Hypothyroidism is more common in the elderly population, and the classic signs and symptoms found in younger people are often not apparent (1), making this an attractive demographic for biochemical screening. In addition, screening identifies subclinical hypothyroidism, which is found in up to 15% of older people (2). Management of subclinical hypothyroidism is controversial, and expert panels have published guidelines for (3) and against (4) routine treatment of subclinical hypothyroidism. An increase in the use of routine thyroid-stimulating hormone (TSH) screening and recognition of overt and subclinical hypothyroidism would be anticipated to lead to rising use of thyroid hormone supplementation in the elderly population. To date, there have been no studies to determine if an increase in thyroid hormone use over time has occurred. We conducted an analysis of individuals taking thyroid hormone preparations who were enrolled in the Cardiovascular Health Study (CHS), a population-based study of community-dwelling individuals aged 65 years and older. We sought to describe trends in the prevalence of thyroid hormone use and predictors of thyroid hormone initiation in a population of elderly men and women.

**Methods**

These analyses are based on data from the CHS (5). The CHS is a population-based, longitudinal study in 5,888 adults 65 years and older. Enrollment of an original cohort of 5,201 adults at four U.S. sites occurred between May 1989 and June 1990, and an additional cohort of 687, predominantly African Americans, was enrolled in 1992–1993. The institutional review boards of all four sites and of the coordinating center at the University of Washington in Seattle approved the study. All participants gave informed consent.

**Brief Report**

Predictors of Thyroid Hormone Initiation in Older Adults: Results From the Cardiovascular Health Study

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**Background.** Despite widespread use, there are no data on initiation of thyroid hormone use in older people. We report the prevalence of thyroid hormone use and predictors of thyroid hormone initiation in a population of older men and women.

**Methods.** Thyroid hormone medication data were collected annually from 1989 to 2006 in community-dwelling individuals aged 65 years and older enrolled in the Cardiovascular Health Study (N = 5,888). Associations of age, sex, race, body mass index, education, and coronary heart disease with initiation were evaluated using discrete-time survival analysis.

**Results.** In 1989–1990, 8.9% (95% confidence interval 8.1%–9.7%) of participants were taking a thyroid hormone preparation, increasing to 20.0% (95% confidence interval 8.2%–21.8%) over 16 years. The average initiation rate was 1% per year. The initiation rate was nonlinear with age, and those aged 85 years and older initiated thyroid hormone more than twice as frequently as those aged 65–69 years (hazard ratio = 2.34; 95% confidence interval 1.43–3.85). White women were more likely to initiate thyroid hormone than any other race and sex group. Higher body mass index was independently associated with higher risk for initiation (p = .002) as was greater education (p = .02) and prevalent coronary heart disease (p = .03).

**Conclusions.** Thyroid hormone use is common in older people. The indications and benefits of thyroid hormone use in older individuals with the highest rate of thyroid hormone initiation—the oldest old, overweight and obese individuals, and those with coronary heart disease—should be investigated.

**Key Words:** Thyroid hormone—Levothyroxine—Elderly population.

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Thyroid hormone medication use was assessed annually from Study Year 1 (1989–1990) through Study Year 10 (1998–1999) via medication bottle examination during annual study visits and from Study Years 11 to 17 (1999–2000 to 2005–2006) by annual surveillance phone calls. Body mass index (BMI) was calculated as kg/m² using objective measures. Diabetes mellitus was classified using the American Diabetes Association criteria (6). Coronary heart disease (CHD) was present if one of the following was reported and confirmed by adjudication: myocardial infarction, angina pectoris, or history of angioplasty or bypass surgery (7). Stroke diagnosis was also confirmed by adjudication.

Statistical Analysis

Study participants’ baseline characteristics were summarized by study cohort, and participants taking a thyroid hormone preparation at baseline were compared with those who were not using a t-test or chi-square test as appropriate. The percentage taking thyroid hormone medication was calculated by year, overall and stratified by sex and race. Annual initiation rates were calculated after exclusion of 508 participants taking thyroid hormone at baseline. Time to initiation was defined as the number of years after baseline that thyroid medication use was first reported. Discrete-time survival analysis was used to evaluate associations of baseline age, sex, race, education, income, smoking, BMI, weight gain, self-reported health, fatigue, diabetes, hypertension, prevalent CHD, stroke, and difficulty in activities of daily living with initiation of use. Only statistically significant (p < .05) variables were retained in the final model. Age and BMI were modeled continuously, and results shown on both continuous and categorical scales, with p values for all variables derived from the continuous model. Participants were censored at the time of their last visit. All analyses were performed using STATA version 9 (StataCorp., College Station, TX).
was not linear, with a higher crude incidence rate, at 1.50% per year, in those aged 85 years and older at baseline than in the younger age groups, in which the crude incidence rate varied from 0.80% to 0.88% per year. In multivariable analyses (Table 2), those aged 85 years and older at baseline were more than twice as likely to initiate thyroid hormone (hazard ratio 2.34; 95% CI 1.43–3.85) than those aged 65–69 years. White women were more likely to initiate thyroid hormone than any other race and sex group (overall $p$ value <.001), with no significant difference in rates of thyroid hormone initiation among white men, nonwhite women, and nonwhite men. Thyroid hormone initiation was higher in those whose BMI was above 25 kg/m² than below, achieving statistical significance for

Figure 1. Proportion of participants taking thyroid hormone medication by calendar year: (A) white and nonwhite women and (B) white and nonwhite men. Black bars indicate nonwhites, gray bars whites.
The differences we found in thyroid hormone use by sex and race correspond to reported findings of demographic differences in TSH distribution (10–13) and suggest that bias in screening practices by sex and race likely play a minor role. We also found a higher thyroid hormone initiation rate with increasing educational level and with CHD, which could suggest higher screening rates in more educated individuals and in those with cardiovascular disease.

We found that a BMI above normal is also associated with increased initiation of thyroid hormone preparations in this elderly cohort. A higher prevalence of subclinical hypothyroidism has been shown in obesity (14), and it is likely that individuals with concerns about their weight were more likely to have thyroid function testing performed and, in turn, to be prescribed thyroid hormone replacement. Interestingly, weight loss after bariatric surgery has been shown to reverse subclinical hypothyroidism in obese younger individuals (15). These data suggest that obesity depletes thyroid reserves, resulting in subclinical hypothyroidism, rather than the converse effect of mild thyroid dysfunction inducing weight gain.

Our most intriguing finding is a higher rate of thyroid hormone initiation among those aged 85 years or older that is independent of sex or race. Although it is possible that there is an increase in overt hypothyroidism in this age-group, the more likely explanation is prescription of thyroid hormone for treatment of subclinical hypothyroidism, which is present in 14.5% of the population of men and women aged 80 years and older (10). However, the benefits of thyroid hormone supplementation of subclinical hypothyroidism are unclear in this age-group. Data from the Leiden 85+ study show lower mortality in 85-year-old men and women with elevated TSH levels compared with their euthyroid counterparts and no difference in functional status (16). Offspring of nonagenarians tend to have higher TSH levels than their partners do, also suggesting a favorable effect of slower thyroid metabolism on longevity (17). A small study of nonagenarians showed no association between TSH level and mortality, although only 4% had elevated TSH levels (18). Furthermore, we have previously found in CHS that overreplacement with thyroid hormone is common in older people (10), and in Study of Osteoporotic Fractures, thyroid hormone use was independently associated with greater declines in lower extremity performance (20).

Our study demonstrates a similar prevalence of thyroid hormone use by sex and race to that reported in the 70- to 79-year-olds enrolled in the Health, Aging, and Body Composition Study in 1997–1999 and to a white, community-dwelling population of women aged 65 years or older enrolled in the Study of Osteoporotic Fractures in 1986–1988, during each of these time frames (8,9). Hashimoto’s thyroiditis is more common in women than in men, and thus, our finding of greater thyroid hormone use in women is not surprising and parallels this sex difference in indication for prescription of thyroid hormone. The differences we found in thyroid hormone use by sex and race correspond to reported findings of demographic differences in TSH distribution (10–13) and suggest that bias in screening practices by sex and race likely play a minor role. We also found a higher thyroid hormone initiation rate with increasing educational level and with CHD, which could suggest higher screening rates in more educated individuals and in those with cardiovascular disease.

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a group in whom polypharmacy is a serious problem (27,28).

A major strength of this study is the use of a large, population-based cohort of older men and women to examine trends in thyroid hormone replacement over 16 years. Thyroid function testing was not performed in the CHS main study, and when it was performed using banked samples, results were never released to participants or their physicians. Thus, participation in CHS should not have influenced the prescribing patterns of participant’s physicians. Limitations of our study include the lack of information on thyroid function testing prior to thyroid hormone initiation or the prescriber’s indication for thyroid hormone prescription, and use of baseline covariates in the models. We were also unable to provide data after the 2005–2006 participant phone call.

Implications

Levothyroxine sodium was the fourth most commonly dispensed medication in the United States in 2008 (29). Mild TSH elevations increase in prevalence with increasing age, particularly in those aged 70 years or older (30). The management of subclinical hypothyroidism in the elderly population is controversial, with observational studies largely showing no harm in those with TSH levels lower than 10 mU/L (31,32) and no data from randomized clinical trials with clinical outcomes. Our data support the need to further investigate the threshold TSH level for thyroid hormone initiation and benefits of thyroid hormone use in the elderly population, particularly in the oldest old (aged 85 years and older), overweight and obese individuals, and those with CHD, who have the highest rates of thyroid hormone initiation.

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