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Accuracy of Self-reported Height and Weight in a Community-Based Sample of Older African Americans and Whites

Gerda G. Fillenbaum,[1,2] Maragatha N. Kuchibhatla,[1,3] Heather E. Whitson,[1,4] Bryan C. Batch,[5] Laura P. Svetkey,[6] Carl F. Pieper,[1,3] William E. Kraus,[7] Harvey J. Cohen,[1,8] and Dan G. Blazer[1,9]

[1]Center for the Study of Aging and Human Development, Duke University Medical Center, Durham, North Carolina. [2]Geriatric Research, Education and Clinical Center, Veterans Administration Medical Center, Durham, North Carolina. [3]Department of Biostatistics and Bioinformatics, [4]Division of Geriatrics, Department of Medicine [5]Division of Endocrinology, Department of Medicine, [6]Division of Nephrology, Department of Medicine, [7]Division of Cardiology, Department of Medicine, [8]Department of Medicine, and [9]Department of Psychiatry, Duke University Medical Center, Durham, North Carolina.

Address correspondence to Gerda G. Fillenbaum, PhD, Center for the Study of Aging and Human Development, Duke University Medical Center, Box 3003, Durham, NC 27710. Email: ggf@geri.duke.edu

Background. To ascertain accuracy of self-reported height, weight (and hence body mass index) in African American and white women and men older than 70 years of age.

Method. The sample consisted of cognitively intact participants at the third in-person wave (1992–1993) of the Duke Established Populations for Epidemiologic Studies of the Elderly (age 71 and older, $N = 1761$; residents of five adjacent counties, one urban, four rural). During in-person, in-home interviews using trained interviewers, height and weight were self-reported (and measured later in the same visit using a standardized protocol), and information were obtained on race, sex, and age.

Results. Accuracy of self-reported height and weight was high (intraclass correlation coefficient 0.85 and 0.97, respectively) but differed as a function of race and age. On average, all groups overestimated their height; whereas (non-Hispanic) white men and women underestimated their weight, African Americans overestimated their weight. Overestimation of height and weight was more marked in persons 85 years and older. Specificity for overweight (body mass index [kg/m^2] ≥ 25) and obesity (body mass index ≥ 30) ranged from 0.90 to 0.99 for African Americans and whites, but sensitivity was better for African Americans (overweight: 0.81, obesity: 0.89), than for whites (0.66 and 0.57, respectively).

Conclusions. Height and weight self-reported by African Americans and whites over the age of 70 can be used in epidemiological studies, with greater caution needed for self-reports of whites, and of persons 85 years of age or older.

Key Words: Height—Weight—Body mass index—Elderly—African American.

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EPIDEMIOLOGICAL surveys that assess the morbidity and mortality associated with overweight and obesity rely on measures of height and weight to calculate body mass index (BMI; kg/m^2). For reasons of cost and simplicity, it is easier to obtain self-reported than measured height and weight. Self-report, however, may be biased, with height overestimated (particularly among shorter people) and weight underestimated (particularly among the heavier), although this may vary by sex, race/ethnicity, and age (1–6). In consequence, BMI ascertained by self-report tends to be underestimated, typically resulting in a stronger correlation with disease than BMI based on objective measures (7–9). To better understand the association of BMI with personal characteristics, health conditions, and mortality in older people, information on accuracy of self-report is essential (10, 11).

The recent exhaustive review by Connor and colleagues (1) indicates that most evidence on the relationship of self-reported to measured height and weight comes from young adults and from the majority non-Hispanic white (henceforth white) population. In particular, there is little information on African Americans in all age groups, and in whites over the age of 74; men and women may be aggregated; and all over the age of 60 may be combined (12), regardless of height and weight differences in this age group (5, 13, 14). Racial/ethnic differences have been insufficiently explored, although African Americans have the highest prevalence of obesity, which may have a different effect in this group (5, 15).

The current study, based on data from a community-dwelling sample of older African Americans and whites 71 years of age and older, examines the extent of agreement

between self-reported and measured height, weight, and BMI as a function of race, sex, and age. Information, particularly on African Americans of this age, is currently largely lacking. Based on previous studies, we expected statistically significant agreement between self-reported and measured height and weight (and hence BMI). We hypothesized, however, that because of cultural preferences (16), there would be greater underestimation of weight by whites, particularly white women, than by African Americans, and that height would be overestimated because of lack of recognition of height shrinkage with age (13, 14).

Methods

Sample

Data are from the third in-person, in-home wave (1992–1993) of the Duke Established Populations for Epidemiologic Studies of the Elderly (17). This was the only occasion when height and weight were self-reported, and, at visit end, measured.

At baseline, 4,162 representative community residents age 65 and older were enrolled (54% African American [an oversample, 35% lived in the geographic area], 45% white, 26 [0.6%] other race/ethnicity). Six years later, 2,567 remained enrolled. For the present study, we excluded persons of other race/ethnicity, as well as proxies, persons interviewed only by telephone, and the cognitively impaired (ascertained by the Short Portable Mental Status Questionnaire (18)) because information on height and weight were either not asked or response would be unreliable. We also excluded those unable to stand independently, and persons with incomplete information. This resulted in a sample of 1,761 African Americans and whites.

Data Gathered

Relevant to the present study, information was also gathered on demographic characteristics, including age (categorized as age 71–74, 75–79, 80–84, 85 and older), sex, race (African American, white), education, and income.

Assessment of height, weight, and BMI.—Self-reported height and weight were obtained in the same interview as, but some time before measured height and weight, in response to the question: What is your height (weight)? Height was recorded in feet and inches, and weight in pounds.

Measured height.—Sample members stood in stockinged feet directly against a door frame, next to a 6-inch length of tape placed vertically at their approximate height. A trimeter was squared on the sample member's head against the door frame, height was marked on the tape with pencil and measured to the nearest inch with a carpenter's ruler after the sample member had stepped away.

Measured weight.—With shoes, heavy outerwear and jewelry removed, and pockets emptied of heavy items, the sample member stepped on a portable, battery-powered, digital scale set to 0, which had been placed on a hard surface, close enough to a wall in case support should be needed. Weight was read and recorded to the nearest pound. All measures were converted into metric units.

Body mass index.—BMI was calculated as kg/m^2.

Statistical Analysis

Sample members with a 10-unit difference between self-report and measured BMI were excluded ($N = 14$) because such a large discrepancy suggested error in recording or data entry. This yielded a final sample size of 1,747. Descriptive statistics (means, standard deviations, percentages, and *t* tests) were used to describe the sample and for basic comparisons. Intraclass correlation coefficients (ICC) were used to compare self-rated and measured status. Analysis of variance, including race, sex, age group (and education and income as control variables), and their interactions, was used to determine whether the differences between measured and self-reported height and weight differed significantly as a function of these characteristics. Categorized self-report-based BMI (<18.5 [underweight], 18.5 to <25.0 [normal weight], 25.0 to <30.0 (overweight); 30.0 to <35.0 [obese I], ≥35.0 [obese II and III]) was cross-classified against measurement-based BMI, to ascertain weighted kappa (level of agreement beyond chance). With measured BMI as the gold standard, we calculated sensitivity (accurate identification of cases) and specificity (accurate identification of noncases) for self-report-based overweight and obesity (sensitivity and specificity provide specific information on location of disagreement that ICC does not). Analyses used SAS version 9.1 (SAS Institute, Cary, NC). This study was performed with the consent of the Institutional Review Board of Duke University Medical Center. Consent forms were signed by participants or appropriate proxies.

Results

The sample was almost evenly divided between African Americans and whites; men constituted approximately 35% in each racial group. Forty-three percent had only a grade school education, an additional 28% had not completed high school. Fifty-nine percent reported an annual income of less than $7,500. All were 71 years of age or older, one third was at least 80 years of age.

There was close agreement between self-reported and measured height, weight, and BMI (ICC = 0.85, 0.97, and 0.91, respectively, for the entire sample; for BMI normal, overweight, and obese, height ICC was 0.88, 0.84, and 0.78, respectively, and 0.92, 0.95, 0.92 for weight). When the difference between self-reported and measured status was calculated as a percentage of measured status, height was

incorrectly estimated to a greater extent than weight (height: 1.8% overestimate for both men and women; weight: 0.8% overestimate for men, 0.1% for women).

Analysis of variance of the total group indicated that neither education nor income reached statistical significance, but that there were statistically significant differences by race, age group, and the interaction of sex and age group for height; and by race and age group for weight. Accordingly, we report information by race; race and sex; and race, sex, and age category (Table 1). Table 1 includes three panels. The first gives raw data on the total sample, the second on African Americans, and the third on whites. Both African Americans and whites (panel 1) overestimated their height (whites on average by 3.35 cm, and African Americans by 2.77 cm, $p = .0015$). On the other hand, while whites underestimated their weight, on average by 0.19 kg, African Americans overestimated their weight, on average by 0.74 kg ($p < .0001$). Overall, however, both African Americans and whites underestimated BMI.

As age increased, so did average overestimation of height and weight. The differences across age groups in these overestimations were significant (height, age 71–74: 2.41 cm; 75–79: 3.30 cm; 80–84: 3.38 cm; 85 years and older: 3.81 cm; $p < .0001$; weight: 0.02, 0.05, 0.38, and 1.45 kg, respectively, $p = .0029$). The only statistically significant interaction was between sex and age group for height ($p = .0291$). Among women, height overestimation increased consistently with age, among men it did not.

Further examination explored responses within each racial group. Among African Americans (panel 2), both men and women overestimated their height (each by an average of 2.79 cm), and weight (on average 1.2 kg for men and 0.46 kg for women). Except among the oldest age group, women tended to increasingly overestimate their height with increase in age, but among men, overestimation was consistent at approximately 2.54 cm until age 85, when it doubled. Both African American men and women overestimated their weight. Weight overestimation was not closely linked to age for African American men, but for African American women underestimation of weight by those less than 80 years of age changed to overestimation of weight, on average by 0.98 kg at age 80–84, and by 2.35 kg at age 85 and older.

In the white sample (panel 3), as in African Americans, height was overestimated by both sexes. Among the white men, there was no consistent effect of age on overestimation of height. Women showed an increase in overestimation of height with age. Estimations of weight were inconsistent with age for both the white men and the white women, but overestimation was greatest in the oldest age group. With a single exception (the oldest African American women), BMI was always underestimated because of overestimation of height.

Table 2 shows, for African Americans and whites, the extent to which BMI category based on self-report agreed with measured BMI category (values in bold indicate percent agreement). We did not subset further by sex because of the small numbers in the extreme BMI categories.

For African Americans, category-specific agreement ranged from 66% to 78%. Underestimation of measured category (the values to the right of the diagonal [in bold]) ranged from 31% (for the underweight) to about 20% each for the normal, overweight, and obese I categories. Overestimation (values to the left of the diagonal), occurred for 22% for those in the obese II+ category, but were less for those in the normal, overweight, and obese I categories (3%, 9%, and 12%, respectively). For whites, complete agreement as to category ranged from 63% to 96% (the latter for obese II+); underestimation was comparable with that of African Americans, except for greater self-reported underweight. Overestimation, however, was lower, ranging from 1% to 10%. Weighted kappa (agreement beyond chance) was 0.76 for African Americans and 0.75 for whites. Looking specifically at identification of overweight or greater (BMI $\geq$25), for African Americans sensitivity and specificity was 0.89 and 0.90, respectively, while for whites it was 0.66 and 0.96. Identification of the obese (BMI $\geq$30), had sensitivity and specificity of 0.81 and 0.97 for African Americans, and 0.57 and 0.99 for whites.

The differences between measured and self-reported weight ranged from an underestimate of 19.5 kg to an overestimate of 20.4 kg, with approximately 90% of the values lying within 5 kg of the measured weight (Supplementary Table 1). For both African Americans and whites, overreporting of weight by the underweight changed linearly to underreporting by the obese, with the differences from measured weight statistically significant in adjacent BMI categories.

Discussion

Our data, gathered in 1992–1993 from a community-based sample of African Americans and whites, 71 years of age and older, indicate high agreement between self-reported and measured height, weight, and consequently BMI (ICC = 0.85, 0.97, and 0.91, respectively). This is consistent with previous reports based on differing samples and age ranges, including Pearson product moment correlations of 0.92, 0.94, and 0.88, respectively, for men, and 0.90, 0.97, and 0.96 for women, age 56–78 (3); Spearman rank order correlations >0.9 for all three assessments for a sample aged 35–76 (19); ICCs of 0.99, 1.00, and 0.99, respectively, for an overweight sample of median age 44.5 years (20); and Pearson correlations for height (comparable information for weight was not given) of 0.87 for men, and 0.77 for women 80 years of age and older (5).

We found good agreement on classification into the five BMI categories (weighted kappa 0.76 for African Americans, 0.75 for whites), and high specificity for overweight (BMI $\geq$25), and obesity (BMI $\geq$30), for both African Americans and whites (0.90–0.99). Comparable values for persons 18–65 years, and 60 years of age and older have been reported

Table 1. Descriptive Characteristics of the Sample by Measured (and self-reported minus measured) Height (m), Weight (kg) BMI (kg/m^2)

	N (%)	Measured Height (m), mean (*SD*)	Height Difference: Self-report—Measured (m), mean, (*SD*)*	Measured weight (kg), mean (*SD*)	Weight Difference: Self-report—Measured (kg), mean (*SD*)	Measured BMI, mean (*SD*)	BMI: Difference Self-report—measured, mean (*SD*)
				Panel 1. Total sample			
Race							
African American	880 (50.4)	1.63 (0.09)	0.03 (0.05)	72.76 (15.47)	0.74 (4.18)	27.5 (5.59)	–0.64 (2.20)
White	867 (49.6)	1.63 (0.10)	0.03 (0.04)	69.45 (14.91)	–0.19 (2.79)	26.0 (4.72)	–1.10 (1.68)
Sex							
Men	624 (35.7)	1.72 (0.07)	0.03 (0.05)	77.97 (14.17)	0.56 (3.93)	26.3 (4.48)	–0.73 (1.84)
Women	1123 (64.3)	1.58 (0.06)	0.03 (0.04)	67.31 (14.51)	0.11 (3.38)	27.0 (5.58)	–0.94 (2.04)
Age (y)							
71–74	623 (35.7)	1.66 (0.09)	0.02 (0.04)	74.89 (15.45)	0.02 (3.78)	27.3 (5.26)	–0.76 (1.99)
75–79	538 (30.8)	1.64 (0.09)	0.03 (0.04)	72.62 (14.98)	0.05 (3.39)	27.2 (5.40)	–1.04 (1.84)
80–84	375 (21.5)	1.61 (0.09)	0.03 (0.04)	67.40 (14.03)	0.38 (3.34)	26.1 (4.97)	–0.93 (1.98)
≥85	210 (12.0)	1.59 (0.09)	0.04 (0.05)	62.64 (12.78)	1.45 (3.69)	24.9 (4.53)	–0.62 (2.17)
				Panel 2. African American			
Men	316 (18.1)	1.72 (0.07)	0.03 (0.04)	77.25 (14.30)	1.22 (4.48)	26.3 (4.51)	–0.41 (1.93)
Women	564 (32.3)	1.58 (0.06)	0.03 (0.05)	70.22 (15.54)	0.46 (3.98)	28.1 (6.01)	–0.76 (2.33)
Men							
71–74 y	129 (40.8)	1.72 (0.08)	0.03 (0.04)	77.79 (15.22)	1.18 (5.21)	26.3 (4.74)	–0.36 (2.14)
75–79 y	102 (32.3)	1.72 (0.07)	0.03 (0.04)	80.20 (14.30)	1.34 (3.53)	27.1 (4.49)	–0.34 (1.65)
80–84 y	54 (17.1)	1.71 (0.07)	0.03 (0.04)	74.25 (11.78)	1.03 (4.31)	25.3 (4.82)	–0.31 (1.59)
≥85 y	31 (9.8)	1.67 (0.08)	0.05 (0.05)	70.58 (11.48)	1.30 (4.48)	25.3 (4.69)	–1.01 (2.40)
Women							
71–74 y	185 (32.8)	1.60 (0.06)	0.02 (0.04)	73.03 (15.16)	–0.08 (4.06)	28.7 (5.96)	–0.78 (2.36)
75–79 y	166 (29.4)	1.58 (0.06)	0.03 (0.04)	73.12 (15.51)	–0.25 (3.78)	29.3 (6.20)	–1.13 (2.18)
80–84 y	134 (23.8)	1.57 (0.06)	0.03 (0.05)	67.54 (15.04)	0.98 (3.46)	27.3 (5.86)	–0.74 (2.30)
≥85 y	79 (14.0)	1.56 (0.07)	0.03 (0.05)	62.10 (13.76)	2.35 (4.34)	25.4 (4.98)	0.01 (2.46)
				Panel 3. White			
Men	308 (17.6)	1.73 (0.07)	0.04 (0.05)	78.74 (14.03)	–0.10 (3.14)	26.3 (4.46)	–1.06 (1.68)
Women	559 (32.0)	1.58 (0.07)	0.03 (0.04)	64.32 (12.76)	–0.24 (2.58)	25.8 (4.85)	–1.13 (1.67)
Men							
71–74 y	146 (47.4)	1.73 (0.07)	0.03 (0.04)	82.06 (15.01)	–0.38 (2.75)	27.3 (4.66)	–1.01 (1.58)
75–79 y	98 (31.8)	1.73 (0.07)	0.04 (0.05)	76.66 (12.22)	0.11 (3.68)	25.7 (4.07)	–1.23 (1.93)
80–84 y	46 (14.9)	1.73 (0.06)	0.03 (0.04)	75.61 (12.84)	–0.16 (3.16)	25.2 (4.08)	–0.83 (1.58)
≥85 y	18 (5.8)	1.72 (0.07)	0.05 (0.04)	71.12 (11.68)	1.03 (2.79)	24.1 (3.94)	–1.00 (1.24)
Women							
71–74 y	163 (29.2)	1.60 (0.06)	0.02 (0.04)	68.31 (13.06)	–0.43 (2.56)	26.6 (5.01)	–0.84 (1.71)
75–79 y	172 (30.8)	1.59 (0.06)	0.03 (0.04)	65.36 (13.05)	–0.48 (2.45)	26.0 (5.12)	–1.27 (1.38)
80–84 y	142 (25.4)	1.56 (0.07)	0.04 (0.05)	62.01 (11.67)	–0.27 (2.69)	25.5 (4.54)	–1.37 (1.83)
≥85 y	82 (14.7)	1.54 (0.07)	0.04 (0.05)	58.24 (10.10)	0.72 (2.56)	24.5 (4.14)	–1.00 (1.81)

Notes: BMI = body mass index; SD = standard deviation.

*Negative sign: Measured value greater than self-reported value. Sign absent: Self-reported value greater than measured value.

Table 2. Self-report-based BMI Cross-tabulated by Measurement-Based BMI Separately for African Americans and Whites (*N* [row %])

Self-report-Based BMI	Measurement-Based BMI					
	Underweight BMI <18.5	Normal BMI 18.5 to <25	Overweight BMI 25 to <30	Obese I BMI 30 to <35	Obese II+ BMI ≥35	Total Self-reported BMI
			African American			
Underweight	25 (**69.4**)*	11 (30.6)	0 (0.0)	0 (0.0)	0 (0.0)	36 (4.1)
Normal	10 (3.4)	226 (**75.8**)	60 (20.1)	2 (0.7)	0 (0.0)	298 (33.9)
Overweight	1 (0.3)	29 (8.6)	239 (**71.3**)	65 (19.4)	2 (0.6)	336 (38.2)
Obese I	0 (0.0)	0 (0.0)	19 (12.3)	102 (**65.8**)	34 (21.9)	155 (17.6)
Obese II+	0 (0.0)	0 (0.0)	2 (3.6)	10 (18.2)	43 (**78.2**)	55 (6.3)
Total measurement-based BMI	36 (4.1)	266 (30.2)	320 (36.4)	179 (20.3)	79 (9.0)	880 (100.0)
			White			
Underweight	27 (**62.8**)	16 (37.2)	0 (0.0)	0 (0.0)	0 (0.0)	43 (5.0)
Normal	6 (1.4)	318 (**75.2**)	94 (22.2)	5 (1.2)	0 (0.0)	423 (48.8)
Overweight	0 (0.0)	15 (4.9)	234 (**76.0**)	58 (18.8)	1 (0.3)	308 (35.5)
Obese I	0 (0.0)	1 (1.5)	6 (8.7)	49 (**71.0**)	13 (18.8)	69 (8.0)
Obese II+	0 (0.0)	0 (0.0)	0 (0.0)	1 (4.2)	23 (**95.8**)	24 (2.8)
Total measurement-based BMI	33 (3.8)	350 (40.4)	334 (38.5)	113 (13.0)	37 (4.3)	867 (100.0)

Note: *Percentages in bold (on the diagonal) indicate percentage agreement between self-reported and measured assessments.

(2, 4). Sensitivity was also high for African Americans (0.81 and 0.89, respectively), possibly because of weight overestimation, but was poor for whites (0.66 and 0.57), who tended to underestimate their weight. Others, however, found little racial difference in sensitivity (2), but noted that sensitivity was poorer in identifying persons who were obese than those who were overweight. Our data for whites are similar, but we found the reverse for African Americans. Overall, however, as BMI increased, overestimation of weight decreased, reducing the self-reported prevalence of obesity. These findings suggest that self-reported height, weight, and consequently BMI, may be used, cautiously (in particular for older whites).

As in previous studies (5, 15), BMI, whether based on self-report or measurement, was greater in African Americans than in whites. Approximately two thirds of the African Americans in the present study were overweight and about a quarter were obese as compared with 55% and 17%, respectively, for whites. Comparison with prevalence rates for overweight and obesity reported by other studies is difficult because of differences in ages and stratification criteria (12, 21–23). The current study extends previous work by examining an older age group, and explicitly considers race, sex within race, and age group within sex and race.

Unlike some previous reports (5, 24), but in agreement with others (4), we found differences between African Americans and whites of sufficient magnitude to merit separate analyses of these two groups. Although the literature typically indicates that weight is underreported (1–6), in the Duke Established Populations for Epidemiologic Studies of the Elderly sample, both African American men and women generally overreported their weight. This is in disagreement with findings based on a substantial sample of volunteers aged 18–65, where both African American men and women underestimated their weight, with underestimation by African American women even greater than by white women (4). The extent to which age or volunteering affected these data is unclear. Among the white men and women of the present sample, only men aged 75 and older, and women 85 years of age and older overestimated their weight. This difference may also reflect incipient disease presaging death. While African American women weighed more than their white counterparts, they underestimated their weight less, and overestimated it more than did white women. The reasons for these African American/white differences are unclear, but may reflect differential race and sex changes in height or weight, or cultural factors (14, 25).

Overestimation of height was greater for whites than for African Americans. In general, differences increased with age, but there were some inconsistencies, probably because of small sample sizes. Incorrect estimation of height (as a percentage of measured height) was greater than incorrect estimation of weight, perhaps because measuring own

weight is easy, but measuring own height is not. Concern that as age increases, accuracy of response declines (5) appears to be justified—additional caution may be needed in using self-reported information from the oldest age groups, information from whom should probably be gathered in person (1).

The current study has certain limitations. Our data are from the southeastern area of the US, where obesity is highest; we were unable to obtain information on all sample members participating at the third in-person wave of Duke Established Populations for Epidemiologic Studies of the Elderly; and some oldest age categories had very small sample sizes. Our self-reports and measures—to the nearest pound and the closest inch—may lack precision. We report results at a single occasion, and so cannot draw conclusions about the use of self-report to detect change in BMI over time. Finally, these data were gathered over a decade ago, and may not hold for incoming cohorts of older people, who will have had different experience and of whom a larger proportion is likely to be obese (26, 27).

It is increasingly recognized that information from younger populations on BMI and its association with various outcomes may not hold for older persons. Studies of the elderly have found that moderate overweight is associated with delayed mortality, but obesity has been found to create problems for mobility and self-care activities, and reduce the opportunity to benefit from improvements in performance of activities of daily living that have otherwise been reported (28–32). Impact of obesity as a risk factor for diabetes, heart disease, and stroke in older age, and particularly in minority populations, remains unclear (25, 32–35); however, it may exert an indirect effect on mortality through cardiovascular conditions (10, 11).

Although well studied in younger populations, little information is available on the accuracy of self-reported height and weight in older community residents, in particular older African Americans. This study is intended to make a contribution in that respect. Given the costs of otherwise obtaining information on height and weight, it is critical to know whether the reports of older persons can be used, or whether they are suspect. Our data suggest that the data from those 71 years of age and older are sound, reasonably accurate for African Americans, but may underestimate BMI for whites, and must be used with caution when obtained from the truly elderly participants.

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Supplementary material

Supplementary material can be found at: http://biomed.gerontologyjournals.org/

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