Reduced Body Mass Index in Patients With Essential Tremor

A Population-Based Study in the Province of Mersin, Turkey

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Background: Body mass index (BMI) is an important health indicator. Individuals with a low BMI are more prone to various health problems and have an increased risk of mortality. A reduced BMI in essential tremor (ET) patients who were referred to a tertiary referral center was previously demonstrated. To our knowledge, this has not been confirmed in other groups of ET patients with different demographic characteristics or in a group of unselected ET patients living in the population.

Objective: To compare BMI in ET case and control subjects in a population-based study in the province of Mersin.

Interventions: The epidemiological survey used door-to-door examinations to evaluate 2253 residents in Mersin. There were 89 ET cases (mean age, 57.3 years) who were matched to 89 controls based on sex, ward (area of residence), and age. The BMI was calculated as weight in kilograms divided by the square of height in meters.

Results: The mean±SD BMI in ET cases was 26.0±4.3 vs 27.5±5.0 in controls (P=.04), representing, on average, a 5.5% reduction in cases. In a linear regression analysis that adjusted for age, sex, years of education, socioeconomic status, urban vs rural dwelling, cognitive screen score, and Cumulative Illness Rating Scale score, the BMI was lower in cases than in controls (P=.02).

Conclusions: A reduction in BMI is a common accompaniment of neurodegenerative diseases; a mild reduction also seems to be a feature of ET. It is important for physicians to be aware of the potential for a low BMI in their ET patients so that nutrition can be addressed as part of the treatment plan.

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BODY MASS INDEX (BMI), calculated as weight in kilograms divided by the square of height in meters, is an important health indicator. Studies have shown that a lower BMI is associated with an increased risk of mortality. Individuals with a lower BMI are more prone to various health problems, and among neurological patients, a lower BMI is associated with an increased risk of hip fracture.

Several neurodegenerative diseases are accompanied by progressive weight loss and a low BMI. The BMI was shown to be lower in essential tremor (ET) patients seen at the Neurological Institute of New York, New York, compared with control subjects of a similar age. Because as few as 0.5% of ET cases in the population seek treatment, studying patients who were referred to tertiary treatment settings has the potential to result in spurious associations based on selection bias.

As part of the Mersin University Neuro-Epidemiology Project, we tested the hypothesis that BMI is lower in ET cases vs controls. Cases were significantly different from the original cohort in terms of ethnicity, age distribution, socioeconomic status, and level of education. Moreover, the Mersin study is population based, allowing us to study BMI in case subjects who were not ascertained from treatment settings and not taking medications for tremor.

METHODS

Mersin, an administrative province on the Mediterranean coast of Turkey, has a population of 386,777 individuals 40 years and older (2000 national census). The sampling method has been described. In the first phase, the province’s 151 Primary Health Care Districts were identified and each ward in each district was considered a cluster. The epidemiological survey used door-to-door interviews and examinations to attempt to evaluate 2500 residents of Mersin, among whom 2253 (90.1%) participated. The 247 nonparticipants either could not be found in their homes on at least 2 visits or refused to participate. Four study neurolo-
Each of the 2253 residents was examined using a standardized tremor examination and a neurological examination to assess signs of parkinsonism and other movement disorders. The tremor examination included 6 tests: 1 test for postural tremor (arm extension sustained for 10 seconds) and 5 tests for kinetic tremor (pouring water, drinking water, using a spoon, finger-to-nose maneuver, and drawing a spiral). The 6 tests were performed with each hand separately (12 tests total). The 2 neurologists used the Washington Heights–Inwood Genetic Study of ET tremor rating scale to rate the severity of the tremor during the examination. They had been trained to use the rating scale by viewing a training videotape. With the use of this training videotape, high agreement between raters with varying levels of experience previously has been demonstrated; the 4 neurologists demonstrated substantial agreement with the training videotape ratings (weighted $k \approx 0.70$ for each neurologist). By using the Washington Heights–Inwood Genetic Study of ET tremor rating scale, each neurologist rated the tremor from 0 to 3 (0 indicates none; 1, mild; 2, moderate; and 3, severe) during each of the 12 tests, resulting in a total tremor score (range, 0-36 [maximum tremor]) for each case and control.

Based on the interview and examination, each neurologist independently assigned a diagnosis of ET or healthy using published diagnostic criteria (moderate-amplitude kinetic tremor during a minimum of 3 tests or a head tremor without signs of dystonia or Parkinson disease). A final diagnosis of ET was assigned when both neurologists agreed on the diagnosis of ET. When the 2 neurologists disagreed, a consensus diagnosis was reached by a combined review of the medical information and a combined reexamination of the subject.

There were 89 ET cases. Eight (9.0%) of the cases had previously been diagnosed by a physician as having ET and 3 (3.4%) were taking a medication to treat their tremor. There were 2164 subjects without ET who were available as potential controls. The 2164 potential controls were stratified by sex, age, and age. One control from the same ward was matched to each case of the same sex based on the proximity of their birthdays. There were 89 controls.

As part of their assessment, each case and control had undergone a weight and height assessment using a standard protocol. With the subject standing, measurements were taken of body weight to the nearest 0.5 kg using a balance scale (model 6163; Soehnle, Murrhardt, Germany). Height was measured to the nearest 0.5 cm using a movable anthropometer (model 5001; Soehnle, Murrhardt, Germany).
Blessed Orientation-Memory-Concentration Test) was administered to assess memory and orientation; this was scored from 0 to 28 (maximally impaired).^{11}

By using published information on typical foods consumed in Turkey,^{12} we collected data on consumption during the previous year of foods in 14 food groups (eg, bread, red meat, cheese, and eggs). Subjects reported the frequency of consumption for each food group.

All analyses were performed using a commercially available software package (SPSS for Windows, version 11.0: SPSS Inc, Chicago, Ill). To test whether the BMI was normally distributed, a 1-sample Kolmogorov-Smirnov test was performed. χ² Tests were used to assess associations between categorical variables, and t tests were used to assess group differences in continuous variables. Pearson product moment correlation coefficients were used to assess correlations between continuous variables. Linear regression analyses were performed in which the dependent variable was BMI and independent variables, in different models, included subject type (case vs control), age (in years), sex, years of education, socioeconomic status (low, middle, or high), urban vs rural vs suburban dwelling, cognitive screen score, and CIRS score. An analysis of covariance was used to test whether there was interaction between sex and subject type in determining BMI. With 89 cases and 89 controls, and an α of .05, the study had 95.4% power to detect a 10% difference in BMI between cases and controls. Data are given as mean ± SD unless otherwise indicated.

**RESULTS**

The 178 participants (89 cases and 89 controls) had a mean age of 57.2 years and a mean of 3.7 years of education. Cases and controls were similar with regard to age and other demographic variables (Table). Cases had a higher mean CIRS score than controls. None had Parkinson disease or dystonia, based on the neurological examination. None had a history of hyperthyroidism.

The BMI was normally distributed (Kolmogorov-Smirnov test, z = 0.8, P = .59). The BMI was 28.7 ± 4.7 in women vs 25.1 ± 4.0 in men (t = 5.5, P < .001). The BMI was inversely associated with years of education (r = −0.16, P = .03). The BMI marginally increased with socioeconomic status, with the value in each level as follows: low, 25.9 ± 4.8; middle, 27.2 ± 4.7; and high, 27.9 ± 3.1 (linear regression analysis testing for trend, β = 1.2, P = .06). The BMI was also related to type of dwelling: rural, 25.6 ± 3.6; suburban, 26.2 ± 4.4; and urban, 27.9 ± 5.3 (linear regression analysis testing for trend, β = 1.2, P = .007). There was no correlation between BMI and age (r = −0.03, P = .54), even among individuals 65 years and older (r = 0.10, P = .48), or between BMI and cognitive screen score (r = 0.0.13, P = .11) or CIRS score (r = −0.02, P = .84). In a multivariate linear regression analysis, a higher BMI was independently associated with female sex (β = 3.6, P < .001) and higher socioeconomic status (β = 1.6, P = .01), but not with age, educational level, urban vs rural vs suburban dwelling, cognitive screen score, or CIRS score.

The BMI was 26.0 ± 4.3 in ET cases vs 27.5 ± 3.0 in controls (t = 2.1, P = .04), representing, on average, a 5.5% reduction in BMI in ET cases. In a linear regression analysis that adjusted for age, sex, years of education, socioeconomic status, urban vs rural dwelling, cognitive screen score, and CIRS score, there was an association between BMI and subject type (ET case vs control, P = .02). Five cases (5.6%) and 5 controls (5.6%) had a BMI that was less than 20, suggesting that malnutrition was not a concern in most subjects.

We also stratified by sex. The BMI was 24.4 ± 3.4 in male cases vs 25.7 ± 4.5 in male controls (t = 1.5, P = .13), which was, on average, a 5.3% reduction in male cases. The BMI was 27.8 ± 4.4 in female cases vs 29.6 ± 4.9 in female controls (t = 1.7, P = .09), which was, on average, a 6.1% reduction in female cases. Sex did not interact with subject type in determining BMI (analysis of covariance, F = 0.1, P = .72). Among cases, BMI was not associated with total tremor score (r = −0.04, P = .73) or disease duration (r = −0.09, P = .45). Cases and controls did not differ with regard to reported frequency of consumption of foods in any of the 14 food groups (data not shown).

A reduction in BMI is a common accompaniment of neurodegenerative diseases, with losses of 7.2% in patients with Parkinson disease when compared with controls and a loss of 3% to 9% in patients with Alzheimer disease. A 6.0% reduction in BMI in ET cases was previously reported at the Neurological Institute of New York, which is a tertiary referral center. The present participants were different from that cohort in multiple respects, allowing us to reexamine the previous finding by studying a group of ET cases with different characteristics. Differences between the present and former cohort included ethnicity (Turkish vs white, African American, and Hispanic), mean age (57.2 vs 67.4 years), educational level (3.7 vs 14.3 mean years), and socioeconomic status. More important, the Mersin study was population based, allowing us to examine BMI in ET case subjects who were not ascertained from treatment settings, were not taking medications for tremor, and were less prone to issues of selection bias. In the present study, there was, on average, a 5.5% reduction in BMI in ET cases compared with controls. This reduced BMI in cases was not a function of age, sex, cognitive screen score, medical comorbidities (CIRS score), educational level, or other socioeconomic variables that we studied, suggesting that it was not an association due to these confounding variables.

The explanation for the observed reduction in BMI in ET cases is not clear. Patients with ET have a mild olfactory deficit, and tremor can make eating and drinking difficult, potentially resulting in lessened food intake. However, in the previous study of BMI, the reported daily caloric (energy) intake was similar in cases and controls, and in the present study, food consumption patterns for 14 food groups were similar, suggesting that the lower BMI in ET cases was due to increased calorie expenditure rather than diminished food intake. Increased calorie expenditure could be due to either the underlying disease or excessive involun-
tary movements. Therefore, it remains uncertain whether a lower BMI is a premorbid condition, detectable before or at the onset of tremor, or whether this is an accompaniment of ET.

This study had limitations. While we excluded cases with comorbidities such as Parkinson disease that could have contributed to a lower BMI and also adjusted in the analyses for several potential confounding variables, other differences between cases and controls, which we did not measure, could have accounted for differences in BMI. Many of these differences (impaired olfaction, use of medications that result in loss of appetite, and intentional dietering), however, would have manifested themselves as a reduction in caloric intake, which was not found in a previous study. Second, individuals with dementia may have a lower BMI. While a brief cognitive screen was performed, we did not exclude the possibility that some of the cases or controls may have had dementia. The mean age of our subjects was 57 years, so it is unlikely that many had dementia. Also, the generalizability of these results to other populations remains to be demonstrated. Many of these differences (impaired olfaction, use of medications that result in loss of appetite, and intentional dietering), however, would have manifested themselves as a reduction in caloric intake, which was not found in a previous study.

In summary, a reduction in BMI is a common accompaniment of neurodegenerative diseases, and in several studies, a mild reduction in BMI seems to be a feature of ET. It is important for physicians to be aware of the potential for a lower BMI in their ET patients so that nutrition can be addressed as part of the treatment plan.

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