Incidence of Diabetes Among Dependents of the U.S. Military Forces Admitted to U.S. Army Treatment Facilities, 1971–1991

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OBJECTIVE — To determine the national incidence of diabetes in children by studying a group representing all parts of the country: the dependent children of U.S. military personnel.

RESEARCH DESIGN AND METHODS — Dates of admission, diagnosis of diabetes, age, and gender were collected for all 522,326 children, age 21 or younger, of active duty military personnel admitted to U.S. Army treatment facilities during fiscal years 1971–1991. Incidence rates were expressed as cases per 100,000 person-years.

RESULTS — A total of 2,308 cases of diabetes were diagnosed in 14.3 million person-years of follow-up over the 21 years. The overall incidence rate of diabetes in this population is 16.2 (95% confidence interval 15.5–16.9). For 1987–1991, the age-specific rates were 8.1 (0–4 years), 15.9 (5–9 years), 25.6 (10–14 years), 23.9 (15–19 years), and 23.4 (20–21 years).

CONCLUSIONS — The rates may be biased because of exclusion of people with diabetes from entering military service, and are limited by lack of age adjustment. The racial admixture of our study population does not match the U.S. population as a whole.

To formulate national health care policy and allocate resources, we need to know the national incidence of diabetes in children. Because of regional variations (1–3), local rates may not reflect national rates. To date, no national study of diabetes incidence has been published. Because the U.S. military is a national organization whose members are drawn from all parts of the country without regard to race or gender, the incidence of diabetes in dependent children of military personnel should more closely approximate the actual national rate than any regional study. We report the incidence and changes in incidence of diabetes among dependent children of active duty military personnel during 21 years (from 1971 to 1991).

RESEARCH DESIGN AND METHODS

— All dependent children, age 21 or younger, of U.S. active duty military personnel admitted to U.S. Army treatment facilities worldwide from fiscal years 1971–1991 were included. Patient data were provided by the Directorate of Patient Administration Systems and Biostatistics Activities, U.S. Army Medical Department Center and School, Fort Sam Houston, Texas. The file, containing 827,716 records, was reduced by removing records of children having nonincreasing age (n = 23,221), nonconstant gender (n = 5,818), visits after death (n = 403), admission date after the disposition date (n = 4), age-range and admission date range differing by more than 1 year (n = 33,281), or an invalid social security number (n = 132). These bad records totaled 137,601 (16.6% of the file) and occurred in 41,852 patient record sets. The final file contained 690,655 records for 522,326 children; of these, 2,308 had diabetes. We assume that diabetes incidence rates do not vary with the sponsor's branch of service (i.e., Army, Navy, Air Force). With this assumption and the negligible loss or gain of children due to shared facilities, rates that are computed based on the population of dependents of all military personnel admitted to Army treatment facilities should closely approximate the rates in the population of dependents of Army personnel.

All rates are computed by fiscal year (1 October to 30 September) and are expressed per 100,000 person-years. Person-years were calculated using population totals by fiscal year. Confidence intervals were computed based on a Poisson

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Table 1—*Yearly population sizes, number of new diabetes diagnoses, and percentages of the population in each of four racial categories*

Year	Population	Diabetes	Population distribution by race (%)			
			White	Hispanic	Black	Other
1971	861,466	149	73.4	5.0	20.0	1.5
1972	768,692	149	78.4	4.0	16.2	1.4
1973	681,031	161	78.9	3.7	16.2	1.3
1974	599,284	117	77.5	4.2	16.9	1.3
1975	652,875	115	75.5	4.4	18.3	1.8
1976	684,708	108	73.7	4.7	19.3	2.3
1977	667,700	97	72.7	4.9	20.3	2.1
1978	665,605	80	70.9	5.0	21.7	2.4
1979	716,380	94	68.4	5.2	23.7	2.8
1980	718,585	94	68.0	4.0	24.8	3.3
1981	593,008	74	66.9	4.2	25.7	3.2
1982	638,401	85	65.4	4.4	26.7	3.5
1983	621,804	77	64.7	4.5	27.2	3.7
1984	651,865	106	63.7	4.6	27.8	3.9
1985	665,001	111	63.3	4.7	27.9	4.2
1986	671,822	120	62.7	4.8	28.2	4.2
1987	677,664	103	61.8	4.9	29.0	4.4
1988	648,014	123	60.9	5.0	29.5	4.7
1989	688,500	129	59.9	5.1	30.2	4.9
1990	692,496	113	58.8	5.2	31.0	5.0
1991	713,744	103	58.3	5.3	31.2	5.2

model (4). Single year rates were computed for each year (5). Population totals by age and gender were available only for the years 1987–1991. Hence, for the years 1971–1986, only yearly overall rates could be computed. Population sizes were taken from Department of Defense publications (6).

RESULTS— Table 1 gives population size and the number of newly diagnosed diabetes cases and the percentage of the population in each of four racial categories (white, Hispanic, black, other) by fiscal year. Age-specific racial data is not available for any year. The diabetes incidence data in Table 1 is plotted in Fig. 1, which also shows the 95% confidence intervals by fiscal year. The overall rate is 16.2 (95% confidence interval 15.5–16.9). Age- and gender-specific rates for 1987–1991 are plotted in Fig. 2 for the age-ranges 0–4 years, 5–9 years, 10–14 years, and 15–19 years. The overall incidence rate for girls was 17.4, and the overall rate for boys was 16.0. For 1987–1991, the age-specific rates were 8.1 (0–4 years), 15.9 (5–9 years), 25.6 (10–14 years), 23.9 (15–19 years), and 23.4 (20–21 years).

CONCLUSIONS— The rates in this population may be lower than the actual national rates because people with diabetes are excluded from entering military service, although people developing diabetes while in the service are not automatically discharged (7). Health care for military personnel and their dependents is free, hence the financial constraint applicable to the civilian population is not present. For this reason, the hospital admission rates in this population of newly diagnosed diabetic children should closely approximate those in Denmark (8) (>98%) and Scotland (9) (94%), two countries with free national health care.

Although we retrieved the first admission with diabetes diagnosis from the database, we could not exclude all prevalent cases because some of the children diagnosed as diabetic in years before our study period (1971–1991) returned for

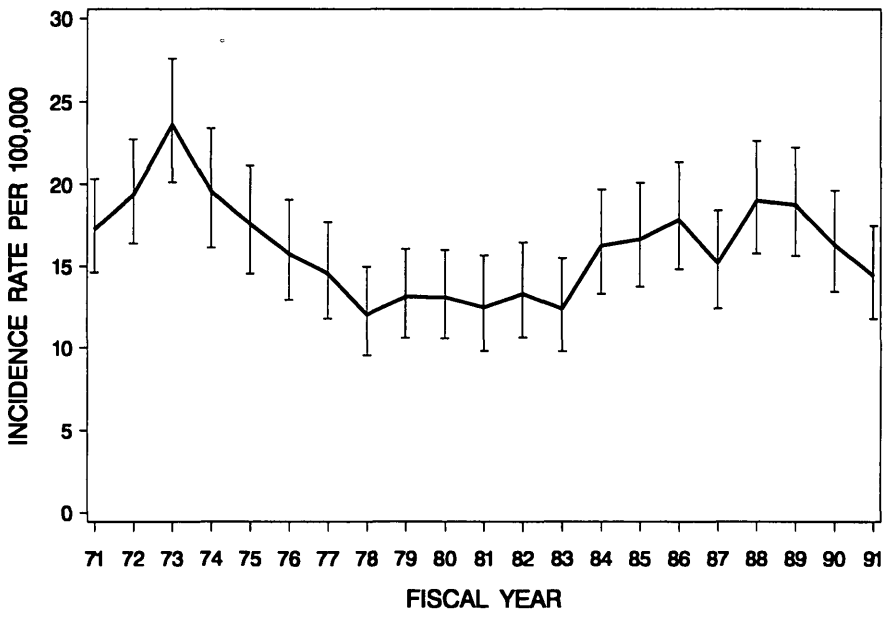

Figure 1—*Diabetes incidence rate by fiscal year with upper and lower 95% confidence interval bounds.*

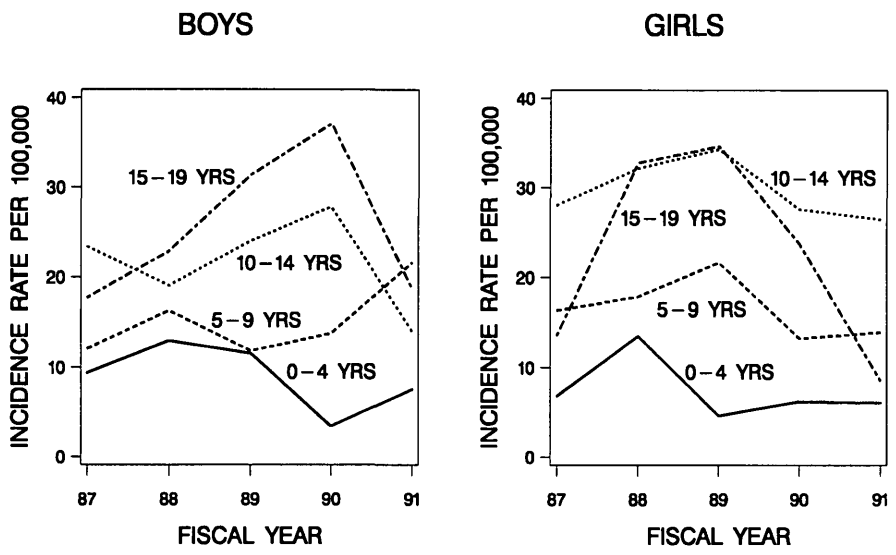

Figure 2—*Diabetes incidence rates by gender, age, and fiscal year 1987–1991.*

follow-up visits. Of the 2,308 children with a diabetes diagnosis at any visit, 89% were diagnosed at their first visit, 53% had only one visit, 19% had two visits, and the median time between the first and second visit was 325 days. Therefore, we conclude that our rates are biased upward for the first few years of the time period.

The rates presented in Table 1 and Fig. 1 are limited by lack of adjustment for age. This will cause negligible distortion in the yearly pattern if the age distributions remained stable from year to year. Changes in the age distribution would cause changes in the yearly rates, however. This lack of adjustment is an essential limitation of the study because age-specific denominators are not available for the years before 1987.

The racial composition of the population of Army dependent children summarized in Table 1 shows a higher percentage of black and a lower percentage of Hispanic diabetic patients than expected relative to the U.S. as a whole. The percentages of the U.S. resident population aged 0–19 in 1980 by racial category were 74.5% white, 14.4% black, and 8.7% Hispanic. The corresponding percentages in 1990 were 69.1% white, 14.8% black, and 12.2% Hispanic (10). In other populations, diabetes rates among blacks, Hispanics, and Asians are lower than the rate among whites (3,11,12). Hence, the overrepresentation of blacks in our studied population would tend to lower our rates somewhat, relative to those of a hypothetical population having the same racial mixture as the U.S. However, blacks with white ancestry have been found to have higher diabetes rates than blacks without white ancestry (13). Thus, racial admixture between whites and blacks in our population would tend to reduce racial differences; however, we have no data regarding ancestry that supports or refutes this hypothesis.

We have no explanation for the 1973 peak and subsequent fluctuations in the yearly rates (Fig. 1). In children 10–14 years of age, the incidence in girls is higher than that in boys (Fig. 2). Feegler et al. (14) noted greater incidence in boys than girls below age 6, with a reversal in children 6–11 years of age.

References

1. Karvonen M, Tuomilehto JL, Libman I, LaPorte RA: A review of the recent epidemiological data on the worldwide incidence of type 1 (insulin-dependent) diabetes mellitus. *Diabetologia* 36:883–892, 1993
2. Green A, Gale EAM, Patterson CC: Incidence of childhood-onset insulin-dependent diabetes mellitus: the EURODIAB ACE study. *Lancet* 339:905–999, 1992
3. American Diabetes Association: Diabetes statistics. In *Diabetes: 1991 Vital Statistics*. Alexandria, Virginia, American Diabetes Association, 1991, p. 13–20
4. Daly L: Simple SAS macros for the calculation of exact binomial and Poisson confidence limits. *Comput Biol Med* 22:351–361, 1992
5. Elandt-Johnson RC, Johnson NL: *Survival Models and Data Analysis*. New York, Wiley, 1980
6. Department of Defense: Defense Manpower Data Center, Monterey, CA
7. Gorham ED, Garland FC, Barett-Conner E, Garland CF, Wingard DL, Pugh ED: Incidence of insulin-dependent diabetes mellitus in young adults: experience of 1,587,630 U.S. Navy enlisted personnel. *Am J Epidemiol* 138:984–987, 1993
8. Green A, Anderson PK: Epidemiological studies of diabetes mellitus in Denmark. *Diabetologia* 25:226–230, 1983
9. Patterson CC, Waugh NR: Urban/rural and deprivational differences in incidence and clustering of childhood diabetes in Scotland. *Int J Epidemiol* 21:108–117, 1992
10. Bureau of the Census: *Statistical Abstract of the United States 1993: New Enlarged Edition*. 113th ed. Washington, DC, Department of Commerce, p. 21
11. Hamman RF, Gay EC, Cruickshanks KJ, Lezotte DC, Klingensmith GJ, Chase HP: Colorado IDDM registry: incidence and validation of IDDM in children aged 0–17 years. *Diabetes Care* 13:499–506, 1990
12. Wagenknecht LE, Roseman JM, Alexander WJ: Epidemiology of IDDM in black and white children in Jefferson County, Alabama, 1979–1985. *Diabetes* 38:629–633, 1989
13. Tull ES, Roseman JM, Christian CLE: Epidemiology of childhood IDDM in U.S. Virgin Islands from 1979 to 1988. *Diabetes Care* 14:558–564, 1991
14. Feegler FM, Rogers KD, Drash A, Rosenbloom AL, Travis LB, Court JM: Age, sex, and season of onset of juvenile diabetes in different geographic areas. *Pediatrics* 63: 374–379, 1979