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Trends and Socio-demographic Distribution of Immunological Diseases in Saint Vincent and the Grenadines

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Authors' contributions

This work was carried out in collaboration among all authors. Authors AO and IA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. AO and IA managed the analyses of the study. All authors managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Background: More than 100 human diseases are due at least in part to an inappropriate immune system response that results in damage to an individual's organs, tissues, or cells. Immunological diseases can affect any part of the body, and have myriad clinical manifestations that can be difficult to diagnose. At the same time, immunological diseases share many features related to their onset and progression. In addition, overlapping genetic traits enhance susceptibility to many of the diseases, so that a patient may suffer from more than one immunological disorder, or multiple immunological diseases may occur in the same family.
Aim: The study aims is to explore the trends and Socio-demographic distribution of Immunological diseases in Saint Vincent and the Grenadines from 2014-2018 in Milton Cato Memorial Hospital Saint Vincent and the Grenadines, including temporal trends and variations in age and sex from

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2014 to 2018 by using routinely collected administrative health data/patient records.
Methods: From 2014 to 2018, individuals with immunological diseases were identified from the hospital records of Milton Cato Memorial Hospital, which records information on all patient coming in for healthcare services. A structured data extraction tool was employed to extract the data from the hospital record using the open data kit (ODK). Data was analysed using Statistical Package for Social Sciences (SPSS) version 23 and R Studio statistical software for analysis. The Chi-square test was used to test for association. All statistical tests were two-tailed and Level of Confidence was set at 95%, and P values < 0.05 was considered to be statistically significant.
Results: The mean age of patient with SLE was ***35.65 ± 21.16*** yrs. old and the median Age was 34 years old, *almost two-third 218(62.6%) were females*. Yearly, women showed a significantly higher incidence of immunological disease than men except in 2017 where the incidence for males were slightly higher than that of the females, there was an annual decrease in the incidence from 2014 to 2018, with a peak incidence in 2016 (0.94/1000 person-years). The lowest incidence was noted in 2018 (0.17/1000 person-years). Among sex, there was an annual decrease in the incidence from 2014 to 2018, with a peak incidence in 2014 for male (0.71/1000 person-years) and in 2016 for females (1.34/1000 person-years). The lowest incidence was noted in 2018 (0.14/1000 person-years) and (0.20/1000 person-years) for both male and female respectively.
Conclusions: The study showed that the incidence of immunological disease, Type 1 diabetes Mellitus Myopathy/Myositis and SLE in Saint Vincent have decreased in the last decade, whereas the mortality rates of both SLE and Type 1 Diabetes Mellitus have increased. This finding of increased mortality of SLE and T1D suggests that this disease is no longer rare and will have implications for future healthcare planning. Age and sex were found to be risk factors for SLE. Our data confirmed the known predilection of SLE in women. The peak age of diagnosis is middle age, contrary to the generally held belief that lupus mainly targets young people.

Keywords: Immunological disease; incidence; Saint Vincent and the Grenadines.

1. INTRODUCTION

More than 100 human diseases are due at least in part to an inappropriate immune system response that results in damage to an individual's organs, tissues, or cells. Immunological diseases are a spectrum of diseases affecting multiple organs and tissues [1]. Immunological disease could be classified as either autoinflammatory or autoimmunity. Autoinflammatory is defined as self-regulated inflammation which is when local mediators at site of cell injury leads to activation of innate immunity cell, and this includes; macrophages and neutrophils, in which its final outcome is to target tissue damage [1]. Autoimmunity is self-regulated inflammation, where there is an anomaly in dendritic cell, B and T cell, response responses in primary and secondary lymphoid organs lead to breaking of tolerance, with development of immune reactivity towards native antigens. The adaptive immune response plays the predominant role in the eventual clinical expression of disease. Organ-specific autoantibodies may predate clinical disease expression by years and manifest before target organ damage is discernible [1].

Immunological diseases can affect any part of the body, and have myriad clinical manifestations that can be difficult to diagnose. At the same time, Immunological diseases share many features related to their onset and progression. In addition, overlapping genetic traits enhance susceptibility to many of the diseases, so that a patient may suffer from more than one immunological disorder, or multiple immunological diseases may occur in the same family [2].

Treatments are available for many immunological diseases, cures have yet to be discovered. For these and other reasons, the immunological diseases are best recognized as a family of related disorders that must be studied collectively as well as individually. While many of these diseases are rare, collectively they affect 14.7 to 23.5 million people in a country like the USA and for reasons unknown their prevalence is rising [2].

Since cures are not yet available for most immunological diseases, patients face a lifetime of illness and treatment. This therefore affects QALY and DALY, QALYs (Quality-Adjusted Life Year) and DALYs (Disability-Adjusted Life Year) are common terms used to evaluate and compare health interventions using cost-effectiveness analysis to measure the impact on both the length and the quality of life. QALYs are

a measure of years lived in perfect health gained whereas DALYs are a measure of years in perfect health lost [3]. They often endure debilitating symptoms, loss of organ function, reduced productivity at work, high medical expenses. Most of these diseases disproportionately affect both sexes, and are among the leading causes of death for young and middle-aged individuals on which they impose a heavy burden on patients' families and on society [3].

There are gaps in evident literature for the Incidence rates of Immunological in the Caribbean and Saint Vincent and the Grenadines in specific. Hence, this gap gave a recognition that more needs to be done to highlight evidence needed to close the gaps in our knowledge and achieve our overall goal of reducing the rising toll of immunological disease. For example, we need to gain a better understanding of the distribution of these diseases through epidemiologic studies, and of the environmental triggers that contribute to their onset. This research would give more insight about the genetic and environmental factors contributing to these diseases, and also set a platform to develop effective prevention strategies that arrest the immunological process before it can irreversibly damage the body.

This research sets forth an ambitious and comprehensive research agenda aimed at generating more accurate epidemiologic profiles of immunological diseases; developing a greater understanding of the fundamental biologic principles underlying disease onset and progression; devising improved diagnostic tools; creating more effective interventions; and producing public and professional education and training programs. The study aims are to explore the trends and Socio-demographic distribution of Immunological diseases in Saint Vincent and the Grenadines from 2014-2018.

2. RESEARCH METHODOLOGY

2.1 Study Area

Saint Vincent and the Grenadines (SVG) is an upper-middle-income multi-island state in the eastern Caribbean, located in the Windward Island chain of the Lesser Antilles. It consists of 32 islands, inlets, and cays, but only 7 of these beyond the main island of Saint Vincent are inhabited (Bequia, Canouan, Mayreau, Union, Mustique, Palm Island, and Petit Saint Vincent) [4]. The main island of Saint Vincent is the largest island in size at 340 square kilometers and in population with over 90 percent of the population. The islands are connected by sea ferries and air charters through four Grenadine airports. The country is divided into six administrative units, or parishes: Charlotte, Grenadines, Saint Andrew, Saint David, Saint George, and Saint Patrick. Five of these parishes are located on the island of Saint Vincent. Kingstown, located in the Saint George Parish on Saint Vincent Island, is the capital of the country and largest urban centre [5].

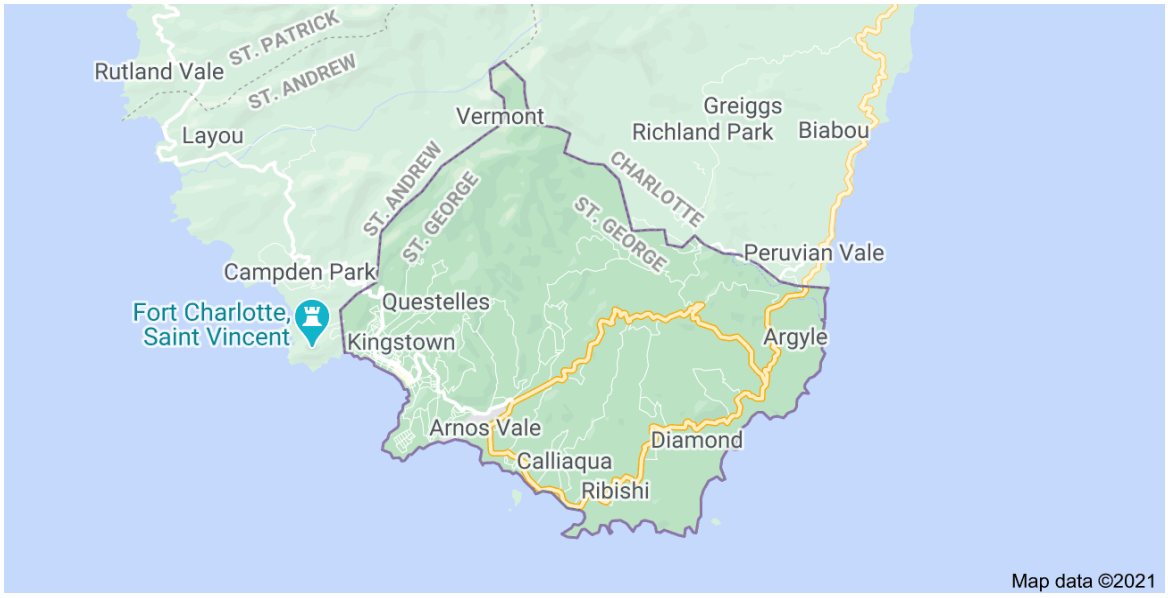


Fig. 1. Map and Parishes of Saint Vincent and the Grenadines

In 2020, SVG had an estimated population of 110172, the male population (56,052) out-numbered the female (54,120). The population is young, with almost 25 per cent under the age of 15 and 41.7 per cent under the age of 35. Although this under-35 age group has decreased since the 2001 census by 6.1 per cent, it remains the largest proportion of the total population. The 2020 census determined the population aged under 5 years to be 8,723. A little over 9 per cent of the population is over the age of 65.5. According to the Saint Vincent 2001 Housing and Population Census, 24.2 percent of the population lived in and around the capital, Kingstown, in 2011 [6]. Since then, the urban population has increased by 2 percentage points [7].

Saint Vincent, like the rest of the countries of the Organization of Eastern Caribbean States (OECS), is experiencing an increase in elderly population and a decline in the fertility rate. This shift is largely the result of long-term successes in increasing access to care and treatment for infectious diseases [8]. The aging population contributes to the increased burden of chronic diseases. Life expectancy for Vincentians averages 72 years of age overall, 74 for females and 70 for males. Chronic noncommunicable diseases (NCDs) account for 70 percent of visits to outpatient services and are among the top five causes of death [9]. In 2004 the top five cause of death, in rank order, were diabetes, malignant neoplasms, cerebrovascular disease, heart disease, and hypertension [8].

As with many of its neighbouring countries, primary care service coverage indicators are extremely strong, with universal coverage of vaccines for key childhood illnesses and skilled attendance at delivery. The country is experiencing epidemiological transitions, as seen in the increasing burden of non-communicable diseases (NCDs), which accounts for the top five causes of death, and in the increasing average age of the population [5]. The estimated prevalence of HIV in Saint Vincent is 1%, but stigma against individuals with HIV and AIDS continues to persist across the islands [5].

Health care service delivery in Saint Vincent is largely provided by the public sector, but the private sector has grown in recent years to complement the limited specialty services and alleviate some of the burden on the public sector [5]. The private commercial sector is not well documented but is known to be concentrated in Kingstown. Data on the division of health services between the public and private sectors are not available. Specialized health services are also concentrated in Kingstown. NGOs provide limited care, mostly through service delivery [5]. At the primary care level, the public sector is divided into nine Health Districts with 39 health clinics spread throughout the country. On average, each health clinic is equipped to cater to a population of 2,900 with no patient required to travel more than three miles to access care. At the secondary level, Milton Cato Memorial Hospital (MCMH) which is a 215-bed hospital, is the country's only governmental acute care referral hospital providing specialist care. The private sector is active at the primary care level with private providers offering generalist and/or obstetric services [4]. Tertiary care is limited on the island in both sectors. The private sector offers more long-term care facilities for the elderly with five facilities, while the one public sector facility primarily serves the impoverished populations. The private sector also offers advanced diagnostics, which are limited in the public sector to the lab at MCMH [5].

Like many other Caribbean countries, many citizens of Saint Vincent travel abroad for tertiary care. Though the majority of health service providers are in the public sector, the private sector also plays a prominent and growing role; physicians in Saint Vincent commonly practice in both the public and private sectors [5].

Financing for the health sector is provided through the Ministry of Health's (MOHE) portion of the Consolidated Fund, the National Insurance Service (NIS), and private expenditures. Available data on private expenditures are limited. Public health services are primarily covered most through the MOHE budget. Primary care services are free of charge and all other services are highly subsidized. NIS covers the costs of hospital services for its members [5].

2.2 Study Design

The study utilized a retrospective population-based study which consists of secondary data derived from Milton Cato Memorial Hospital of patients with Immunological disease from 2014-2018.

2.2.1 Inclusion criteria

Data on Immunological disease from 2014-2018 (For the purpose of this study, Immunological consisted of both autoinflammatory disease

cases and autoimmune disease cases. Cases of autoinflammatory disease was identified as cases in which: (1) there is an idiopathic recurrent fever with systemic inflammation, (2) an inflammatory finding for which the trigger is not clear is present, (3) there is no association with a high titre of autoantibodies or self-responsive T cells and (4) an abnormality of innate immunity is observed [1]. Cases of autoinflammatory disease was identified cases in which; [1] t an abnormality of adaptive immunity is observed, [2] there is an association with a high titre of autoantibodies or self-responsive T cells [1].

2.2.2 Exclusion criteria

Incomplete data on Immunological disease from 2014-2018.

2.3 Data Collection Procedure

A structured data extraction tool was employed to extract the data from the hospital record with the aid of an android mobile device using the open data kit (ODK). The data extraction tool was developed and modified with reference to existing tools used in similar studies. The data extraction tool comprises of information on sociodemographic (age, sex), year of diagnosis and diagnosis.

2.4 Outcome Measures and Data Analysis

For annual incidence, the year-specific numerator included subjects with incident cases of immunological disease in the specific calendar year, and the denominator included the mid-year population from the Population and Demographic Health Survey (DHS) from 2013-2019 which are cross-sectional surveys conducted every year, compiled by the Statistical Office Ministry of Finance, Economic Planning, Sustainable development and Information Technology of the Government of Saint Vincent and the Grenadines Population This nationally representative survey involved a multi-stage sampling design up to the household level with enumeration areas distributed by region and type of residence using the most recent national census as its sampling frame. Crude rates, sex- and age-specific rates, standardized rates adjusted for sex and age using the 2014-2018 mid-year population, and their 95% confidence intervals (CIs) were calculated.

Incident cases of immunological disease were defined as those without immunological disease, disease in a particular year (e.g., 2014) and the preceding year (e.g., 2012 to 2013) that met the algorithm in that year (e.g., 2014) and the following year (e.g., 2015). Subgroup analyses were performed according to age and sex.

Data was edited, collated and entered into the 2019 Microsoft Excel Data Sheet, after which it was exported into the International Business Machine (IBM) Statistical Package for Social Sciences (SPSS) version 23.0 and R Studio statistical software for analysis. The analysis involved the calculation of descriptive statistics (such as frequency distributions, percentages and means) and inferential statistics. Continuous variables were expressed as means ± standard deviation while categorical variables were expressed as absolute frequencies. Parametric analysis was used after tests for normality confirmed that continuous variables were normally distributed. The Chi-square test was used to test for association. All statistical tests were two-tailed and Level of Confidence was set at 95%, and P values < 0.05 was considered to be statistically significant. Test of normality was done to check for normal distribution of data using the Shapiro-Wilk test and Kolmogorov-Smirnov Test with significance level set at 0.05. Assumptions were set that If the Sig**.** value of both Test ($p>0.05$), the data is normal. If it is below 0.05, the data significantly deviates from a normal distribution and non-parametric testing was employed such as the median will be used instead of the mean to represent summative statistics due to the median is not affected by outliers or extreme values.

The information provided by the probability value (p-value) does not provide an estimate for the magnitude of the effect of interest and the precision of this magnitude [10]. As a result of this, most of the inferential statistics reported in this report, did not only provide information on the p-value but also on the magnitude of the effect (effect size statistics) in the form of correlation coefficient, regression coefficient and also their confidence intervals (CIs). Confidence intervals (CIs) were interpreted as the value that encompasses the population or ‘true’ value. This style of reporting both the effect sizes and their CIs gave a clear understanding of the relationships between the variables [10].

3. RESULTS

Table 1, shows the socio-demographics distribution of patient with immunological diseases in respect to age and sex. From 2014 to 2018, the total number of immunological cases seen in Milton Cato General Hospital was

347, with almost one-third 104(30%) occurring in the year 2016. Among the cases of immunological diseases, the mean age was ***35.65 ± 21.16 yrs old*** and the ***median Age= 34 yrs old,*** *almost two-third 218(62.6%) were females.*

Table 2 shows that a greater percentage 125(36.0%) had diabetes Mellitus Type 1, 111(32.0%) had Unspecified myopathies, 26(7.5%) had SLE, only a few rare diseases were identified, this includes Charge disease 1(0.3%), Iridocyclitis 17(4.9%) and ARPKD 2(0.6%)

Table 3 shows that among patients with Diabetes Mellitus, more than two-thirds 81(64.8%) were females. In patient with SLE, only few 2(7.7%) were males with almost all 24(92.3%) females. Females with Myositis more than half 62(55.9%) compared to the males 49(44.1%) with myositis.

Table 4 shows that among patients with Diabetes Mellitus, all of the patients 125(100%) are within 21-40 years of age.

Fig. 2 shows the trend in incidence by year. Yearly, women showed a significantly higher incidence of immunological disease than men except in 2017 where the incidence for males were slightly higher than that of the females, there was an annual decrease in the incidence from 2014 to 2018, with a peak incidence in 2016 (0.94/1000 person-years). The lowest incidence was noted in 2018 (0.17/1000 person-years). Among sex, there was an annual decrease in the incidence from 2014 to 2018, with a peak incidence in 2014 for males (0.71/1000 person-years) and in 2016 for females (1.34/1000 person-years). The lowest incidence was noted in 2018 (0.14/1000 person-years) and (0.20/1000 person-years) for both male and female respectively.

Fig. 3 shows that the overall peak age of incidence was 31 to 35 years in 2014. In 2014, the peak age incidence among men was different > 70 years. However, the peak age of prevalence among women was similar to the overall incidence graph 31 to 35 years of age.

Table 1. Socio-demographics Characteristics of Patients

Variable	Frequency (n=347)	Percentage (%)
Age		
≤5	23	6.6
6-10	18	5.2
11-15	22	6.3
16-20	32	9.2
21-25	28	8.1
26-30	18	5.2
31-35	45	13.0
36-40	46	13.3
41-45	20	5.8
46-50	13	3.7
51-55	12	3.5
56-60	20	5.8
61-65	11	3.2
66-70	16	4.6
>70	23	6.6
Sex		
Male	129	37.2
Female	218	62.8
Year		
2014	103	29.7
2015	62	17.9
2016	104	30.0
2017	59	17.0
2018	19	5.4

Mean ± S.D (35.65 ± 21.16 yrs. old), 95% C.I for Mean (33.41-37.88), Median Age= 34 yrs. old
S.D =Standard deviation, C. I= Confidence Interval

Table 2. Type of Immunological Diseases/Rare Disease

Variable	Frequency (n=347)	Percentage (%)
Disease Type		
ADPKD	9	2.6
ARPKD	2	0.6
Autoimmune Hemolytic Anemia	2	0.6
Calciphylaxis	1	0.3
Charge Syndrome	1	0.3
Crohn Disease	1	0.3
Crohn Disease/Diabetes Type 2	1	0.3
Cryoglobulinemia	1	0.3
Diabetes Type 1	125	36.0
Diabetes Type 2/Pseudogout	1	0.3
Gout	11	3.2
Gout /Diabetes Type 2	1	0.3
Gout/Iridocyclitis	1	0.3
Iridocyclitis	16	4.6
Iridocyclitis/Diabetes Type 2	2	0.6
Juvenile Arthritis	1	0.3
Kawasaki	5	1.4
Leukemia	2	0.6
Myasthenia Gravis	1	0.3
Unspecified Myopathy/Myositis	111	32.0
Unspecified Myopathy/Myositis/Diabetes Type 2	7	2.0
Pernicious Anemia	1	0.3
Idopathic hypophysitis	2	0.6
Rheumatoid Arthritis	5	1.4
Sarcoidosis	1	0.3
Sjogren Syndrome	3	0.9
Systemic Lupus Erythematous (SLE)	26	7.5
SLE/Diabetes Mellitus/Type 2	1	0.3
Systemic Sclerosis	3	0.9
Ulcerative Colitis	3	0.9

ADPKD= Autosomal Dominant Polycystic Kidney Disease, ARPKD= Autosomal Recessive Polycystic

Fig. 4 shows that the overall peak age of incidence was 31 to 35 years in 2015. In 2015, the peak age incidence among men was similar to the overall incidence graph 31 to 35 years of age. However, the peak age of prevalence among women was different (56-70) years of age to the overall incidence graph.

Fig. 5 shows that the overall peak age of incidence was 66-70 years in 2016. In 2016, the peak age incidence among men and women was similar to the overall incidence graph 66-70years of age.

Fig. 6 shows that the overall peak age of incidence was 36-40 to years in 2017. In 2017, the peak age incidence among men and women was similar to the overall incidence graph 36-40 years of age.

Fig. 7 shows that the overall peak age of incidence was 66-70 years in 2018. In 2014, the peak age incidence among men was different > 70 years. However, the peak age of prevalence among women was similar to the overall incidence graph 66-70 years of age.

In the Table 5, among sex, the females had higher proportions across the years (2014-2018) compared to that of the male we hereby fail to reject the null hypothesis which postulates that, ***there is no significant higher proportion of females to males who have a immunological disease from 2014 -2018 in Saint Vincent and the Grenadines*** due to there was no statistically significant association observed *(p>0.05)*. Among the age groups, those within the age group of 31-40 years had significantly higher proportions across the years (2014-2018) compared to that of other age groups, this difference was statistically significant *(p<0.05)*.

Table 3. Distribution of Immunological Diseases by Sex

Variable	Sex		
	Male	Female	
Rare Disease	**Freq (%)**	**Freq (%)**	**Total (%)**
ADPKD	5(55.6)	4(44.4)	9(100)
ARPKD	2(100)	0(0)	2(100)
Charge Syndrome	0(0)	1(100)	1(100)
Calciphylaxis	1(100)	0(0)	1(100)
Pituitary Adenoma	0(0)	1(100)	1(100)
Immunological Disease			
Autoimmune Haemolytic Anaemia	0(0)	2(100)	2(100)
Crohn Disease	0(0)	1(100)	2(100)
Cryoglobulinemia	0(0)	1(100)	1(100)
Diabetes Type 1	44(35.2)	81(64.8)	125(100)
Gout	7(63.6)	4(36.4)	11(100)
Iridocyclitis	7(43.8)	9(56.2)	16(100)
Juvenile Arthritis	0(0)	1(100)	1(100)
Kawasaki	1(20)	4(80)	5(100)
Leukaemia	0(0)	2(100)	1(100)
Myasthenia Gravis	0(0)	1(100)	1(100)
Unspecified Myopathies/Myositis	49(44.1)	62(55.9)	111(100)
Pernicious Anaemia	0(0)	1(100)	1(100)
Rheumatoid Arthritis	2(40)	3(60)	5(100)
Sarcoidosis	1(100)	0(0)	1(100)
Sjogren Syndrome	0(0)	3(100)	3(100)
Systemic Lupus Erythematous (SLE)	2(7.7)	24(92.3)	26(100)
Systemic Sclerosis	1(33.3)	2(66.7)	3(100)
Ulcerative Colitis	0(0)	3(100)	3(100)
Immunological Disease with Comorbidity (Diabetes Type 2)			
Crohn Disease & **Diabetes Type 2**	0(0)	1(100)	1(100)
Unspecified Myopathies/Myositis & Diabetes Type 2	5(60)	2(40)	7(100)
Pseudogout & Diabetes Type 2	0(0)	1(100)	1(100)
Gout & Diabetes Type 2	1(100)	0(0)	1(100)

Variable	Sex		
	Male	Female	
Rare Disease	**Freq (%)**	**Freq (%)**	**Total (%)**
Gout & Iridocyclitis	1(100)	0(0)	1(100)
Iridocyclitis& Diabetes Type 2	0(0)	2(100)	2(100)
SLE & Diabetes Type 2	0(0)	1(100)	1(100)

ADPKD= Autosomal Dominant Polycystic Kidney Disease, ARPKD= Autosomal Recessive Polycystic
N.B: Unspecified myopathy/myositis are collection of inflammatory and non-inflammatory muscle disorders with clinical and /or laboratory evidence

Table 4. Distribution of Immunological Disease by Age

Variable	Age								
	≤10	11-20	21-30	31-40	41-50	51-60	61-70	>70	
Rare Disease	**Freq (%)**	**Freq (%)**	**Freq (%)**	**Freq (%)**	**Freq (%)**	**Freq (%)**	**Freq (%)**	**Freq (%)**	**Total (%)**
ADPKD	0(0)	0(0)	1(11.)	1(11.1)	2(22.)	1(11.1)	3(33.3)	1(11.1)	9(100)
ARPKD	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1(50)	2(100)
Charge Syndrome	1(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1(100)
Calciphylaxis	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1(100)	0(0)	1(100)
Pituitary Adenoma	0(0)	0(0)	0(0)	0(0)	1(50)	1(50)	0(0)	0(0)	2(100)
Immunological Disease									
Autoimmune Haemolytic Anaemia	0(0)	2(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	2(100)
Crohn Disease	0(0)	0(0)	0(0)	0(0)	1(0)	0(0)	0(0)	0(0)	1(100)
Cryoglobulinemia	0(0)	0(0)	0(0)	0(0)	0(0)	1(100)	0(0)	0(0)	1(100)
Diabetes Type 1	0(0)	0(0)	0(0)	125(100)	0(0)	0(0)	0(0)	0(0)	125(100)
Gout	0(0)	2(18.2)	0(0)	0(0)	0(0)	3(273)	2(18.2)	1(9.1)	11(100)
Iridocyclitis	0(0)	1(6.2)	2(12.5)	4(25.0)	5(31.2)	3(18.8)	1(6.2)	0(0)	16(100)
Juvenile Arthritis	1(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1(100)
Kawasaki	5(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	5(100)
Leukaemia	1(50)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1(50)	2(100)
Myasthenia Gravis	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1(100)	1(100)
Unspecified Myopathies/Myositis	13(11)	20(18.0)	11(9.9)	14(12.6)	11(9.9)	17(15.3)	11(12.6)	14(12.6)	111(100)
Pernicious Anaemia	1(100)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1(100)
Rheumatoid Arthritis	0(0)	0(0)	0(0)	0(0)	1(20)	3(60)	0(0)	1(20)	5(100)

Variable	Age								
	≤10	11-20	21-30	31-40	41-50	51-60	61-70	>70	
Rare Disease	**Freq (%)**	**Freq (%)**	**Freq (%)**	**Freq (%)**	**Freq (%)**	**Freq (%)**	**Freq (%)**	**Freq (%)**	**Total (%)**
Sarcoidosis	0(0)	0(0)	1(100)	0(0)	0(0)	0(0)	0(0)	0(0)	1(100)
Sjogren Syndrome	0(0)	0(0)	1(33.3)	2(66.7)	0(0)	0(0)	0(0)	0(0)	3(100)
Systemic Lupus Erythematous (SLE)	1(3.8)	7(26.9)	6(23.1)	8(30.8)	3(11.5)	1(3.8)	0(0)	0(0)	26(100)
Systemic Sclerosis	0(0)	0(0)	0(0)	0(0)	2(66.7)	0(0)	0(0)	1(33.3)	3(100)
Ulcerative Colitis	0(0)	0(0)	1(33.3)	0(0)	0(0)	0(0)	2(66.7)	0(0)	3(100)
Immunological Disease with Comorbidity (Diabetes Type 2)									
Crohn Disease & **Diabetes Type 2**	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1(100)	0(0)	1(100)
Unspecified Myopathies/Myositis & Diabetes Type 2	1(14.3)	0(0)	0(0)	0(0)	0(0)	1(14.3)	3(42.8)	2(28.6)	7(100)
Pseudogout & Diabetes Type 2	0(0)	0(0)	0(0)	0(0)	0(0)	1(100)	0(0)	0(0)	1(100)
Gout & Diabetes Type 2	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1(100)	1(100)
Gout & Iridocyclitis	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1(100)	0(0)	1(100)
Iridocyclitis& Diabetes Type 2	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	2(100)	0(0)	2(100)
SLE & Diabetes Type 2	0(0)	0(0)	0(0)	0(0)	1(100)	0(0)	0(0)	0(0)	1(100)

ADPKD= Autosomal Dominant Polycystic Kidney Disease, ARPKD= Autosomal Recessive Polycystic

N.B: Unspecified myopathy/myositis are collection of inflammatory and non-inflammatory muscle disorders with clinical and /or laboratory evidence

Table 5. Trend Analysis by Age group and Sex

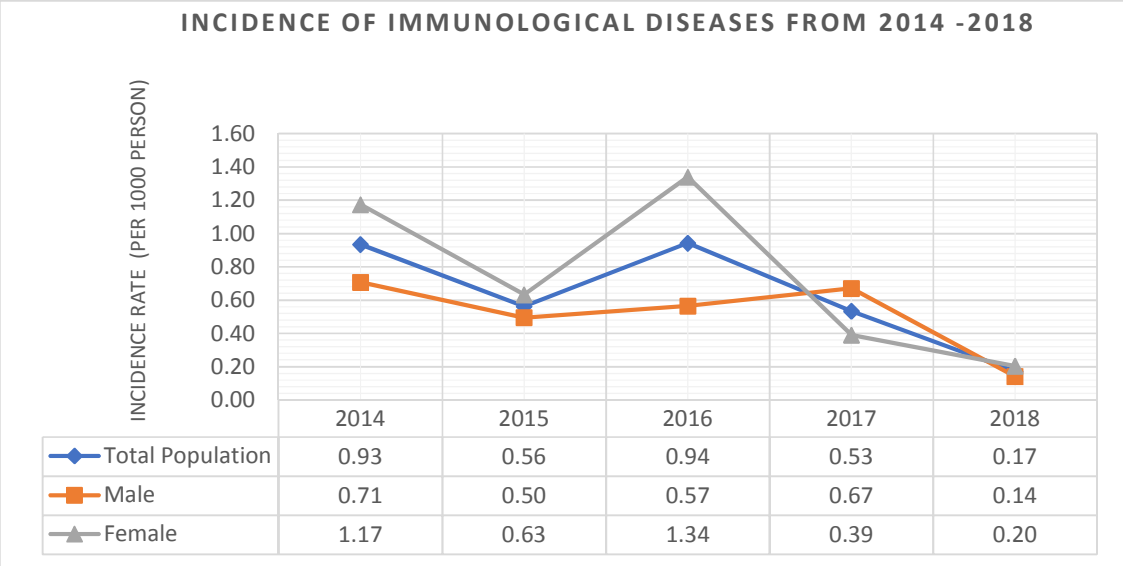
Variable							df	χ2 (p-value)	*95% Confidence Interval (p-value)*	
Sex	**2014**	**2015**	**2016**	**2017**	**2018**					
	Freq (%)	**Freq (%)**	**Freq (%)**	**Freq (%)**	**Freq (%)**	**Total (%)**			**Lower Limit**	**Upper Limit**
Male	40(38.8)	28(45.2)	32(30.8)	21(35.6)	8(42.1)	129(37.2)				
Female	63(61.2)	34(54.8)	72(69.2)	38(64.4)	11(57.9)	218(62.8)	4	3.971 (0.423) ^{F}	0.371	0.475
Total	**103(100)**	**62(100)**	**104(100)**	**59(100)**	**19(100)**	**347(100**				
Age										
≤5	8(7.8)	5(8.1)	5(4.8)	4(6.8)	1(5.3)	23(6.6)	4	80.026 (0.000) ^{F*}	0.00	0.09
6-10	2(1.9)	5(8.1)	9(8.7)	0(0.0)	2(10.5)	18(5.2)				
11-15	9(8.7)	3(4.8)	2(1.9)	5(8.5)	3(15.8)	22(6.3)				
16-20	10(9.7)	4(6.5)	13(12.5)	4(6.8)	1(5.3)	32(9.2)				
21-25	7(25.0)	4(6.5)	7(6.7)	9(15.3)	1(5.3)	28(8.1)				
26-30	4(22.2)	2(3.2)	8(7.7)	4(6.8)	0(0)	18(5.2)				
31-35	19(42.2)	11(17.7)	9(8.7)	4(6.8)	2(10.5)	45(13.0)				
36-40	7(6.8)	6(9.7)	15(14.4)	18(30.5)	0(0.0)	46(13.3)				
41-45	9(8.7)	5(38.5)	3(2.9)	2(3.4)	1(5.3)	20(5.8)				
46-50	3(2.9)	2(3.2)	5(4.8)	2(3.4)	1(5.3)	13(3.7)				
51-55	2(1.9)	4(33.3)	2(1.9)	2(3.4)	2(10.5)	12(3.5)				
56-60	7(6.8)	5(25.0)	6(5.8)	1(1.7)	1(5.3)	20(5.8)				
61-65	2(1.9)	3(27.3)	3(2.9)	2(3.4)	1(5.3)	11(3.2)				
66-70	4(3.9)	0(0.0)	10(9.6)	1(1.7)	1(5.3)	16(4.6)				
>70	10(9.7)	3(4.8)	7(6.7)	1(1.7)	2(10.5)	23(6.6)				
Total	**103(100)**	**62(100)**	**104(100)**	**59(100)**	**19(100)**	**347(100**				

**Statistically significant (p<0.05). F (Fisher's Exact test) CI = Confidence Interval) χ2= chi-square test statistics, df= degree of freedom*

Table 6. Association between Social demographic characteristics

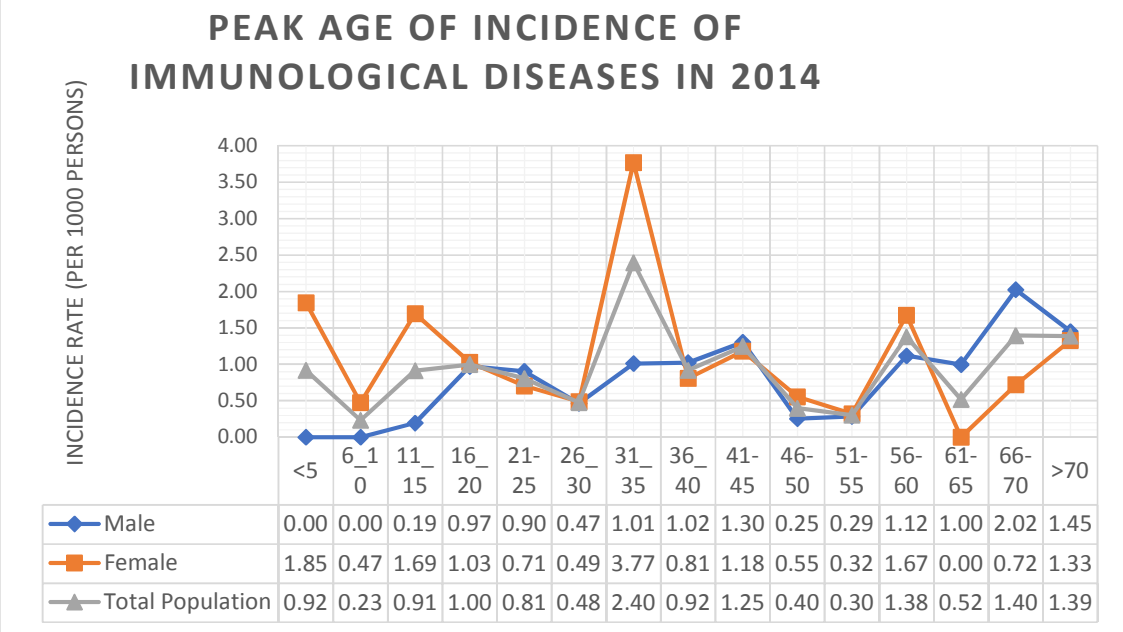
Variable	Sex			df	χ2 (p-value)	*95% Confidence Interval (p-value)*	
Sex	**Male**	**Female**					
	Freq (%)	**Freq (%)**	**Total (%)**			**Lower Limit**	**Upper Limit**
Age							
≤5	4(3.1)	19(8.7)	23(6.6)	14	24.861 (0.017) F*	0.04	0.31
6-10	5(3.9)	13(6.0)	18(5.2)				
11-15	2(1.6)	20(9.2)	22(6.3)				
16-20	14(10.9)	18(8.3)	32(9.2)				
21-25	13(10.1)	15(6.9)	28(8.1)				
26-30	5(3.9)	13(6.0)	18(5.2)				
31-35	15(11.6)	30(13.8)	45(13.0)				
36-40	20(15.5)	26(11.9)	46(13.3)				
41-45	6(4.7)	14(6.4)	20(5.8)				
46-50	4(3.1)	9(4.1)	13(3.7)				
51-55	4(3.1)	8(3.7)	12(3.5)				
56-60	11(8.5)	9(4.1)	20(5.8)				
61-65	6(4.7)	5(2.3)	11(3.2)				
66-70	7(5.4)	9(4.1)	16(4.6)				
>70	13(10.1)	10(4.6)	23(6.6)				
Total	**129(100)**	**218(100)**	**347(100)**				

**Statistically significant (p<0.05). F (Fisher's Exact test) CI = Confidence Interval) χ2= chi-square test statistics, df= degree of freedom*



	2014	2015	2016	2017	2018
Total Population	0.93	0.56	0.94	0.53	0.17
Male	0.71	0.50	0.57	0.67	0.14
Female	1.17	0.63	1.34	0.39	0.20

Fig. 2. Incidence of immunological diseases from 2014 -2018



	<5	6_10	11_15	16_20	21-25	26_30	31_35	36_40	41-45	46-50	51-55	56-60	61-65	66-70	>70
Male	0.00	0.00	0.19	0.97	0.90	0.47	1.01	1.02	1.30	0.25	0.29	1.12	1.00	2.02	1.45
Female	1.85	0.47	1.69	1.03	0.71	0.49	3.77	0.81	1.18	0.55	0.32	1.67	0.00	0.72	1.33
Total Population	0.92	0.23	0.91	1.00	0.81	0.48	2.40	0.92	1.25	0.40	0.30	1.38	0.52	1.40	1.39

Fig. 3. Peak Age of Incidence of immunological diseases in 2014

In the Table 6, a statistically significant association was observed between Age and Sex, those within the age group of 36-40 years had significantly higher proportions of both male and female compared to that of other age group, this difference was statistically significant *(p<0.05)*.

4. DISCUSSION

Findings from the study showed that Type I diabetes was the leading immunological disease in the country, which was followed by Myopathies and Myositis. In contrast to the study findings, a systematic review conducted reported that celiac disease increased the most and the highest increase in incidence, comparing old to new surveys is allocated to myasthenia gravis [11]. However, the study also indicated that between the countries, celiac disease, type 1 diabetes and myasthenia gravis frequencies increased the most in Canada, Israel and Denmark, respectively.

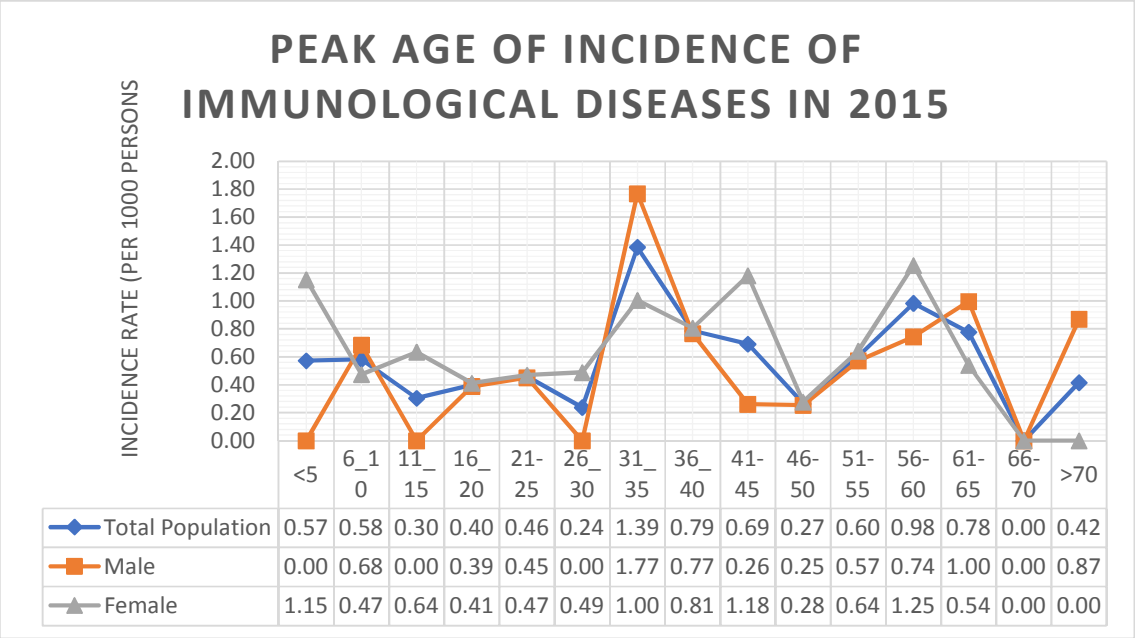


Fig. 4. Peak Age of Incidence of immunological diseases in 2015

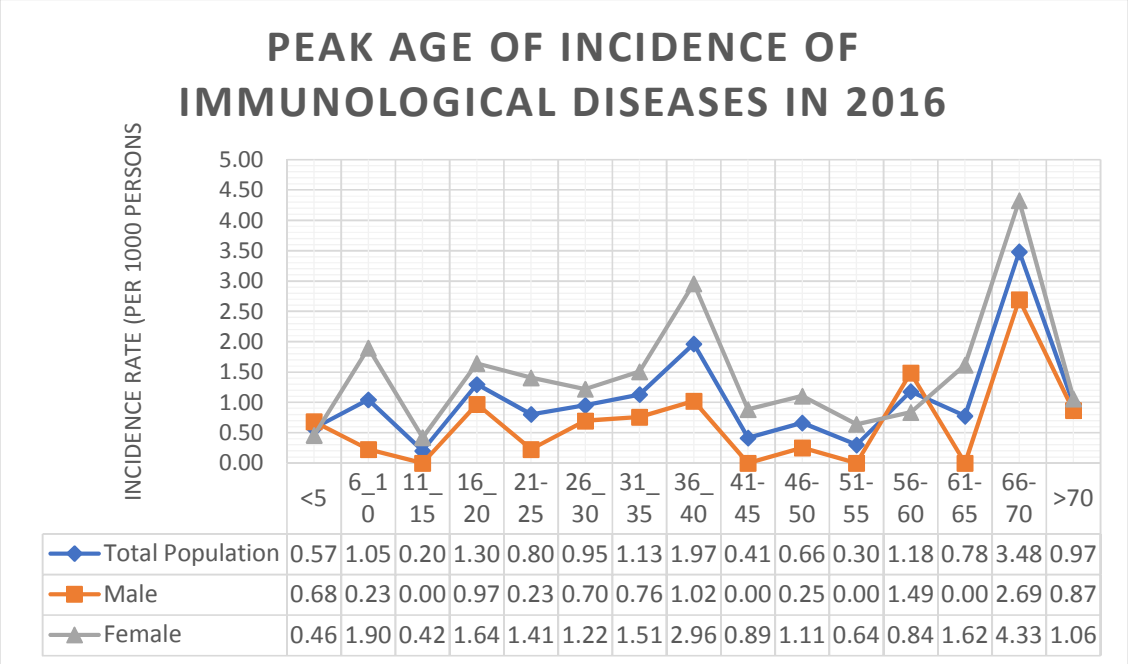
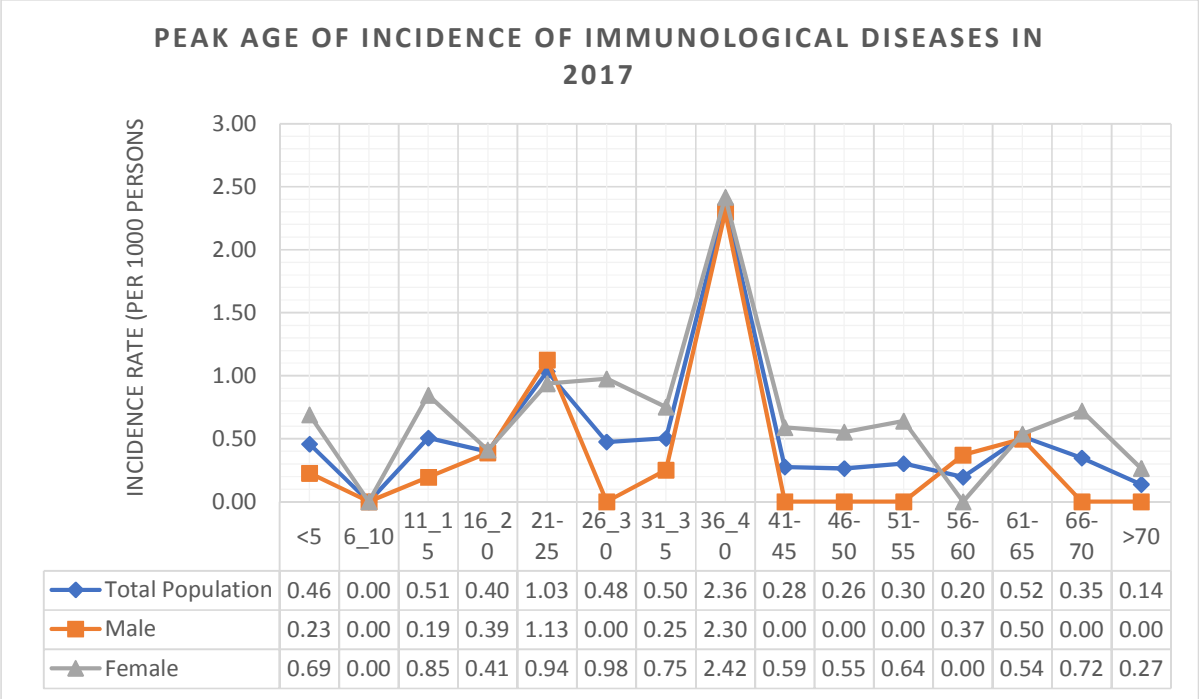


Fig. 5. Peak Age of Incidence of immunological diseases in 2016

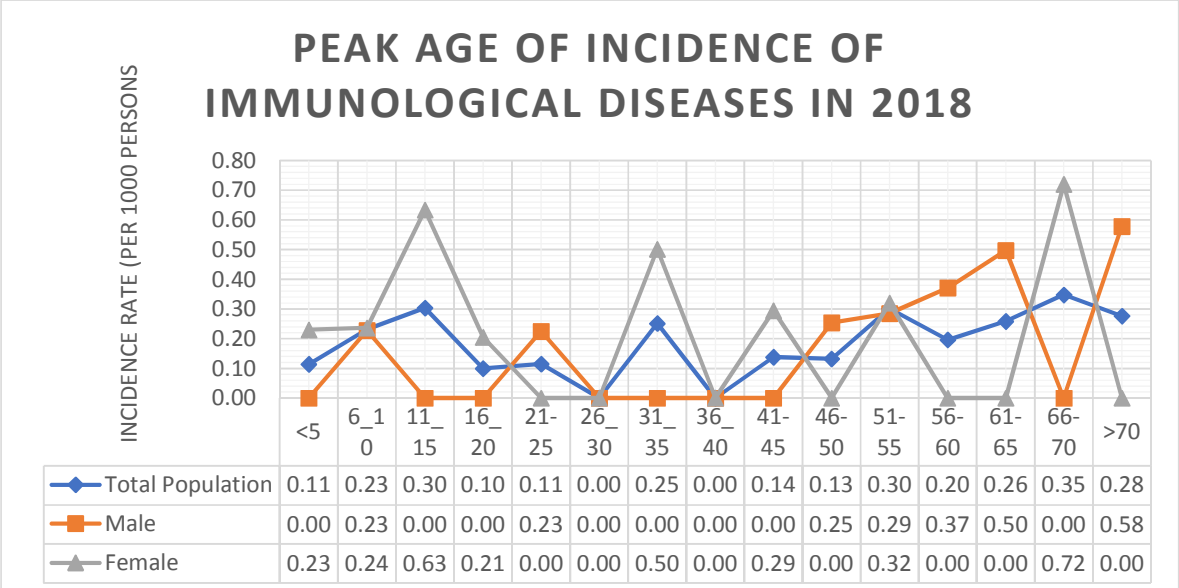
In this study we observed a decreasing trend in the incidence of immunological diseases, also observed was an annual decrease in the incidence from 2014 to 2018, with a peak incidence in 2016 (0.94/1000 person-years). The lowest incidence was noted in 2018 (0.17/1000 person-years). The decrease in trend reported in the present study might be explained due to the use of the hospital database could stem from the lack of accurate diagnosis which could lead to missed or undiagnosed cases. Another explanation of the findings is that data analysed

in this study were obtained when subjects visited healthcare institutions. Therefore, no information was available for immunological diseases patients who did not visit a healthcare institution, which could underestimate the immunological diseases burden. The incidence rate of immunological diseases reported was lower compared to the findings in a systematic review which reported a Mean ± S.D of the net % increased /year incidence of autoimmune diseases worldwide were 19.1±43.1 [12].



	<5	6_10	11_15	16_20	21-25	26_30	31_35	36_40	41-45	46-50	51-55	56-60	61-65	66-70	>70
Total Population	0.46	0.00	0.51	0.40	1.03	0.48	0.50	2.36	0.28	0.26	0.30	0.20	0.52	0.35	0.14
Male	0.23	0.00	0.19	0.39	1.13	0.00	0.25	2.30	0.00	0.00	0.00	0.37	0.50	0.00	0.00
Female	0.69	0.00	0.85	0.41	0.94	0.98	0.75	2.42	0.59	0.55	0.64	0.00	0.54	0.72	0.27

Fig. 6. Peak Age of Incidence of immunological diseases in 2017



	<5	6_10	11_15	16_20	21-25	26_30	31_35	36_40	41-45	46-50	51-55	56-60	61-65	66-70	>70
Total Population	0.11	0.23	0.30	0.10	0.11	0.00	0.25	0.00	0.14	0.13	0.30	0.20	0.26	0.35	0.28
Male	0.00	0.23	0.00	0.00	0.23	0.00	0.00	0.00	0.00	0.25	0.29	0.37	0.50	0.00	0.58
Female	0.23	0.24	0.63	0.21	0.00	0.00	0.50	0.00	0.29	0.00	0.32	0.00	0.00	0.72	0.00

Fig. 7. Peak Age of Incidence of immunological diseases in 2018

This difference between the incidence rate of both studies can be overestimated or underestimated due to various population size of both countries and the difference in multiplier rate (1000 vs 100000) by both studies which impairs the basis of comparison. The population size in the Caribbean was approximately 120,000 people as at the time of the study.

4.1 Social Demographic Characteristics of Individuals Who Have Immunological Disease

The incidence of immunological disease peaked within the age group of 31-40 years, after which it declined slowly. The incidence of immunological disease among female was higher compared to that of males with a peak age occurring at 31-35 years. Findings from the study was in conformity with that of a systematic review which reported most immunological diseases were more common in women and a disproportionate occurrence of these diseases among these women [12].

5. CONCLUSION

Sequel to the findings of this study, this study showed that the incidence of immunological disease, Type 1 diabetes Mellitus Myopathy/Myositis and SLE in Saint Vincent have decreased in the last decade, whereas the mortality rates of both SLE and Type 1 Diabetes Mellitus have increased. This finding of increased mortality of SLE and T1D suggests that this disease is no longer rare and will have implications for future healthcare planning. Age and sex were found to be risk factors for SLE. Our data confirmed the known predilection of SLE in women. The peak age of diagnosis is middle age, contrary to the generally held belief that lupus mainly targets young people.

6. RECOMMENDATIONS

Disease Registries should be expanded to a population-based multidisciplinary immunological diseases registry to enhance collection and analysis of data over time on causation, natural history, morbidity and mortality of immunological diseases. Utilizing a multidisciplinary, integrated approach with collection of data on multiple diseases. Support research on the feasibility and optimal design of the registry to allow collation of data at the state and national levels. Provide epidemiology, statistical, clinical disease, and bioinformatics expertise, incorporate biomarker data in registries and provide infrastructure for long-term support of registries and epidemiology studies.

Provide long-term support for existing genetic repositories; establish genetic repositories for additional immunological disorders; ensure adequate representation of disease phenotypes and races. Develop high throughput, standardized, specific, and sensitive laboratory assays for infectious and non-infectious environmental factors that can be used in large epidemiologic studies.

Identify new opportunities and continue support for training and career development for new and established basic science and clinical investigators in immunological disease research. Include specialized training in epidemiology and bioinformatics. Provide increased training opportunities for health care professionals by establishing collaborative training programs between professional and non-profit health organizations and clinical programs for research in immunological disease. Develop and promote the use of a wide range of educational programs and continuing medical education materials in immunological disease for health care professionals, incorporating the latest research advances on autoimmunity and autoimmune diseases.

Establish a centralized, consolidated immunological disease information centre accessible to professionals and the public via the Internet where there is provision of information about clinical trials to evaluate prevention and treatment regimens that will enable patients and their physicians to make informed choices.

The present literature survey is not aiming to investigate etiologies or environmental factors affecting immunological induction or progression. It is expected that an improved knowledge of the worldwide distribution of immunological disorders will help to understand the role of different genetic factors and different environmental influences involved in auto-immunogenesis.

Support research on gene/environment interactions important in development and manifestation of immunological diseases. Provide resources for production, storage, and distribution of materials and probes for genetic research to the research community centrally.

Support research to develop novel assays to identify prior exposures to environmental agents, including chemicals, toxins, and infectious agents. Support basic and clinical research on

mechanisms by which infectious agents or other environmental factors may trigger or modulate immunological diseases.

Support basic research on mechanisms and loss of self-tolerance, including mechanisms to control autoreactive cells. Support basic research on tissue specificity, target organ recognition, and immune injury and pathogenesis among different immunological diseases. Support core facilities for production and distribution of specialized reagents for research, including MHC-tetramers, antibodies, and microarrays.

7. STRENGTH AND LIMITATION OF STUDY

Despite our important findings, this study had a few strengths and limitations. The strengths to this study include; the data being population based, recall bias was not an issue to any misclassification errors on the side of providing conservative estimates, and it is the first of its kind to estimate the incidence of immunological diseases in Saint Vincent and the Grenadines.

Some apparent limitations of using the patient records, which signifies our prevalence and incidence estimate were based on use of health services; stem from, implication from this signifies that data analysed in this study were obtained when subjects visited healthcare institutions. Therefore, no information was available for patients with immunological diseases who did not visit a healthcare institution, which could underestimate the autoimmune burden. However, this may not have had a substantial impact on our findings, as the Milton Cato General Hospital provides diverse healthcare delivery services that is accessible and affordable compared to other public and private healthcare providers.

CONSENT

It is not applicable

ETHICAL APPROVAL

Ethical approval was gotten to access medical information of patients from the Ministry of Health and Wellness and Hospital Administrator at Milton Cato Memorial Hospital in Saint Vincent and the Grenadines.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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