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# All-cause and CVD mortality in Native Hawaiians☆

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ABSTRACT

*Aims:* Cardiovascular disease (CVD) is the leading cause of death among Native Hawaiians. In this article, all-cause and cardiovascular mortality rates among Native Hawaiians are examined, along with associated CVD risk factors.

*Methods:* A total of 855 Native Hawaiians (343 men and 512 women, ages 19–88) were examined as participants of the Cardiovascular Risk Clinics program (1992–1998) and underwent surveillance through September 2007. Cause of each death was determined by review of medical records, death certificates, newspapers, and through queries to community members.

*Results:* CVD accounted for 55% of deaths. Coronary heart disease (CHD) accounted for the majority of CVD deaths. CVD increased with age and was higher in those with diabetes, hypertension, or high low-density lipoprotein cholesterol (LDL-C). CVD rates were higher in men than in women and fourfold higher in those with diabetes. In addition to age, diabetes, hypertension, and elevated LDL-C were major risk factors.

*Conclusions:* Diabetes is a major determinant of CVD in this population and most of the CVD is occurring in those with diabetes. Strategies to prevent diabetes and manage blood pressure and lipids should reduce CVD rates in Native Hawaiians.



## 1. Introduction

Cardiovascular disease (CVD) is the leading cause of death among Native Hawaiians [1,2], but data to date have been obtained from state health records that are based solely on death certificates. The only systematic population-based study of Native Hawaiian adults, the Native Hawaiian Health Research Project, did not examine mortality records to

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determine cause of death [3]. More information can be obtained by reviewing cause of death in medical records, where standardized methods allow for comparisons with other populations [4–7]. This analysis was conducted to provide systematic data on CVD mortality in Native Hawaiians and to examine the roles of potential CVD risk factors.

From 1992 to 1998, the Cardiovascular Risk Clinic (CRC) program on the island of Moloka'i examined a population-based sample of Native Hawaiians [8]. Information on physiologic and lifestyle risk factors was obtained using systematic methods, and all deaths in this population since the beginning of the CRC program have been reviewed, with cause of death adjudicated using standardized criteria. In this article, the data on all-cause and cardiovascular mortality rates in this population, along with associated CVD risk factors, will be presented.

## 2. Subjects

The CRC was a screening program initiated in 1992 and implemented by Na Pu'uwai, the Native Hawaiian Health Care System serving the island of Moloka'i, to identify adults at risk for CVD and refer them to health care services [9]. Native Hawaiian male and non-pregnant female residents ≥age 18 were recruited for participation. Recruitment strategies involved mailings and direct contact by community health workers. The CRCs were conducted in the main town and also in rural areas to accommodate those residing in remote communities on the island. Although the recruitment was not systematically population-based, efforts were made to identify and contact all Native Hawaiian residents and accommodations made to ensure participation regardless of socioeconomic status or health condition. The only data available to allow comparisons between our study population and the population of Moloka'i as a whole are from the U.S. census. However, the population covered by the U.S. census differs from our population in age, proportion of self-identified Native Hawaiians, and average household income [10,11].

The CRC program examined 947 men and women ≥age 18 between 1992 and 1998, approximately half of the adult Native Hawaiian population of the island in that age range. After excluding 80 participants who identified themselves as non-Native Hawaiian, 5 participants whose diabetes status could not be determined, 3 decedents whose families declined permission for follow-up, and 4 decedents who had no medical records and for whom the state of Hawaii could not provide death certificates, the current cohort consisted of 855 participants (343 men and 512 women, ages 19–88). Surveillance of this cohort continued through September 2007.

## 3. Materials and methods

### 3.1. *Examination*

The baseline examination consisted of a questionnaire evaluating behavioral risk factors, including smoking, alcohol use, physical activity, and diet. Measurements of height, weight, waist and hip circumference, and blood pressure (BP) were made by trained observers. A morning urine specimen was obtained for protein and glucose, and a fasting blood sample was obtained for cholesterol, triglycerides (TG), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), hemoglobin A1c, and glucose. BP was recorded as the average of the second and third consecutive resting measures taken with a standard arm cuff and aneroid sphygmomanometer. Participants were considered hypertensive if they reported a previous diagnosis of hypertension, reported taking antihypertensive medication, or had a systolic BP (SBP) ≥140 mm Hg or a diastolic BP (DBP) ≥90 mm Hg. Body mass index (BMI) was calculated by the equation ([weight (lb)/[height (in.)]$^2$] × 703). Total cholesterol (TC), HDL-C, TG, and glucose concentrations were determined by enzymatic methods using a Roche Hitachi 747 chemistry analyzer and consistent, standardized reagents (Boehringer Mannheim, Indianapolis, IN). LDL-C was calculated in those with TG < 400 mg/dL using the equation (TC-HDL-(TG/5)). For the 42 people with TG > 400 mg/dL and for whom LDL-C was not calculated, LDL-C values were imputed using the mean method.

Diabetes was identified by self-report or fasting glucose (FG) ≥126 mg/dL. Use of hypoglycemic agents was not ascertained. Diabetes duration was determined via questionnaire.

### 3.2. *Follow-up*

All Native Hawaiian CRC participants were eligible for the follow-up surveillance and written informed consent was obtained from them or, if deceased, from the next of kin. The primary objective of the surveillance of the CRC cohort was to collect all-cause mortality data and relate them to information obtained in the baseline exam; information on vital status was available for all participants. Retrospective surveillance began from the date of the baseline (CRC) examination and continued until September 30, 2007, thereby providing approximately 15 years of surveillance of this cohort.

Deaths occurring in the cohort since the baseline exam were ascertained by queries to community members and local leaders and through community newspapers and notices. Copies of all death certificates were obtained from the State Department of Health.

Cause of each death was determined by review of medical records and other available information. The medical record was reviewed, and pertinent information was abstracted and de-identified by a trained medical records abstractor. Discharge summaries, examination reports, and, in the case of potential CVD deaths, procedures, laboratory test results, and other relevant materials were photocopied.

Records for all deaths (N = 69) were reviewed by two trained physician reviewers, and cases with ambiguous causes of death were adjudicated by a third reviewer or by an adjudication discussion. Deaths were classified as CVD; malignant neoplasm; infection (including pneumonia, influenza, septicemia, and HIV/AIDS); other chronic condition (chronic obstructive pulmonary disease, diabetes, liver disease/cirrhosis, nephritis, nephritic syndrome, and end-stage renal disease); or trauma (unintentional injury, motor vehicle accident, homicide, or suicide). CVD deaths were further classified as myocardial infarction (MI), coronary heart disease (CHD), stroke, heart failure, or other CVD using standardized criteria from the MESA study [12]. These criteria were derived