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Feasible Use of Estimated Height for Predicting Outcome by the Geriatric Nutritional Risk Index in Long-Term Care Resident Elderly

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Key Words
Standing height · Knee height · Estimated height · Geriatric nutritional risk index · Nutritional assessment

Abstract
Background: The Geriatric Nutritional Risk Index (GNRI) is a new index recently introduced for predicting risk of nutritional-related complications in elderly patients. It combines albumin with information about body weight: GNRI = (1.489 × albumin, g/l) + (41.7 × present/ideal body weight), with ideal weight calculated according to the Lorentz formula. Because standing height (SH) is frequently difficult to obtain in older people, in Lorentz equations this parameter has been replaced by estimated height (EH) from knee height. Though, if EH is well accepted as a valid surrogate for SH, the same might not be expected for its use in ideal body weight calculation, with possible consequences in grading nutritional risk correctly. ***Objective:*** The aim of this study was to investigate whether the use of SH rather than EH for the calculation of ideal body weight predicts similar outcomes by GNRI. ***Methods:*** Body weight, SH and EH were obtained in 231 long-term care resident elderly (88 males and 143 females, mean age ± SD 80.0 ± 8.4, range 65–97 years). Blood samples were assessed for albumin concentration. Ideal body weight was derived from the Lorentz formula using both SH and EH. According to both ideal weight estimates, nutritional risk was defined by the GNRI score. ***Results:*** The Pearson correlation coefficients were high for both EH (with SH; $r = 0.90$) and estimates of ideal body weight ($r = 0.90$) and all were highly significant ($p < 0.0001$). A statistically significant difference was found between SH and EH ($p = 0.0265$). Similar and expectable differences in significance have also been observed between ideal body weights ($p = 0.0271$). However, an accordance of 95.2% has been detected (Kendall's τ test: $\tau = 0.85$, $p < 0.0001$) in grading nutritional risk by GNRI. ***Conclusion:*** The use of EH for ideal body weight calculation and nutritional risk assessment by GNRI is feasible. Thus, GNRI seems to have been designed in the best way and its use is really attractive, particularly when considering the low-grade participation demanded of the patient in the assessment. This simple and valid assessment tool should be taken into greater consideration.

Introduction

Twenty years have passed since Chumlea et al. [1] published their first report on how to estimate height from knee height (KH) in older people. These equations, derived from healthy North American people, are still in use and their sufficient accuracy in estimating height has recently also been renewed in European elderly [2, 3].

Although standing height (SH) is often difficult to measure in bedridden elderly, various indexes of nutritional assessment and equations for estimating resting energy expenditures [4–8] require stature measurement.

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In the last few years greater attention has been paid to the elaboration of different methods to evaluate nutritional state [4]. A new index has recently been validated: the Geriatric Nutritional Risk Index (GNRI) [6]. It combines albumin with information about body weight: GNRI = (1.489 × albumin, g/l) + (41.7 × present/ideal body weight). The ideal body weight (IBW) is calculated according to the Lorentz formula: height – 100 – (height – 150)/4, for men, and height – 100 – (height – 150)/2.5, for women. However, SH is often difficult to obtain in the elderly. Faced with this problem, Bouillanne et al. [6] have replaced this value with estimated height (ES) from KH. On the other hand, although derivation of the body mass index (BMI) and body surface area seems not to be affected by the use of EH [2], the same might not be expected for IBW, with possible consequences in grading nutritional risk correctly. Moreover, GNRI validity and effectiveness may appear to be only theoretical.

With this in mind, we decided to investigate whether the use of measured height for the calculation of IBW predicts similar outcomes by GNRI.

Methods

Body weight, SH and EH were obtained in 231 long-term care resident elderly (88 males and 143 females, mean age ± SD 80.0 ± 8.4, range 65–97 years). KH (to the nearest 0.5 cm) was measured as the supine subject bent the left knee to the 90° angle. One blade of a sliding caliper (Anthropometric Caliper; Beaverton, Oreg., USA) was placed under the heel of the foot and the other blade was placed on the anterior surface of the thigh. The shaft of the caliper remained parallel to the long axis of the tibia and gentle pressure was applied to compress the tissue [1]. EH (cm) was calculated with the equations of Chumlea et al. [1]: for men, [2.02 × KH (cm)] – [0.04 × age (years)] + 64.19, and for women, [1.83 × KH (cm)] – [0.24 × age (years)] + 84.88. The measurement of SH (to the nearest 0.5 cm) was taken with the subject standing in a maximally erect (stretched) position with a portable stadiometer (Telefix, Metrica, Italy), at the end of a maximal inspiration. The head was held in the Frankfurt plane with the eyes and nose directed straight forward [3]. All measurements were performed in triplicate and the relative mean was taken into account. Accordingly IBW, using the Lorentz formula, and BMI, using real weight, were derived from both SH and EH [6]. Overnight fasting venous blood samples were assessed for serum albumin, and GNRI was derived from both values of IBW.

Statistical analyses were all performed by using SAS System 8.2 (SAS Institute Inc., Cary, N.C., USA). Student's t test was used to compare SH with EH and IBW estimates and Pearson's correlation coefficients were calculated to demonstrate the degree of association. The agreement in grading nutritional risk was assessed by Kendall's τ test.

Table 1. Demographic features of the population

	Median	Range
Age, years	80	65–97
SH, cm	157.5	139.0–183.7
EH, cm	156.2	138.0–185.0
BMI-SH, kg/m^2	24.8	13.4–39.0
BMI-EH, kg/m^2	25.3	14.2–39.2

Results

The demographic features of the population are presented in table 1.

A statistically significant difference (mean ± SD; difference 1.9 ± 4.0 cm; p = 0.0265) was found between both heights (SH 158.1 ± 9.3 cm; EH 156.2 ± 8.8 cm). In contrast to previous validation studies of EH [1–3], this observation might find an explanation in the voluntary inclusion of subjects with excessive spinal curvature. Similar and expectable differences in significance (p = 0.0271) were also observed between IBWs (IBW-SH 55.9 ± 6.9 kg; IBW-EH 54.5 ± 6.5 kg; difference 1.4 ± 3.0 kg). However, it is noteworthy that no discrepancies (p = 0.1772) were detected between BMI values (BMI-SH 25.2 ± 4.8 kg/m^2; BMI-EH 25.8 ± 4.9 kg/m^2; mean difference 0.61 ± 1.33 kg/m^2). The Pearson correlation coefficients were high for both EH (with SH; r = 0.90) and estimates of IBW (r = 0.90) and all were highly significant at $p < 0.0001$.

Referring to GNRI cutoff values (severe risk GNRI <82; moderate risk GNRI 82 to <92; low risk GNRI 92–98; no risk GNRI >98) patients were respectively classified as follows: 5.2% (n = 12), 15.1% (n = 35), 35.9% (n = 83), 43.8% (n = 101) for GNRI EH, and 5.6% (n = 13), 16.1% (n = 37), 35.9% (n = 83), 42.4% (n = 98) for GNRI SH. In grading nutritional risk, an accordance of 95.2% was found (τ = 0.85, $p < 0.0001$).

Discussion

Middle life is increasing, and providing better health care to older people is a clinical imperative. Malnutrition is a key issue in the management of this population and both screening of at-risk subjects and identification of those malnourished should be improved [9].

GNRI has been described as an accurate tool for predicting nutritional-related complications in patients admitted to geriatric rehabilitation care units [6]. It has also been suggested as a possible indicator of short-term mortality in acute hospitalized elderly [10] and a tool for grading malnutrition [11].

According to the present observations, GNRI seems to have been designed in the best way. What is really attractive with this index is the low-grade participation demanded of the patient. Both EH and body weight measurements are feasible, and a blood sample (for albumin) is simple to collect.

The utility of EH is clearly presented, and the estimating equations of Chumlea et al. [1] are further indirectly validated.

More widely, the importance of complete anthropometric evaluation in the assessment of institutionalized elderly has once again been underscored. A low BMI, depletion of subcutaneous fat (by triceps skinfold), and wasting of muscles (through mid-arm muscular circumference and muscle area) always represent a valid indicator for deeper diagnostic measures [7, 9]. Unfortunately, although requiring minimal participation of the patient, such evaluation is not often performed in routine practice.

Simple and valid tools for nutritional assessment should be given greater consideration.

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