

Research brief

## Serum magnesium and the development of diabetes

To the Editor:

Of 11 cohort studies testing the relation between dietary magnesium and incidence of diabetes, six have shown an inverse association [1]. Four of the six studies assessed diet only, and two considered diet and supplements. Kao et al. [2] found no association between dietary magnesium and incident diabetes but did find an inverse relation between serum magnesium and incident diabetes among white participants of the Atherosclerosis Risk in Communities Study. No association between serum magnesium and incident diabetes was found among black participants. Because of the inconclusive evidence to date, we undertook an additional study investigating the relation between serum magnesium and development of diabetes in an 18-y population-based cohort.

Our cohort study followed individuals who were 25 to 74 y old at the time of the baseline interview in the National Health and Nutrition Examination Survey I (1971 to 1974; NHANES I). The NHANES I baseline data were analyzed with the NHANES I Epidemiologic Follow-up Studies (1982 to 1984, 1986, 1987, and 1992) for the same cohort of individuals. We excluded individuals with diabetes at baseline from our cohort. We identified participants with incident diabetes from nursing home and hospital records and death certificates. *International Classification of Diseases, Ninth Revision* codes representing diabetes mellitus (250.0 through 250.9) were used to identify individuals who were admitted to a health care facility. The same diagnosis codes were used to identify participants who died of any of the 20 primary or secondary causes of death. Our cohort included 9784 participants, which when weighted represented 67 676 094 Americans.

Serum magnesium was measured in non-fasting samples by atomic absorption spectrophotometry [3] and analyzed as quartiles of the cohort. Quartile 1 was <1.60 mEq/L, quartile 2 was 1.60 to 1.68 mEq/L, quartile 3 was 1.69 to 1.77 mEq/L, and quartile 4 was  $\geq 1.78$  mEq/L. We performed adjusted Cox's regressions using SUDAAN (SUDAAN Statistical Software Center, Research Triangle Park, NC, USA). Control variables were age, gender, race, education, exercise, body mass index, hypertension, and total cholesterol at baseline. Age was characterized as five 10-y classes; race as white or black and other; education as less than high school or at least high school;

Table 1

Adjusted Cox's regression showing the association of serum magnesium with incident diabetes in an 18-y population-based cohort\*

Serum magnesium <sup>†</sup>	Hazard ratio	95% Confidence interval	Cases <sup>‡</sup>	Person-years <sup>‡</sup>	Persons <sup>‡</sup>
Quartile 1	1.51	1.12–2.03	202	35 565	2404
Quartile 2	1.20	0.88–1.62	168	36 593	2412
Quartile 3	0.99	0.73–1.34	166	37 515	2490
Quartile 4	1.00	—	154	37 101	2478

\* Adjusted for age, gender, race, education, exercise, body mass index, hypertension, and total cholesterol.

<sup>†</sup> Quartile 1, <1.60 mEq/L; quartile 2, 1.60 to 1.68 mEq/L; quartile 3, 1.69 to 1.77 mEq/L; quartile 4,  $\geq 1.78$  mEq/L.

<sup>‡</sup> Unweighted number.

exercise as much, moderate, or little or no; body mass index as  $\leq 30$  or  $>30$  kg/m<sup>2</sup>; hypertension as yes or no; and total cholesterol as  $\leq 200$  or  $>200$  mg/dL.

Results of our Cox's regression are presented in Table 1 and support the hypothesis that low serum magnesium is associated with the development of diabetes. Only 1598 participants were minorities, so we did not test for racial differences in the association. A similar analysis of the NHANES I baseline data and NHANES I Epidemiologic Follow-up Studies showed an inverse relation between serum magnesium and incidence of myocardial infarction.

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### References

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