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Research Article

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A Retrospective Evaluation of the Burden of Diabetes in Grenada

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Abstract

Objective: *To analyze the burden of diabetes in Grenada and to understand the local/national significance of interventions implemented to combat this burden.*

Methods: *Through analysis in trends of incidence, amputation procedures and gender discrepancies over the period 2008 – 2012.*

Results: *There were no statistically significant differences or trends (relationships) found between number of amputations and incidences of diabetes with respect to time respectively. There was also no statistically significant gender disparity with the incidence of diabetes. Most of the amputations performed in Grenada during 2008 - 2012 were below the knee and peripheral neuropathy, associated with type 2 diabetes, was found to be the leading reason for amputation.*

Conclusion: *While there was no definite trend found for the burden of diabetes in Grenada, the global incidence of chronic disease cannot be ignored. National preventative interventions to decrease the incidence of amputations should be focused on the role of peripheral neuropathy; which is what the Ipswich Touch Toe Test specifically targets.*

Keywords: Grenada, Amputation, Diabetes, Touch Toe Test, Peripheral Neuropathy.

Introduction

Recent years have demonstrated a trend of lower incidence of infectious diseases, while the incidence of chronic disease has increased [1]. Since the negative effects of chronic diseases do not occur until a later time when compared to those of infectious diseases, the subsequent cost of treatment of these effects are much higher over a longer span of time, or in most cases, the rest of chronically ill patients' lives [2]. One, or a combination of those effects from chronic disease, may result in a number of treatments, including limb amputation.

Diabetes is one of the most serious chronic diseases with a "global burden" and incidence of over 25% in some countries, alongside hypertension [3, 4]. This is noteworthy, as early 80% of lower extremity amputations (LEAs) attributed to diabetes could be avoided with self-management health behaviors [5]. The physical and mental changes that diabetic patients undergo pre- and post-amputation are also very significant and include increased depression, lower self-confidence and affected Quality of Life (QoL), everyday competence and body image scores [5]. In a study conducted by Eiser, et al on the implications of QoL as a consequence of post-amputation surgeries using the SF-36 Health Survey, significantly lower scores for QoL is seen amongst post-amputees than amongst those of similar age in the population who didn't have an amputation. Similarly, in a study done by Lewko, et al, where they assessed the QoL of diabetic patients with peripheral neuropathy on the extremities, it is seen that there are associations between poor health-related utility, QoL -as defined by statuses of employment, improper use of medication, negative cognitive perspectives on life and little self-confidence – and their neural condition [6, 7].

Understanding this global burden, the Windward Islands Research and Education Foundation (WINDREF) of St. George's University in Grenada collaborated with a number of local organizations to implement community-based initiatives to encourage better diets and increased physical activity for a healthier lifestyle [8]. For example, the Sport for Health program has a reach of four community centers and all secondary schools in Grenada and Carriacou. Therefore, WINDREF, together with its partnerships has a potential to implement primary and secondary levels of prevention interventions, including the practice and education of the Ipswich Touch Test in late 2012 [8, 9]. The Ipswich Touch Test is a simple, yet effective evaluation of peripheral competency from a neurological perspective in which a positive test result is closely associated with chronic disease, namely type 2 diabetes [10, 11]. Understanding this and the global burden of diabetes, WINDREF has focused on attempting to lower the incidence of diabetes and lower limb amputation in Grenada [8].

Research, as it pertains to the effect of amputations on amputees in terms of their QoL and future life expectancy is not existent in Grenada. As a result, economic evaluation techniques such as cost-benefit analysis and cost-effectiveness analysis to allow for the improvement of amputees' lifestyle are also not possible. These improvements would be possible by interventions such as health policy modification and implementation and better funding/resource

allocation. However, globally, research into the QoL of chronically diseased patients from their diagnosis to prognosis indicate that existing public policies specifically formed for disabled citizens have strong influences on the QoL of a population [6]. As a result, understanding the incidence and trend of diabetes and amputation in Grenada is imperative to improve the lives of the greater population, a key role of public health initiatives.

Methods

To understand the trend of the diabetes diagnosis in Grenada, an analytical cross-sectional study was required. Hospital records from the St. George's General Hospital, Princess Royal Hospital and Mount Gay Hospital were accessed and analyzed. This extraction was consented and approved by the relevant Institutional Review Boards within St. George's University, Grenada and the Chief Medical Officer within Grenada's Ministry of Health. The sampling frame and population of this study was the hospital records sorted and extracted by patients who had an amputation and patients who were diagnosed with diabetes. These hospital records were required to be those that belonged to amputee adults (of age 18 and over) and diabetic Grenadian adults – male and female; aged 18 and over–who has been diagnosed between the years January 2008 and December 2012. Those excluded from this study were records of patients who were under the age of 18 and patients who had an amputation done prior to January 2008 and after December 2012.

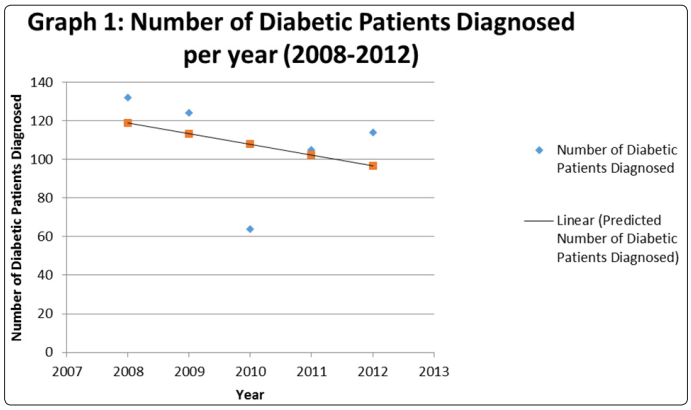
Using this raw data, the gender, number of diagnosed diabetic patients and a number of amputations were calculated per year between 2008 and 2012. These statistics were then used to determine any significant differences by t-test and one-way ANOVA. Regression analysis was also done to determine any relationship of the incidence of diabetes over time. Significance was set at $p < 0.05$. All statistical calculations were computed by Microsoft Office 2013 Excel's Data Analysis Tool. These trends were graphically represented for visual appreciation of those who received amputations, the type of amputation done and the dominant cause for need of surgery was also noted.

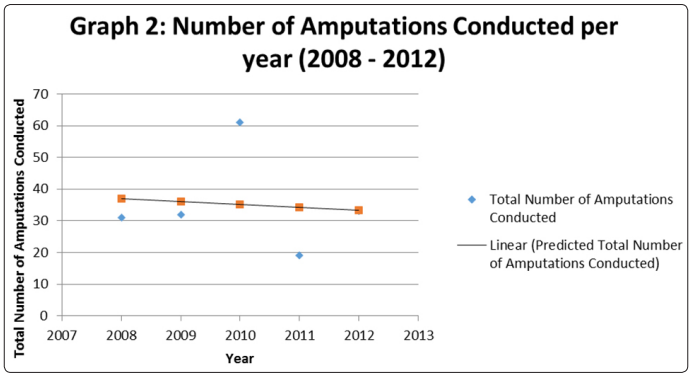
Results

Table 1 shows the raw data collected. As shown, the maximum number of diabetic incidences was 132 cases in 2008, while the maximum number of amputations done in any specific year was 61 (2010). Graph 1 shows a negative trend of diabetic incidences over time while Graph 2 shows no significant trend of amputations conducted over time. The majority of amputations performed were below the knee and amongst type 2 diabetics who suffered from peripheral neuropathy.

Table 1: Number of Diabetic Patients Diagnosed and Respective Gender from 2008-2012, per year; Number of Amputations conducted from 2008-2012, per year

Year	# of Diabetic Patients Diagnosed	# of Male Diabetic Patients Diagnosed	# of Female Diabetic Patients Diagnosed	Total Number of Amputations Conducted
2008	132	38	94	31
2009	124	41	83	32
2010	64	32	32	61
2011	105	54	51	19
2012	114	57	57	33





Differences in gender

From the t-test that was done for gender differences over time, it was found that there were no statistically significant differences between gender and the incidences of diabetes found over the five-year period of 2008 – 2012 (t-statistic: 2.306, $p > 0.05$; Table 2).

Table 2: t-test Analysis for Significant Differences in Gender of newly diagnosed patients over from 2008-2012

	Number of Male Diabetic Patients Diagnosed	Number of Female Diabetic Patients Diagnosed
Mean	44.4	63.4
Variance	114.3	625.3
Observations	5	5
Pooled Variance	369.8	
Hypothesized Mean Difference	0	
df	8	
t Stat	-1.562212656	
P(T<=t) one-tail	0.078431657	
t Critical one-tail	1.859548038	
P(T<=t) two-tail	0.156863314	
t Critical two-tail	2.306004135	

Predicting diabetes incidences

To determine the relationship between the dependent variable, incidences of diabetes, and independent variable, time (years), regression analysis was done for the time period 2008 – 2012. Using Pearson's Correlation Coefficient, it was found that there was no statistical significance for a negative association with the dependent variable ($r = -0.1899$, $p > 0.05$; Table 3).

Table 3: Regression Analysis of Relationship between Incidence of Diabetes and Time (years)

Regression Statistics					
Multiple R	0.327939147				
R Square	0.107544084				
Adjusted R Square	-0.189941221				
Standard Error	28.92691941				
Observations	5				
ANOVA					
	df	SS	MS	F	Sign. F
Regression	1	302.5	302.5	0.361510576	0.59006462
Residual	3	2510.3	836.7666667		
Total	4	2812.8			

Predicting amputation incidences

To determine the relationship between the dependent variable, incidences of amputations, and independent variable, time (years), regression analysis was done for the time period 2008 – 2012. Using Pearson's Correlation Coefficient, it was determined that there was a high statistical insignificance for a negative association with the dependent variable ($r = -0.3220$, $p > 0.05$; Table 4).

Table 4: Regression Analysis of Relationship between Number of Amputations and Time (years)

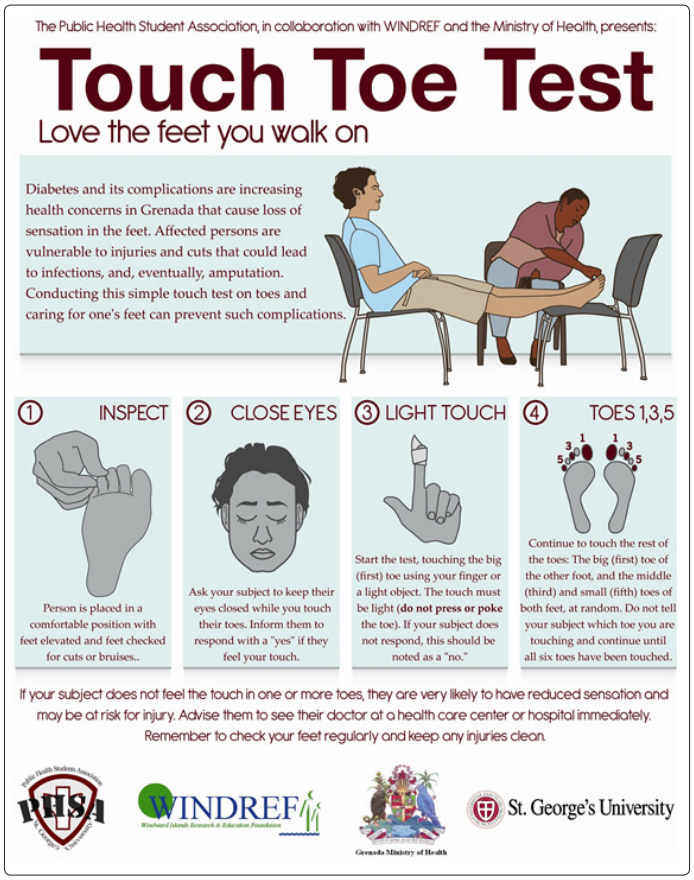
Regression Statistics					
Multiple R	0.091817616				
R Square	0.008430475				
Adjusted R Square	-0.322092701				
Standard Error	17.82040029				
Observations	5				
ANOVA					
	df	SS	MS	F	Sign. F
Regression	1	8.1	8.1	0.025506455	0.883258651
Residual	3	952.7	317.5666667		
Total	4	960.8			

All regression statistical analyses were assumed to homoscedastic, independent and fall within the normality of error.

Discussion

This is a cross-sectional study which analyzed raw data annually between 2008 and 2012. Statistical analysis has shown that there are no discrepancies between sex and the incidence of diabetes. This is important from a systems-thinking standpoint because planned interventions to lower the incidence of diabetes in Grenada would not have to be gender-specialized to attain maximum benefit. By extension, costs of implementations such as those involved in educating and training of intervention leaders would be cheaper and more transparent due to a lesser complexity, benefitting gender. The insignificant trend found for the negative relationship of the incidence of diabetes over time, calls for additional research. This would be to determine the possibility of a significant positive trend. This implies that from a biostatical perspective, as the years progressed from 2008 – 2012, hypothesizing that the incidence of diabetes is decreasing was found to be insignificant. This finding could be attributed to the increasing burden of diabetes globally; however, additional research would have to be done for confirmation. Trends for the number of amputations conducted in Grenada over time have also been found to be statistically insignificant, which means that there is no significant increase or decrease of amputations done per year seen over time. However, the other findings show that peripheral neuropathy consistently accounted for the majority of the amputations from 2008-2012. This is a significant finding, which allows for a positive avenue for intervention, as done by WINDREF.

Even without these newfound conclusions, WINDREF understood the global burden of diabetes and implemented a program in late 2012 to educate the Grenadian population on diabetes and advocate the Ipswich Touch Toe Test as an effective means of primary and secondary prevention [8]. Poster 1 shows the publication that was distributed to the Grenadian population, where the procedure for the Ipswich Touch Toe Test is detailed. Other means of advocacy include television and radio interviews and broadcast to online social media such as Facebook and YouTube.



Poster 1: Ipswitch Touch Toe Test Flyer Distributed in the Grenadian Community.

The effectiveness of the Touch Toe Test as a means of diagnosis for peripheral neuropathy and preventative care is supported by many researchers [9, 12-14]. Cost benefits analysis of a similar implementation done to diagnose early signs of peripheral neuropathy show that a significant amount of human and financial resources are saved economically [15]. These findings would make implementation in Grenada worthwhile. This, coupled with the

funding that was provided by multiple organizations (governmental non-governmental) to educate and advocate the Ipswich Touch Toe test will undoubtedly be beneficial to Grenada's economy and population health.

Limitations include unavailability of all hospital records in Grenada, though to minimize this, as many records as possible from all the major hospitals were collected to help the sample represent the population of Grenada. Study errors and abnormalities such as bias and cofounding were taken into consideration and have been minimized as much as possible by the researcher. Observer bias from the identified cause for need of amputation while possible is also unlikely due to the seriousness of the condition of peripheral neuropathy. Other means of reducing bias was the collection of definite data such as dates and gender instead of arbitrary opinionated identifiers.

In prospect, the Grenadian Government could use the findings of this study, together with information from the World Health Organization to understand the burden diabetes has in Grenada and therefore plan further community initiatives that would improve the lives of the population. This study would then contribute to the Assessment function in Public Health, which is the first building block to the other core functions: Policy Development and Assurance. Continuous research is also suggested during these phases for systems management so that continuous improvement and proper effectiveness are secured.

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