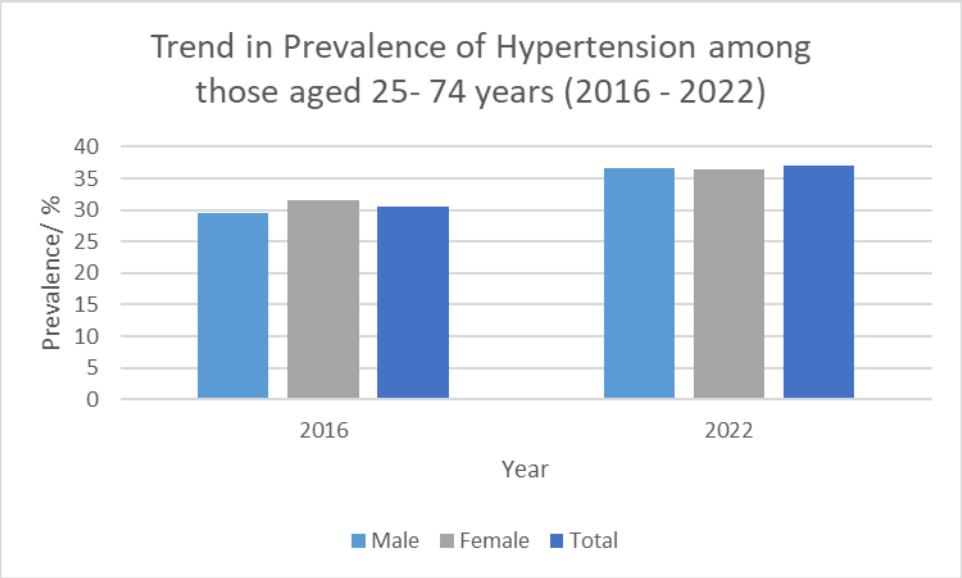

Figure 3: Trend in Prevalence of Hypertension in Rodrigues since 2016

From 2016 to 2022, the prevalence trend for hypertension has increased as shown in Figure 3.

7.0 Overweight and Obesity

7.1 Background

Obesity is strongly linked to type 2 diabetes and is a major risk factor not only for type 2 diabetes but also for 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.

7.2 Definition

Overweight and obesity were defined using the criteria based on BMI (weight/height^2), and waist circumference. The WHO recommends different cut-off points depending on ethnicity (see below), with lower cut-offs for Asians vs. others. The European cut-offs are used for people of African ethnicities i.e. Creoles in Rodrigues. While BMI is used as a measure of overall adiposity (Table 12), the waist circumference is a more accurate measure of visceral adiposity (Table 13).

Table 12. Body Mass Index (BMI) Classification of obesity (kg/m^2)

	Creoles	Indian Asian/ Chinese
Underweight	<18.5	<18.5
Normal	18.5–24.9	18.5–22.9
Overweight	25–29.9	23–27.4
Obese	30+	27.5+

Table 13. Classification of abdominal obesity by waist circumference (cm)

	Men	Women
Large waist *	90	80
Large waist#	94	80

Notes: * Indian Asian/Chinese cut-off points; # European and African (Creole) cut-off points.

7.3 Results

The crude prevalence of obesity by 10-year age-group for all and stratified for sex is shown in Table 14. The age standardised prevalence was 37.7% (95% CI 34.4-40.9), and the prevalence was higher in women in all age-groups. The crude prevalence of overweight was 31.7% (95% CI 28.6-34.8) with less difference between men and women. Altogether 69.4% of all survey participants were obese or overweight.

Table 14. Overweight and obesity in all and stratified for sex in 2022.

Age-group	All (%)	Men (%)	Women (%)
<25	22.7	19.5	25.0
25 – 34	34.3	23.2	42.3
35 – 44	33.3	18.8	44.0
45 – 54	38.6	19.8	55.1
55 – 64	48.1	27.5	63.8
65 – 74	41.6	31.9	52.3
Age-standardised prevalence Obese	**37.7**	**22.4**	**49.6**
Overweight	**31.7**	**34.6**	**29.0**

NW=normal weight, OW=overweight

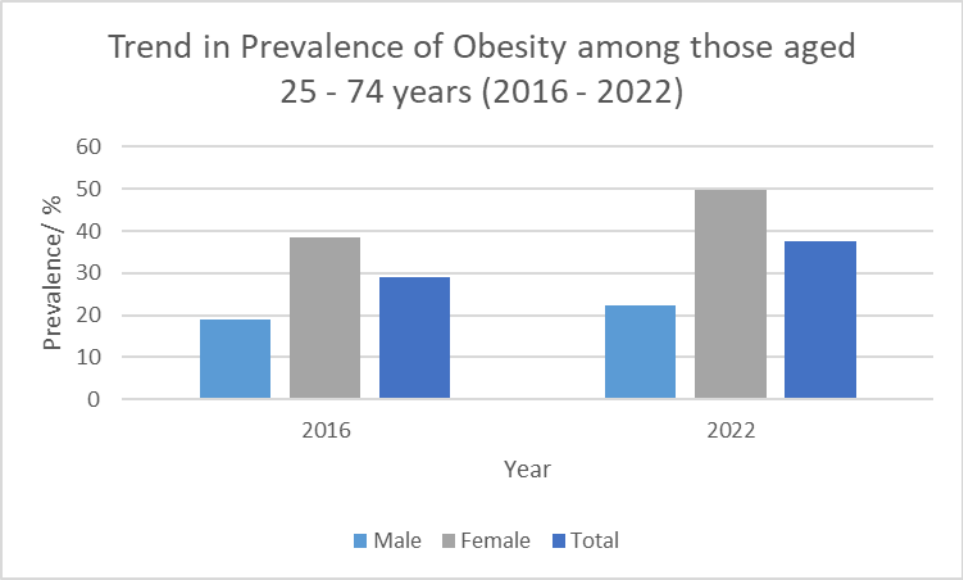

Figure 4: Trend in Prevalence of Obesity in Rodrigues since 2016

The prevalence of obesity for women is more as compared to men since 2016 and the overall prevalence trend for obesity has increased in 2022.

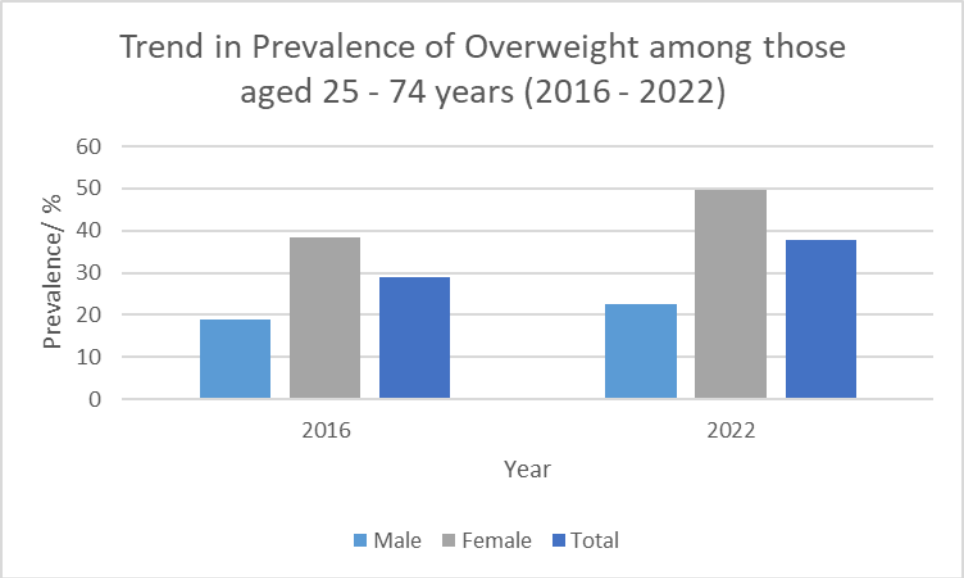

Figure 5: Trend in Prevalence of Overweight in Rodrigues since 2016

The prevalence of overweight for women is more as compared to men since 2016 to 2022 and the overall prevalence trend for obesity has increased in 2022.

Table 15. Abdominal obesity by age-group

Age-group	All (%)	Men (%)	Women (%)
<25	37.1	29.3	42.9
25 – 34	47.9	25.7	63.9
35 – 44	58.2	32.5	77.1
45 – 54	64.7	44.2	82.7
55 – 64	75.8	58,0	89.5
65 – 74	76.1	66.7	86.4
Age-standardised prevalence	**60.7**	**39.2**	**77.0**

Women were more often obese than men in all age groups. Obesity was more common than overweight in women whereas overweight was more common than obesity in men.

In 2016, the age and sex standardised prevalence of obesity, as per Rodrigues NCD Survey 2016, was 28.9%: 19% in men and 38.4% in women. The prevalence of overweight was 35.9%: 38.3% in men and 33.5% in women. Compared with 2016, the prevalence of obesity has increased in both men and in women whereas overweight has decreased in both men and women.

The crude prevalence of abdominal obesity by 10-year age-group for all and stratified for sex is shown in Table 15. The age standardised prevalence was 60.7% (95% CI 57.5-64.0) with a higher prevalence in women than in men. The prevalence increased with age but was high already in the younger age-groups.

In 2016, the prevalence of abdominal obesity was 37.6%: 14.7% in men and 59.7% in women. The prevalence has thus increased significantly for abdominal obesity.

Table 16. Age-standardised prevalence of obesity (%) by glucose tolerance category

	NGT (%)	IFG (%)	IGT (%)	NDM (%)	KDM (%)
All	33.5	29.8	49.5	56.4	53.8
Men	17.5	26.7	32.4	41.7	38.8
Women	46.6	35.3	60.3	67.7	64.3

Individuals with impaired glucose regulation were more obese than those with NGT (Table 16).

8.0 Lipids

8.1 Background

Today, it is well established that blood lipids are a major cause for the development of atherosclerotic vessel disease. The decreasing incidence of acute coronary heart disease in many western countries have been attributed to decreasing levels of serum cholesterol in the population due to life-style changes and to some extent due to efficient cholesterol lowering therapies which can reduce serum cholesterol levels to target levels in many people.

Total serum cholesterol (TC) is an umbrella for different lipoprotein fractions like High-Density Lipoprotein (HDL) and Low-Density Lipoprotein (LDL). TC and LDL can be

determined accurately even in a non-fasting state. For initiation of treatment and for the assessment of treatment efficacy, non-HDL cholesterol (TC-HDL) or LDL is used. HDL alone is not used for the risk estimation and pharmacological treatment trying to improve the CVD risk.

Serum triglycerides (TG) is another lipid, reflecting more the metabolic condition and varies highly depending on diet. In contrast, LDL is commonly calculated from TC, HDL and TG using Friedwald's formula. In this report, calculated LDL values are reported, and a goal for the good achieved lipid control was set to 1.7 mmol/L. However, it should be emphasised that according to the latest European guidelines, the goal is 1.4 mmol/L in high-risk populations such as individuals with diabetes and/or previous CVD. For TC, in the previous reports from the Mauritius NCD Surveys, a cut-off of ≥ 5.2 mmol/L was used to indicate high cholesterol levels. Such results are also given in this report for comparison, although the most important public health message is LDL (or Non-HDL) in high-risk populations.

8.2 Results

Mean levels of TC, HDL, LDL and TG are given in Table 17. The age and sex adjusted prevalence of high TC (≥ 5.2 mmol/L) was 21.5% (95% CI 18.8-24.2): 27.6% in men and 16.9% in female. As usually known, women had higher LDL and lower TG mean levels.

TC=Total Cholesterol, HDL=HDL cholesterol (measured), LDL=LDL cholesterol (calculated), TG=Triglycerides. The unit is mmol/L.

Table 17: The means of serum total cholesterol and lipoprotein fractions by sex

Lipid fraction	All	Men	Women
Total cholesterol (TC) (mmol/L)	4.5	4.5	4.5
Triglycerides (TG) (mmol/L)	1.1	1.2	0.9
HDL-cholesterol (mmol/L)	1.43	1.36	1.48
LDL-cholesterol (mmol/L)	2.6	2.6	2.6
Non-HDL cholesterol (mmol/L)	3.0	3.1	3.0

Table 18. Elevated serum total cholesterol levels (≥ 5.2 mmol/L) by age-group and sex

Age-group	All (%)	Men (%)	Women (%)
<25	7.0	4.8	8.6
25 – 34	14.2	21.4	9.1
35 – 44	20.2	33.3	10.7
45 – 54	25.9	30.2	22.2
55 – 64	28.9	25.6	31.4
65 – 74	25.4	26.4	24.2
Age-standardised prevalence	**21.5**	**27.6**	**16.9**

Lipid lowering drug treatment was reported by 19.0% and varied between 7.7% in people with NGT to 63.6% in those with KDM. Only 25.0% of people with KDM had an LDL level equal to 1.7 mmol/L or lower Lipid lowering medication was reported by 50.0% of those with known CVD but only 21.4% had an LDL level equal to 1.7 mmol/L or lower.

In 2016, the age-sex standardised prevalence of elevated serum total cholesterol (≥5.2 mmol/l) was 33.3%. It has decreased compared to the Rodrigues NCD Survey 2016.

Total cholesterol and LDL- cholesterol levels have decreased in Rodrigues since 2016. Elevated cholesterol levels (28.9%) were noted higher for the age group 55 – 64. A larger proportion of people with increased risk for CVD has achieved a better control of their LDL-levels. The usage of lipid lowering therapy was higher in these groups than in the general population.

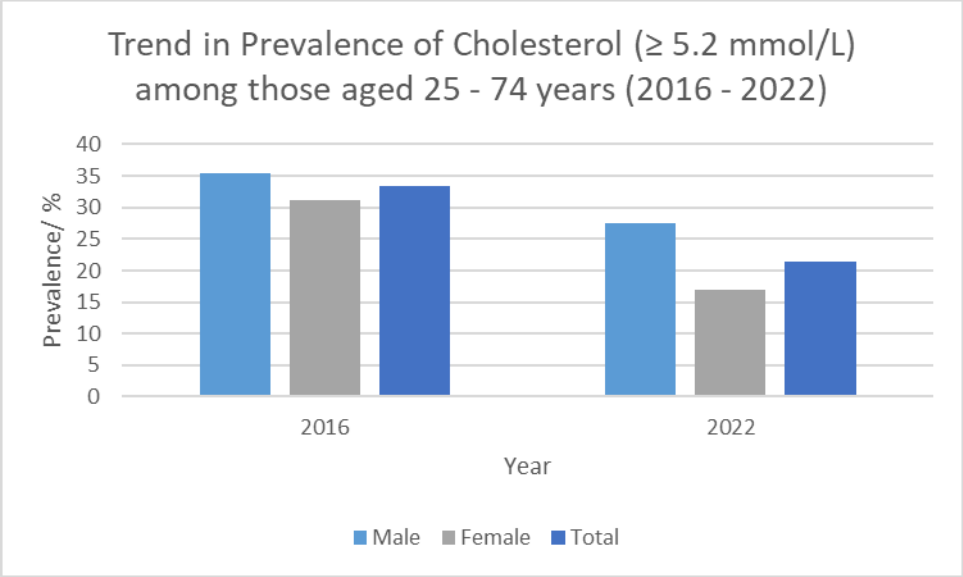

Figure 6: Trend in Prevalence of Cholesterol in Rodrigues since 2016

Figure 6 shows that the prevalence of cholesterol has significantly decreased in 2022 compared to 2016.

9.0 Smoking

9.1 Background

Current smokers in this report are those reporting active and ongoing smoking at the time of the survey. Ex-smokers are not reported. Type of smoking, like cigarettes and water-pipe etc. is not reported separately.

9.2 Results

The crude prevalence of current smoking by 10-year age-group for all and stratified for sex is shown in Table 16. The age standardised prevalence was 22.2%, and the prevalence was much higher in men (43.1%) than in women (6.5%).

The prevalence of smoking in younger men and women was much higher than in older age-groups. Smoking was also prevalent in men younger than 25 years.

Table 19. Current smoking status per age-group

Age-group	All (%)	Men (%)	Women (%)
<25	20.0	40.5	5.2
25 – 34	26.6	48.6	11.1
35 – 44	27.5	55.6	7.1
45 – 54	18.9	37.2	3.0
55 – 64	14.4	30.5	1.9
65 – 74	12.3	18.1	6.1
Age-standardised prevalence	**22.2**	**43.1**	**6.5**

In 2016, the age- and sex-standardised prevalence of smoking was 22.7%: 41.5% in men and 4.6% in women. The smoking prevalence in Rodrigues has remained stable since 2016. Smoking was common in persons with diabetes, 24% of men and 5.6% of women with KDM were currently smoking.

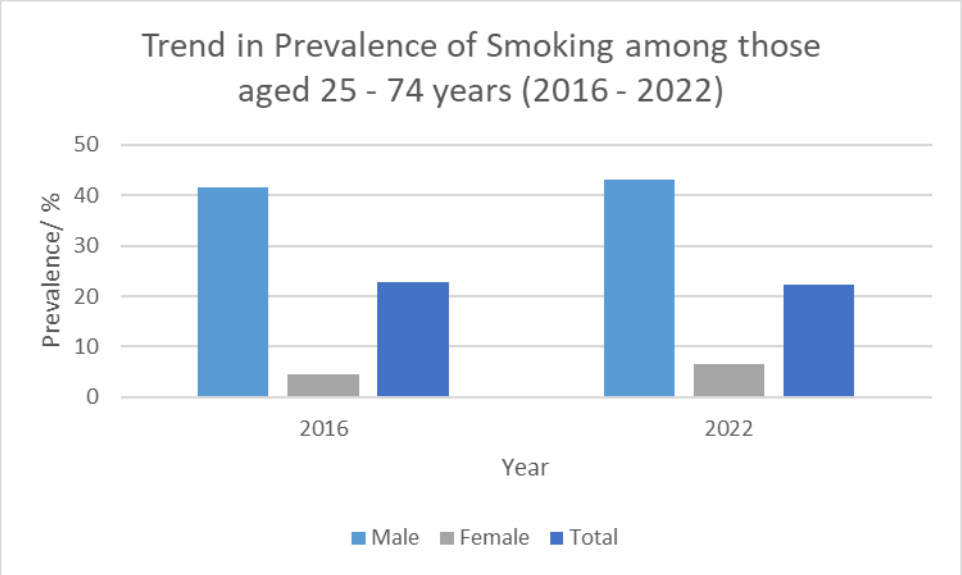

Figure 7: Trend in Prevalence of Smoking in Rodrigues since 2016

The prevalence of smoking for men is more as compared to women since 2016 to 2022 and the overall prevalence trend for smoking was stable between 2016 and 2022 appears to be stable.

10.0 Alcohol Consumption

10.1 Background

Excessive alcohol consumption is a major public health issue but is notoriously difficult to evaluate as questionnaire data are very often unreliable due to various biases, not least in women. Furthermore, "zero-consumption" is often used as the "healthy" reference but not consuming alcohol can truly represent a lifelong teetotaller, or be due to various health problems. Until recently, alcohol research used only questionnaire data for estimation of individual consumption. Today, a biomarker for alcohol intake has been discovered (PETh) reflecting intake over a couple of weeks. This biomarker should ideally be used in future studies.

In Rodrigues survey 2022, the questionnaire contained questions about consumption per week (from none to seven days) and number of standard drinks per occasion (from none to more than five). In addition, alcohol specific medical complications and/or alcohol related hospital admissions were recorded. Harmful drinking was defined as drinking 2 or more days per week and/or three or more drinks per occasion.

10.2 Results

Table 20. Harmful alcohol consumption per age-group and sex

Age-group	All (%)	Men (%)	Women (%)
<25	36.1	58.6	20.2
25 – 34	35.5	57.1	20.2
35 – 44	29.0	56.8	8.9
45 – 54	23.9	48.2	3.0
55 – 64	22.2	46.9	2.9
65 – 74	15.3	25.4	4.5
Prevalence	**27.7**	**51.4**	**9.6**

The crude prevalence of harmful consumption of alcohol per 10-year age-group for all and stratified for sex is shown in Table 20. The age standardised prevalence was 27.7%: in men 51.4%, and in women 9.6%. The prevalence of harmful drinking was highest in participants younger than 25 years. If disease and admission due to alcohol is included, the age standardised prevalence was 28.4%: in men 52.6%, and in women 10.1%.

11.0 Physical Activity

11.1 Background

Self–reported data on physical activity (PA) was collected using the Global Physical Activity Questionnaire (GPAQ). This questionnaire asks about moderate and vigorous PA during work and leisure time and about commuting (walking and travelling) to and from work.

According to guidelines, physical activity can be presented as either metabolic equivalents (MET) or as minutes per day performing physical activity. MET is the ratio of a person's working metabolic rate relative to the resting metabolic rate. One MET is defined as the energy cost of sitting quietly and is equivalent to a caloric consumption of 1 kcal/kg/hour. WHO recommends 150 minutes of moderate-intensity physical activity per week or 75 minutes of vigorous-intensity physical activity per week or an equivalent combination of moderate- and vigorous-intensity physical activity achieving at least 600 METs per week. In this report, PA is presented as METs based on the sum of PA at work and during leisure time plus commuting (cycling or walking) to and from work, and as the sum of minutes per day spent on vigorous and/or moderate PA during leisure time plus transport to and from work.

11.2 Results

The age and sex adjusted prevalence of PA in 2022 are shown in Table 21. Altogether 14.2% and 41.5%, respectively, reported vigorous and moderate intensive PA at work, and 14.2% and 27.4%, respectively, reported vigorous and moderate intensive PA during leisure time. Nearly 69% reported that the used cycling and or walking for transport to work.

Table 21. Physical activity (25 - 74 years)

	All (%)	Men (%)	Women (%)
Vigorous intensity work	14.2	17.9	11.5
Moderate intensity work	41.5	47.9	36.5
Bicycle or walk ≥ 10'	68.5	70.0	67.5
Vigorous leisure activity	14.2	14.8	13.9
Moderate leisure activity	27.4	27.9	26.7

In 2022, 75.4% reported PA corresponding to 600 MET or more: 79.8% in men and 72.0% in women, and 50.0% reported PA during leisure time or during transport equal or more than 30 minutes per day: 54.6% in men and 46.7% in women. Men and women in younger age groups reported more PA compared with older people, see table 24.

Table 22. PA expressed as more that n 600 MET or PA 30 minutes or more daily

Age-group	MET ≥ 600			PA ≥ 30 minutes		
	All (%)	Men (%)	Women (%)	All (%)	Men (%)	Women (%)
<25	69.7	81	61.4	53.5	64.3	45.6
25 - 34	80.5	85.7	76.8	53.8	58.6	50.5
35 - 44	72.4	76.3	69.6	49	60	41.1
45 - 54	75	77.9	72.4	46.7	47.7	45.9
55 - 64	74.7	79.3	71.2	50.5	51.2	50
65 - 74	68.6	76.4	60	47.4	47.2	47.7
Prevalence	**75.4**	**79.8**	**72**	**50**	**54.6**	**46.7**

MET= metabolic equivalents, PA=physical activity

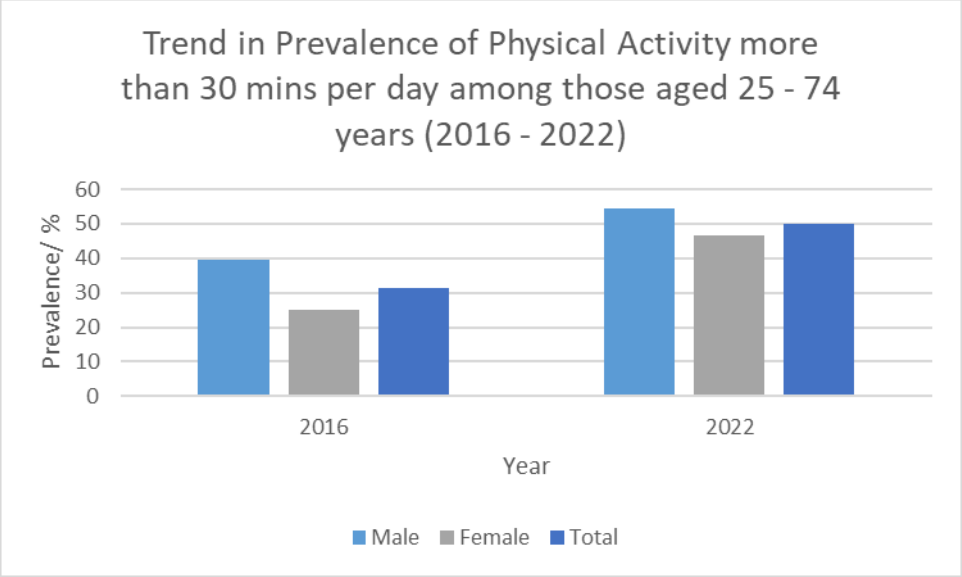

Figure 8: Trend in Prevalence of Physical Activity in Rodrigues since 2016

The trend for the prevalence of physical activity has increased since 2016 till 2022.

12.0 Chronic Kidney Disease

12.1 Background

The kidneys have several vital functions in the body like excretion of waste-products, and regulation of blood pressure, blood volume, etc. The glomerular filtration rate (GFR) of the in large epidemiological studies is estimated GFR (eGFR).

Normally, albumin remains in the blood circulation but the presence of albumin in the urine indicates that the pores of the glomerular capsule in kidneys are damaged. The presence of proteins (other than albumin) in the urine can indicate tubular damage in kidneys. The albumin content in the urine is usually related to the creatinine concentration in urine and therefore an albumin-creatinine ratio (ACR) above 3 mg/mmol is considered to indicate albuminuria (2.5 mg/mmol for men and 3.5 mg/mmol for women).

In this report the Lund-Malmö formula was used for estimating GFR, as this formula does not include ethnicity. An eGFR less than 60 ml/min is considered as moderate kidney failure (chronic kidney disease (CKD) stage CKD3 to CKD5).

12.2 Results

The age and sex adjusted prevalence of reduced kidney function (eGFR <60 ml/min) was 2.7% (95% CI 1.6-3.7), 1.7% in men, and 3.3% in women. The prevalence has stabilised as compared to 2016 when the corresponding prevalence was 2.3%: 4.5% in men, and 1.0% in women. Reduced GFR was seen in all glucose intolerance categories and in particular in association with KDM, see Table 23.

Table 23. Reduced GFR per glucose tolerance category

	NGT (%)	IFG (%)	IGT (%)	NDM (%)	KDM (%)
All	1.9	8.5	8.3	7.1	11.6
Men	0.4	10.0	2.6	8.3	10.0
Women	3.1	5.9	12.1	6.3	12.7

The age and sex adjusted prevalence of albuminuria was 5.5% (95% CI 4.0-7.1), 4.9% in men, and 6.0% in women. The prevalence of albuminuria has decreased since 2016 (7.4%) and it was more common in individual with reduced glucose tolerance and in particular associated with KDM (Table 24).

Table 24. Albuminuria per glucose tolerance category

	NGT (%)	IFG (%)	IGT (%)	NDM (%)	KDM (%)
All	3.4	6.4	7.34	7.1	21.5
Men	2.9	6.7	10.5	4.2	18.0
Women	3.8	5.9	5.3	9.4	23.9

Sex specific cut-offs, 2.5 mg/mmol for men and 3.5 mg/mmol for women.

13.0 Asthma

13.1 Background

Asthma is a reversible airway obstruction causing wheezing in the chest without any relation to infection. The cause is sometimes allergy, and the attacks can be life-threatening. Chronic obstructive pulmonary disease (COPD) is characterised by non-reversible damage to the airway producing obstructive symptoms, and the cause is very often smoking and/or other inhaled particles and pollutants. To diagnose these conditions correctly, spirometry is needed with challenge with an airway dilatator in order to distinguish between asthma and COPD. In this survey, we had only questionnaire data and 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 in which breathlessness occurred during the wheezing episode, and these symptoms occurred in the absence of a cold. We also included those who reported current medication for asthma.

13.2 Results

Using the ECHRS questionnaire definition, the age and sex standardised prevalence of asthma was 8.0% with no statistical difference between men (8.7%) and women (7.4%) (Table 25).

In 2016, the age and sex standardised prevalence of asthma in adults was 6.3%: 5.6% in men and 7.0% in women. Since 2016, the prevalence of asthma in Rodrigues has increased.

Table 25. Age-specific prevalence of asthma stratified for sex

Age-group	All (%)	Men (%)	Women (%)
<25	7.0	4.8	8.6
25 – 34	8.4	8.8	8.1
35 – 44	6.8	6.3	7.1
45 – 54	7.6	9.3	6.1
55 – 64	9.1	11.0	7.7
65 – 74	10.3	11.1	9.4
Age-standardised prevalence	**8.0**	**8.7**	**7.4**

Current smoking was common amongst individuals with asthma, 30.6% in men with asthma and 3.6% in women with asthma.

14.0 Cardiovascular Disease Risk Factors

14.1 Background

CVD risk factors tend to occur simultaneously due to the combined effect of genetic susceptibility and lifestyle factors. In this report, the presence of the following risk factors was given 1 point each and then summarized, and each person could get between 0 to 6 points. The factors were glucose intolerance (DM, IGT, IFG), hypertension (≥140 and/or ≥90 and/or treatment), abdominal obesity (ethnic cut-offs), smoking (ongoing), serum total cholesterol (≥5.2 mmol/L), and albuminuria (sec-specific cut-offs). From previous studies (i.e. Interheart etc.) it is known that the presence of several risk factors increases the risk for CVD more than the sum of the separate risk factors.

The presence of CVD was based on the self-reported interview at the study site and the participants were asked if he/she have been told by a doctor that he/she have or have had

myocardial infarction, stroke, angina, coronary by-pass surgery (CABG), and/or coronary angiography with stenting (PCI).

14.2 Results

Three or more risk factors were present in 34.3%: 36.0% in men and 33.0% in women. In contrast, 40.7% had only one or less risk factor: 37.6% in men, and 43.3% in women.

The age standardised prevalence of CVD was low for overall 1.3% (95% CI 0.5-2.0): men 1.1% and women 1.3%. Individuals that reported CVD had high LDL-cholesterol but only 1 out of 14 participants was still smoking.

This highlights that future interventions must address several risk factors simultaneously, and that the risk profile changes over time. This must be considered when planning future actions against NCDs.

15.0 Survey methods (Survey protocol and procedures)

15.1 Survey Design

The Rodrigues NCD Survey 2022 is a cross-sectional study based on a representative sample of the Rodriguan adult population.

15.2 Sampling and Sample Size

Considering information from past surveys on the prevalence of diabetes, the degree of precision desired around the new prevalence estimates, and the cluster effect, a minimum sample size of 1250 participants was required for the study.

The target population comprises of Rodriguan adults aged 20 to 74 years. In order to obtain reliable estimates of the prevalence of the diseases being studied as well as their risk factors, the participants were drawn from all over the island to represent all socio-economic groups. Based on known prevalence rates and desired level of precision, a sample size of 1,250 individuals was randomly selected from 5 clusters distributed geographically across the island of Rodrigues.

Listing of members of households in the randomly selected localities was carried out. The details of each person within each of the enumerated households during the listing exercise will include names, contact details, address, date of birth and gender. Some 3000 households were enumerated.

Households within the identified localities were visited by enumerators in an orderly manner and all persons aged 20 to 74 years within each household were registered. An enumeration form was used to record all relevant details required for the final selection of persons invited to participate in the study. All details so collected were entered into a computer.

After the exercise of data capture, the listed individuals from the 5 clusters were pooled together to obtain a master file. All the listed adults were grouped by sex and then sorted by age. A systemic sampling was then carried out within each group wherein each interval was dependent on the minimum number of individuals invited in each group. Considering the non-response factor, a total of 1,250 participants were invited to participate in the survey.

To obtain reliable national estimates of the parameters under study, the main findings will be standardized using the Mauritian population distributed by aged-group and sex.

15.3 Response Rate

The target population for the NCD Survey 2022 was Rodriguan adults aged 20 - 74 years. Of those invited to participate in the survey (n=1,250), 972 attended the survey sites and thus the overall response rate was 77.8%

15.4 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 06 30 hours and were asked to fast for at least 10 hours and to bring along any medications (If any).

Participants were tested at each of the sites. On-site testing commenced on 27 October 2022 and finished on 8 November 2022.

15.5 Training

A team of survey staff was recruited to carry out the field activities of the survey. All staff attended a one-day training workshop, which was conducted by the Principal Investigator / Project Manager, staff from the Ministry of Health and Wellness including Central Health Laboratory, Professor Jaakko Tuomilehto, Professor Stefan Soderberg and Mr Ville Stenback. Staff were briefed on the survey's background, objectives and methodology to ensure accurate and consistent data collection.

15.6 Physical examination

The physical examination procedures closely followed 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 Youth Centre, Area Health Centre and Community Centre. Survey activities at the testing site commenced at 06 30 hours and typically finished at 13 00 hours. On average, approximately 97 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 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.

15.7 Anthropometry

Height was measured to the nearest 0.1 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. Neck girth was measured in the midway of the neck, between mid-cervical spine and mid-anterior neck. In men with a laryngeal prominence (Adam's apple), it was measured just below the prominence. Measures were

recorded to the nearest 0.1 centimetre (rounding up if necessary) and repeated following both initial recordings. If there was a variation greater than 2 cm between duplicate readings, then a third was taken and recorded alongside the second. (In these cases, the 2 most consistent readings were used in analyses).

15.8 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 also available. Three measurements were taken, with a 1-minute interval between the readings, and the mean of the closest two measurements was calculated.

15.9 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. Questions were asked in a standard manner using the appropriate language (usually Creole), and numbers recorded legibly in pencil in appropriate boxes. Specific instructions regarding completion of the questionnaire were given to the staff involved.

15.10 Biochemistry Report

BACKGROUND

As in all previous surveys and screening activities (1992, 1999, 2004, 2009 & 2016), there has been a significant involvement of the Biochemistry Department of the Central Health Laboratory of the Ministry of Health and Wellness.

Assays of specific markers in blood and urine of subjects were carried within the Total Quality Assurance schemes laid down, which include standardized specimen collection and storage, reliable analytical performance, and acceptable quality control programmes.

The main markers analysed in blood were glucose (fasting & 2hr post glucose load)), urea, high-density lipoprotein (HDL) cholesterol, cholesterol, triglycerides, uric acid, creatinine, ALT (SGPT), GGT, insulin and glycated haemoglobin (HbA1c). Creatinine and microalbumin were measured in spot urine samples. The methods of these assays are described below.

METHODS

Specimen handling

Blood samples were collected in appropriate tubes and stored in cool box on site until dispatched to the Central Health Laboratory (Mauritius) on the same day. Morning urine samples were also kept in cool box. Samples were transported to the laboratory in two batches to ensure shortest delay for analysis.

Specimen collection:

Participants were asked to present at respective sites in the morning following an overnight fast. Following registration, all subjects undertook the same range of procedures for specimen collection:

(a) venous blood collected into (1) 5 ml fluoride oxalate (2) 5 ml EDTA and (3) 3x5ml plain tubes;
(b) a random urine specimen collected in a 20 ml screw capped universal container;
(c) except for known diabetics and pregnant women, a second venous blood was collected 2 hours after the subject had taken a 75 g glucose solution (250 ml). This specimen was dispensed into 5 ml fluoride oxalate for glucose assay.

Specimen transport and processing

Blood and urine samples were placed in cool box on ice packs and transported to the Central Health Laboratory by air to ensure that samples are processed within the required time.

In the laboratory, blood samples were centrifuged at 4000 rpm for five minutes, serum and plasma separated and aliquoted into respective collection tubes labelled for the purpose. Urine

specimen were spun at 2000 rpm for 10 minutes and supernatant was aliquoted in a 5 ml plastic storage tube.

Sample aliquoting and storage

Plasma from the fluoride oxalate samples were aliquoted in respective labelled tubes and analysed for glucose immediately after processing.

Serum samples were transferred to labelled tubes as follows: (1) aliquot for routine biochemistry tests; (1) aliquot for insulin assay (1) aliquot in 5ml plastic tubes stored at -20˚C and (2) aliquots into cryovials for storage at -20˚C.

The EDTA tubes were analysed as primary samples for HbA1c test. An aliquot of the EDTA sample was transferred into cryovials for storage at -20 ˚C.

Urine samples were aliquoted as follows: (1) aliquot for microalbumin and creatinine assays and (1) aliquot stored frozen at -20˚C.

Blood glucose on site:

Fasting plasma glucose from finger prick samples was measured on-site using the HemoCue Glucose 201RT-*plasma equivalent* system (HemoCue, Sweden). This test was done mainly to ensure that the glucose tolerance test is administered to eligible participants according to criteria as per protocol.

Biochemistry Tests

The Biochemistry tests carried out at the Biochemistry Department of the Central Health Laboratory were:

In the blood samples glucose, urea, uric acid, creatinine, total cholesterol, HDL cholesterol, triglycerides, ALT (SGPT), Gamma GT, Insulin and HbA1C were measured. Microalbumin and creatinine were determined in urine specimen.

Assays were carried out on automated systems: (a) Abbott Architect C4000 (Abbott Diagnostics USA), (b) Beckman Coulter AU 680, (c) Abbott Architect i2000 (Abbott

Diagnostics, USA), (d) Cobas Integra (Roche, France) and (e) Tosoh G8 HbA1c analyzer (Tosoh Biosciences, Japan). Calibration of all automated systems were performed prior and during the survey works.

Plasma Glucose

Plasma Glucose was measured by the glucose hexokinase method using reagents from Beckman Coulter (Ref OSR 6221), adapted on the Beckman AU680 automated system. Method calibrated using system calibrator, (Ref 66300).

Urea

Urea was measured by the Urease/Glutamate Dehydrogenase-UV Kinetic method using Biosystems reagents (Ref 11517 – Biosystems, Spain). The method was adapted on the Architect C4000 automated system and calibrated using clinical chemistry calibration sera level 2 and 3 (Ref 2350/2351 -Randox -UK)

Uric Acid

The Enzymatic Colorimetric Method (DIALAB reagents): Uric acid is oxidized to allantoin by Uricase. The generated hydrogen peroxide reacts with 4-aminoantipyrine and 2,4,6-tribromo-3-hydroxybenzoic acid (TBHBA) to quinoneimine and was adapted on the Architect C4000 automated system and calibrated using clinical chemistry calibration sera level 2 and 3 (Ref 2350/2351-Randox -UK).

Creatinine

Serum creatinine was measured using a kinetic alkaline picrate method, reagents from Abbott Diagnostics-USA (Ref 3L81) adapted on the Architect C4000 automated system and calibrated using clinical chemistry calibration sera level 2 and 3 (Ref 2350/2351-Randox -UK).

Creatinine in urine was measured using an Enzymatic colorimetric calibrated to IDMS, reagents from Creatinine Roche CREP Gen 2, cat no. 03263991190.

Total Cholesterol

Total cholesterol was determined by the enzymatic endpoint Cholesterol Oxidase/Peroxidase method (Biosystems Kit Ref COD 11506 – Biosystems Spain). The method was adapted on

the Architect C4000 automated system and calibrated using clinical chemistry calibration sera level 2 and 3 (Ref 2350/2351-Randox -UK).

HDL Cholesterol

HDL Cholesterol was determined by the Ultra HDL (Abbott Ref 3K33-22), methodology used is the accelerator selective detergent. The method was adapted on the Abbott Architect C4000 automated system and calibrated using kit calibrator, Ref 1E68-03 HDL Calibrator.

Triglycerides

Triglycerides in the sample was determined by the enzymatic endpoint GPO-PAP method (kit Ref COD11529 - Biosystems Spain) The method was adapted on the automated system of Abbott Architect C4000 and calibrated using clinical chemistry calibration sera level 2 and 3 (Ref 2350/2351-Randox -UK)

ALT/SGPT

ALT/SGPT was measured using Biosystems reagents, IFCC method with tris buffer & pyridoxal phosphate. The method was adapted on the automated system of Abbott Architect C4000 and calibrated using clinical chemistry calibration sera level 2 and 3 (Ref 2350/2351-Randox -UK)

GGT

Gamma- Glutamyl Transferase was measured using Abbott reagents Ref. 7D65-22. The method was adapted on the automated system of Abbott Architect C4000 and calibrated using clinical chemistry calibration sera level 2 and 3 (Ref 2350/2351-Randox -UK).

Glycated Haemoglobin (HbA1C)

EDTA whole blood was processed and analysed using the HPLC cation exchange method on the Tosoh G8 HbA1c analyzer (Tosoh Biosciences-Japan). Method was calibrated using Tosoh HbA1c calibrator (ref 0018767). Tests were carried out on three G8 equipment in parallel and method correlation was carried out on a weekly basis to ensure result reliability.

Insulin

Serum Insulin was measured on the Abbott Architect i2000 Immunoassay System. The assay is based on the chemiluminescent microparticle immunoassay (CMIA). Reagents (Kit Ref 8K41) and calibrated using Architect insulin calibrators (Ref 8K41-02) both from Abbott Diagnostics-USA.

Microalbumin in Urine Samples

Procedure used for microalbumin was based on immunoturbidimetric assay using kit from Roche (Ref ALB-T TQ Gen2). The method was adapted on the Roche Cobas Integra automated system and calibrated using Roche calibrator (C.f.a.s PUC Ref. 03121305) & using Precinorm PUC Roche as controls. Albumin: Creatinine ratio (ACR) was calculated and reported for all samples.

Protein stix

Urine samples with microalbumin level ≥ 3+ were reported accordingly. Every tenth sample was tested for presence of proteins using the Protein stix from Siemens (Ref 02614217).

QUALITY ASSURANCE

Quality assurance includes information on how and when to collect specimen and subject preparation, interpretation of test results, analytical performance and turnaround time.

Subject preparation and collection of specimen were carried out on-site, involving non-laboratory staff as per established protocol. This section will deal with quality assurance relating mainly to analytical performance.

Levey Jenning Charts

Quality assessment materials of two different levels (high and low) were run in each batch of tests. Initially, each type of the quality material was assayed repeatedly over two weeks prior to the analysis of NCD samples. The mean and SD for each analyte of interest were calculated

and respective Levey Jenning Charts were constructed showing the mean value with -1SD, -2SD, - 3SD and + 1SD, + 2SD, and + 3SD. Results of subsequent analyses of the assessment material were plotted above the appropriate date of analysis. Not more than one in twenty values should fall outside the 2SD lines.

Westgard rules were applied (Westgard JO et al, 1981) and batch of tests had to be repeated if:

- One result exceeded a 3SD limit
- Both results exceeded the same 2SD limit
- Each result exceeded a different 2SD limit.
- The last four consecutive results on both materials exceeded the same 1SD limit
- The last ten consecutive results on both materials were on the same side of the mean.

Intra-Quality Control

Human assayed control from (i) Randox assayed chemistry control level 2 (Ref HE 1530) and level 3 (Ref HE 1532) (UK) were run daily for the following assays-glucose, urea, uric acid, creatinine, total cholesterol, HDL cholesterol, triglycerides SGPT & GGT. For HbA1C, Biorad Lyphochek Diabetes Bilevel controls were used (Ref 740). For urine microalbumin and creatinine, Roche Precinorm PUC control (Ref 03121313 122) was assayed. Biorad Lyphochek Immunoassay plus trilevel Control (Ref 370) was used for Insulin assay.

Within and between Batch Imprecision

Control samples were run twice in each batch, once at the beginning and once at the end. The same control samples were analysed between days. After several pairs of values the within batch and between batch variation were calculated.

Subject based Precision

Assayed sample from a particular day's workload was stored under standard conditions to be reintroduced on the following day's run. The between batch imprecision was calculated after each week of operation. This exercise was carried out on every tenth sample of the batch analysed on a day.

External Quality Assessment

The External Quality Assessment which is an ongoing scheme from the WHO collaborating Centre for Research and Reference for clinical chemistry (Birmingham Quality, Queen Elizabeth Medical Centre, Birmingham, United Kingdom) provides the overall performance of the laboratory on a monthly basis. The Biochemistry Department of Central Laboratory is a participant in the scheme since 1984.

The performance of the Laboratory is also monitored every month of the year through participation in the Biorad Immunoassay EQAS and the department participates in the EQA system of the Swiss Quality Control Centre (CSCQ) for HbA1c on a regular basis since 2007.

RESULTS

Validation of test results was done at four levels – (a) on test bench in the routine laboratory, (b) on test site in the special assay laboratory, (c) by the team responsible for result reporting and (d) final vetting by the Principal Clinical Scientist.

After validation for quality control rules as described above, all analytical results were entered on an Excel Spreadsheet. A print out of the sheet was cross-checked with the original result data by different operators. Wherever required, analyses were repeated. All raw data and transcribed data have been kept in appropriate files.

List of staff who worked on the study

Survey Officers	Name	Survey Officers	Name	Survey Officers	Name
Chief Investigator	Dr B. Ori Mrs Lallmohamed	**Senior Survey Officer**	Mrs A. Rampersad	**Medical Officer**	Dr S. Boodhoo
		Survey Officer	Mrs E. Pydatalli Mrs S. Sauntokhee	**Survey Blood Pressure Supervisor**	Mr K. Fowdar
Principal Investigator / Project Manager	Dr S. Kowlessur				
		Word Processing Survey Operator	Mrs J. Tapsee	**Officers for measuring blood pressure**	Mr Bachoo Mrs Teeha Mrs J. Perrine
General Administrator	Mrs S.C. Kalasopatan-Chellen	**Survey Procurement Officer**	Mr A. Soobratty		Ms N. Jolicoeur-Perrine Mrs M. Y. Azie Ms S. L. Edouard
General Administrator (Rodrigues)	Mr J. A. Chang Siow	**Data Coordinator**	Mr A. Seebun	**Labelling Identification Officer**	Mrs Hossenbaccus Ms A. Begue
		Survey Operational Coordinator	Mr R. Bookal Mr I.S. Neetye		
Survey Liaison Officer	Mr J.L.D. Bhujoharry	**Data Editor**	Mrs O. Greedharry	**Officers for taking blood specimen**	Mr Boodhoo Mrs Patel Ms M. A. J. Perrine
Survey Liaison Officer (Rodrigues)	Mrs C. Prudence	**Data Entry Officer (Survey)**	Mr P. Neamuth Mrs Y. Gunness Mrs Ramjaune		Mr J. K. Lalanne Mr R. Casimir
Data Manager	Mr. N. Jeeanody		Mrs Audit Mrs Dinaully	**Blood Specimen Assistant**	Mrs M. N. Botte
Laboratory Manager	Dr S. Hunmah		Mrs Hosseny		
				Registration Officers	Mr J. Gaonjur Mrs Y. Guness Mrs Z. M. Onorina Ms S. Legentil
Principal Survey Coordinator	Mr J. Heecharan	**Survey Site Administrator**	Mr L. Casimir		
Finance Survey Officer	Mr B.A. Heenaye	**Interview Supervisor**	Ms L. Babajee		

Survey Officers	Name	Survey Officers	Name	Survey Officers	Name
Diabetes Complication Survey Officers	Mrs Ramsoful	**Staff for guest participant**	Ms R. M. Clair Mr L. Larcher Mr J. A. Rose Mr K. Casimir		
Interviewer	Mrs Doorgah Mr Raghoonath Mrs Boodhoo Mrs Persand Mrs Dulloye Mrs Sobrun Mr C. Raboude Ms M. J. Collet Ms M. M. Perrine-Louis Ms M. Casimir Ms K. Samoisy-Clair	**ECG Technician**	Mr Gaoneadry Mrs Lallmohamed Ms A. C. Larose Mrs Jhungeer		
Officer for measuring height, weight, Waist Hip, Neck circumference	Mr Mungroo Ms Chekori Mrs M. R. Perrine	**Staff for administering oral glucose**	Mr M. Mecure		
Hand Grip Strength	Mrs Domah	**Chaser**	Mr Moongah		
Officer for Pulse Wave Velocity	Mrs Fallee Mrs Cowlessur	**Urine Collection Officer**	Mrs Lutchoomanin		
Retinal Photography Survey Coordinator	Dr Y. Oozeer	**Urine Collection Attendant**	Mr S. Azie Mr J. Prudence		
Sleep Assessment Survey Coordinator	Dr S. Mudoo	**Survey Site Assistant**	Mrs Narayadu		
		Retinal Photography Survey Officer	Mr Sadasing		

Acknowledgements

This Rodrigues Non Communicable Diseases (NCD) Survey 2022 could not have been completed without the contribution of a large number of individuals who each made unique and often unrecognized contributions to its realization.

The initiative of Dr the Honourable Kailesh Kumar Singh Jagutpal, Minister of Health and Wellness for his tremendous interest, support and commitment is highly commendable and appreciated.

Our thanks also go to Mr Johnson Roussety, Chief Commissioner, Rodrigues Regional Assembly and Mr Jean Nicolas Volbert, Commissioner for Health and Others for their remarkable and outstanding contribution and unflinching support.

We would like to thank Monash University, Australia; University of Helsinki, Finland; Umea University, Sweden; Imperial College, London, United Kingdom; Baker Heart and Diabetes Institute, Australia; and World Health Organization for their invaluable support and collaboration throughout the project.

We also thank Mrs Devi Chand Anandi Rye Seewooruthun, Senior Chief Executive, Mrs Z. B. Lallmahomed, Permanent Secretary, Mr D. Conhye, Permanent Secretary, Mr D. Dassaye, Permanent Secretary, Mrs S. Kalasopatan-Chellen, Ag Deputy Permanent Secretary and Mr J. Ah Leong Chang Siow, Ag Departmental Head, Commission for Health and Others for their continuous encouragement, guidance, and collaboration.

We extend our sincere thanks and gratitude to all those who assisted in the undertaking of this Survey. This includes the Ministry of Health and Wellness Officials, namely: Directors Health Services; Regional Health Directors; NCD Coordinators; Mr Hurbissoon, Former-Director Nursing; Director Nursing; Regional Nursing Administrators; Regional Health Services Administrators; Health Director, Queen Elizabeth Hospital, Rodrigues; Mrs Larose, Nursing Administrator, Queen Elizabeth Hospital, Rodrigues; Manager Financial Operations; Manager Human Resources; Director Pharmaceutical Services; Mr B. Gowreesungker, Senior Manager, Operation Support Services; Manager Procurement & Supply; Mr Ramjaun, Senior Procurement & Supply Officer; Mrs Malhotra, Transport Supervisor; Medical, Nursing and

Para Medical Staff from Mauritius and Rodrigues; Staff of the Central Health Laboratory; Drivers; those responsible for motivating participants; all those staff who worked for the Survey; and many others not covered by these designations.

Our special thanks go to Mr D. Bhujoharry, Assistant Permanent Secretary; Mr. J. Heecharan, Nursing Supervisor; Dr D. Soobrayen Jhugroo; Dr K. Boodoo; Dr Ramphul; Ms C. Prudence, Administrative Officer, Commission for Health and Others; Mr L. Casimir, Hospital Administrator, Queen Elizabeth Hospital, Rodrigues; and staff of the NCD, Health Promotion and Research Unit for the pivotal role in the organization and coordination of the project activities and we warmly welcome their continued support.

We would also like to thank Dr Anne Ancia, WHO Representative in Mauritius; and staff of the Statistics Mauritius for making the survey a success.

Our special gratitude and thanks to all the participants and their relatives who were instrumental in providing valuable information without which the project would not have been possible.

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