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All-cause mortality in a population-based type 1 diabetes cohort in the U.S. Virgin Islands

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ABSTRACT

Objective: Type 1 diabetes remains a significant source of premature mortality; however, its burden has not been assessed in the U.S. Virgin Islands (USVI). As such, the objective of this study was to estimate type 1 diabetes mortality in a population-based registry sample in the USVI.

Research design and methods: We report overall and 20-year mortality in the USVI Childhood (<19 years old) Diabetes Registry Cohort diagnosed 1979–2005. Recent data for non-Hispanic blacks from the Allegheny County, PA population-based type 1 diabetes registry were used to compare mortality in the USVI to the contiguous U.S.

Results: As of December 31, 2010, the vital status of 94 of 103 total cases was confirmed (91.3%) with mean diabetes duration 16.8 ± 7.0 years. No deaths were observed in the 2000–2005 cohort. The overall mortality rates for those diagnosed 1979–1989 and 1990–1999 were 1852 and 782 per 100,000 person-years, respectively. Overall cumulative survival for USVI was 98% (95% CI: 97–99) at 10 years, 92% (95% CI: 89–95) at 15 years and 73% (95% CI: 66–80) at 20 years. The overall SMR for non-Hispanic blacks in the USVI was 5.8 (95% CI: 2.7–8.8). Overall mortality and cumulative survival for non-Hispanic blacks did not differ between the USVI and Allegheny County, PA.

Conclusions: This study, as the first type 1 diabetes mortality follow-up in the USVI, confirmed previous findings of poor disease outcomes in racial/ethnic minorities with type 1 diabetes.

1. Introduction

Unlike type 2 diabetes, where prevention is possible [1], type 1 diabetes is currently a lifelong incurable metabolic disorder. Despite increased access to treatment, improved disease management, and successful reduction of complications through intensive therapy [2], the major complications of type 1 diabetes (retinopathy, nephropathy, neuropathy, and cardiovascular disease) persist as significant sources of morbidity and early mortality [3]. Prior mortality studies estimate type 1 diabetes mortality in the U.S. to be 5–7 times higher than the general population [4]; higher than estimates in other developed nations [5,6]. Recent reports from the

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Allegheny County population-based registry indicated that type 1 diabetes mortality has improved in recent decades and the proportion of deaths due to often preventable acute complications has greatly decreased [7,8]. Researchers also confirmed that African-Americans with type 1 diabetes were at a nearly 2.5-fold increased risk of premature death compared to Caucasians, as shown in several earlier studies [9–12]. Roy et al. also reported long-term type 1 diabetes mortality to be 6–12 times higher in an all-African-American cohort compared to the general population [13]. Thus, further assessment and understanding of the mortality associated with type 1 diabetes in non-Hispanic blacks is critical. The United States Virgin Islands (USVI), a predominantly non-Hispanic black population, provides an ideal population. Diabetes has risen to the fourth leading cause of death in the USVI [14]; however, the mortality and survival associated specifically with type 1 diabetes has yet to be evaluated and is of concern as the incidence of type 1 diabetes in the USVI has risen over the past 30 years to levels higher than anticipated based on worldwide estimates [15,16].

We thus investigated mortality rates in a population-based childhood onset type 1 diabetes cohort in the USVI with a mean follow-up of 16.8 years to assess trends in mortality by race, sex, age of diagnosis, and year of type 1 diabetes diagnosis and to compare rates to the non-Hispanic black cohort of the Allegheny County Type 1 Diabetes Registry, a U.S. population-based registry.

2. Methods

2.1. Study population

The USVI Childhood Diabetes Registry Cohort includes any individual diagnosed with diabetes before age 19 and living in the territory at the time of diagnosis between January 1, 1979 and December 31, 2005 [17]. Cases were ascertained through retrospective review of medical records at all hospitals and community health clinics. Individuals were excluded if pregnant (likely gestational diabetes) or not a USVI resident. Diabetes type was determined by health professional diagnosis. The registry cohort is composed of a total of 103 eligible type 1 diabetes cases from all three islands (St. Croix, St. Thomas, and St. John).

The Allegheny County Type 1 Diabetes Registry ($n = 1075$) has been described in detail [18], and consists of all individuals diagnosed with childhood-onset (age < 18 years) type 1 diabetes in Allegheny County, PA between 1 January 1965 and 31 December 1979, and placed on insulin at diagnosis. Individuals were identified via hospital record review and validated by contacting pediatricians throughout the county (ascertainment $> 95\%$) [19]. Children developing diabetes from a secondary cause (i.e., cystic fibrosis, Down's syndrome, or steroid-induced diabetes) were excluded. This cohort has been part of a comparative international study (Diabetes Epidemiology Research International, DERI) of type 1 diabetes mortality rates and was selected in this study as a proxy for type 1 diabetes mortality in the U.S. [20]. Notably, the registry is composed of 7.5% African-Americans.

2.2. Vital status

Vital status for the USVI registry was ascertained as of December 31, 2010, by first contacting all participants via postal mail and telephone to update registry contact information. When participants were not contactable via telephone or mail, attempts were made to contact family members listed in the registry via telephone. Finally, telephone books and Internet search engines were used to identify updated contact information for participants.

The USVI Territorial Death Index, the U.S. Social Security Death Index (SSDI), and the National Death Index (NDI) were then searched to confirm possible deaths among non-contacted participants. Death certificates were obtained from the USVI Bureau of Vital Statistics for all deaths occurring within the territory. NDI data was ascertained for all deaths occurring outside of the territory, to determine cause of death.

Vital status for the Allegheny County Type 1 Diabetes Registry was ascertained as of January 1, 2008. Similarly, all participants were contacted initially by letter, then by telephone if necessary, to complete a brief health update questionnaire. The study protocol was approved by the University of Pittsburgh Institutional Review Board.

2.3. Statistical analysis

Student's t-test and one-way ANOVA were used to compare continuous variables across groups (sex, race, and diagnosis cohort), adjusting for multiple comparisons using the Bonferroni correction. The χ^2 (or Fisher's exact) test was used to compare categorical variables between groups. Diagnosis year was categorized into three groups, based on decade (1979–1989, 1990–1999, and 2000–2005) to assess temporal trends in overall mortality. Age at diagnosis was categorized as pre-pubertal (<10 years), peri-pubertal (10–14 years), and post-pubertal (>14 years). Race was categorized as non-Hispanic white (NHW), non-Hispanic black (NHB), and Hispanic (H), based on race abstracted from the USVI Childhood Diabetes Registry. Mortality rates were estimated using person-years method, and 95% CIs were determined using the Poisson distribution. Non-Hispanic whites were not included in the analysis, because no deaths have occurred to date. Each individual's person-years contribution was calculated from the date of diagnosis to the December 31, 2010, date of death, of the date of last follow-up. Life-table analyses by the Kaplan–Meier method were performed. Log-rank test was used to determine the statistical difference between survival curves. Age- and sex-adjusted standardized mortality ratios (SMRs) were calculated as the observed divided by the expected number of deaths in each age, and sex category for non-Hispanic blacks. Expected mortality was calculated using population life tables for USVI, obtained from the USVI Department of Health Bureau of Vital Statistics [21]. Background mortality rates covering the same period were used. SMRs were not calculated for Hispanics due to the lack of population life tables for Hispanics in the USVI. 95% CIs were determined with the Poisson distribution. Mortality rates and SMRs were compared using rate ratio (RR) analyses and calculating 95% CIs [22]. Multivariate Cox proportional hazard models were used to assess the effects of sex, race, age at onset