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Original

Equation to estimate body weight in elderly Mexican women using anthropometric measurements

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Abstract

Introduction: **Body weight is useful for many medical and nutritional procedures. When it is difficult or impossible to measure body weight in hospitalized/institutionalized elderly, it can be estimated through equations based on anthropometry generated in other countries, although their validity in other contexts has been poorly studied.**

Objectives: **To create and validate an equation for estimating body weight for both, hospitalized and nursing home residents Mexican elderly women (institutionalized) using anthropometric measurements.**

Methods: **A validation study was carried out in elderly women (≥ 60 years old), admitted to the Geriatrics Service of the Hospital Civil de Guadalajara "Fray Antonio Alcalde" during February-April 19th (n = 43) and April 20th-June 2005 (n = 29), and elderly women residing in three nursing homes in the Metropolitan Area of Guadalajara evaluated during June 2003-June 2004 (n = 23). Subjects were weighed using a scale which was adapted to their clinical situation and were anthropometrically assessed. In the first sample, we generated a new equation using multiple regression analyses. Then, the equation was validated in the other two samples. We also estimated weight using Chumlea's equations: in all samples, estimated and actual weights were compared between each other through a paired t-test. A $p < 0.05$ was considered as significant.**

Results: **Mean ages in each sample were: 84.3 ± 7.3, 84.4 ± 9.1, and 84.2 ± 8.5 years, respectively. Mean actual weights were: 48.2 ± 13.5, 48.1 ± 10.1, and 55.0 ± 12.3 kg, respectively. The resulting equation was: estimated**

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ECUACIÓN PARA ESTIMAR PESO CORPORAL EN ANCIANAS MEXICANAS A PARTIR DE MEDIDAS ANTROPOMÉTRICAS

Resumen

Introducción: **El peso corporal es útil para llevar a cabo diversos procedimientos médicos y nutrimentales. Cuando se dificulta o es imposible medir el peso corporal en ancianos hospitalizados/institucionalizados, se puede estimar a partir de ecuaciones basadas en antropometría, generadas en otros países, aunque su validez en otros contextos ha sido poco estudiada.**

Objetivos: **Crear y validar una ecuación para estimar peso corporal, tanto en ancianas hospitalizadas, como institucionalizadas en asilos, usando medidas antropométricas.**

Métodos: **Se llevó a cabo un estudio de validación en ancianas (≥ 60 años), admitidas al Servicio de Geriatría del Hospital Civil de Guadalajara "Fray Antonio Alcalde" en el periodo Febrero-Abril 19 (n = 43) y Abril 20-Junio 2005 (n = 29), y ancianas residentes de tres asilos en la Zona Metropolitana de Guadalajara evaluadas en el periodo Junio 2003-Junio 2004 (n = 23). Los sujetos fueron pesados utilizando una báscula adaptada a su situación clínica y se les realizó una evaluación antropométrica. Con la primera muestra, generamos una nueva ecuación mediante análisis de regresión múltiple. Después, la ecuación se validó en las otras dos muestras. Asimismo, se estimó el peso mediante las ecuaciones de Chumlea: en todas las muestras, se compararon los pesos estimados con el real mediante un t-test pareado. Se consideró una $p < 0.05$ como significativa.**

Resultados: **El promedio de edad para cada muestra fue: 84.3 ± 7.3, 84.4 ± 9.1, y 84.2 ± 8.5 años, respectivamente. El promedio de peso fue: 48.2 ± 13.5, 48.1 ± 10.1, y 55.0±12.3 kg, respectivamente. La ecuación resultante fue: peso estimado = (1.599* altura talón-rodilla) + (1.135* circunferencia media de brazo) + (0.735* circunferencia de pantorrilla) + (0.621* pliegue cutáneo tricipital)–83.123 ($R^2 = 0.896$, $p < 0.001$). En las mujeres hospitalizadas no se encontraron diferencias estadísticamente**

weight = (1.599* knee height) +(1.135* mid arm circumference) + (0.735*calf circumference) + (0.621* tricipital skinfold thickness)–83.123 (R^2= 0.896, p < 0.001). In hospitalized women, there were no significant differences between estimated and actual weight (sample 1:D-0.02 ± 4.3kg, p = 0.976; sample 2: D-0.7 ± 4.2 kg, p = 0.352). In female nursing homes residents (institutionalized women) weight was significantly overestimated (1.9 ± 3.2 kg p < 0.01), but the mean difference was smaller than the ones found using Chumlea's equations.

***Conclusions:* The developed equation predicted accurately hospitalized elderly women's body weight in our context. In institutionalized elderly women, weight was significantly overestimated. It would be useful to derive equations for different settings.uals who present normal body weight.**

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Key words: *Body weight and measures. Anthropometry. Elderly.*

significativas entre los pesos estimados y el real (muestra 1: D-0.02 ± 4.3 kg, p = 0.976; muestra 2: D-0.7 ± 4.2 kg, p = 0.352). En las ancianas residentes de asilos (mujeres institucionalizadas) el peso se sobreestimó de manera significativa (1.9 ± 3.2 kg p < 0.01), aunque el promedio de las diferencias fue menor que el encontrado con las ecuaciones de Chumlea.

***Conclusiones:* La ecuación desarrollada estimó de manera precisa el peso corporal de las ancianas hospitalizadas en nuestro contexto. En mujeres institucionalizas, el peso fue sobreestimado de manera significativa. Sería útil derivar ecuaciones para diferentes contextos.**

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Palabras clave: *Peso corporal y mediciones. Antropometría. Adulto mayor. Ancianos.*

Introduction

In older adults, body weight measurement is vital for assessing nutritional status,[1] for estimating resting energy expenditure,[2] and for designing and following up a nutrition care process, since body weight is a measure of the quantity of body fluids and tissues. Any change on body weight denotes also a variation in body constituents, like fat mass or lean mass[1]. Besides, body weight in older adults is very important in medication dose assignment, especially for those older patients with immobility syndrome, pressure ulcers, hip fractures, among other conditions. Therefore, the measurement of body weight is a tool for an early identification of elderly persons at nutritional risk, allowing us to improve the quality of their care.

In spite of the importance of measuring body weight, it has been reported that this variable is not recorded for more than 20% of elderly patients with mobility problems in hospitals due to difficulties or to the impossibility of measuring it.[3-5] When it is not possible to measure body weight by the conventional way, other accurate methods can be used, such as specialized scales for nonambulatory patients. Nevertheless, due to their cost they are very unusual, especially in developing countries' public hospitals, which give medical treatment to people with low income and frequently without medical insurance.

There are other alternative methods, like self-reporting and the use of equations, as those created by Chumlea and colleagues.[4] These equations are based on anthropometric variables considered as indicators of weight components or body composition (arm and calf circumferences, subscapular skinfold thickness, knee-height). In Mexico and in other countries, these equations are widely used to assess body weight in elderly subjects.

However, in Italy[6] and China[7] these and other American equations do not estimate accurately body weight of the elderly, and equations for their respective populations have been proposed.

In our case, the need to analyze the precision of body weight estimation by equations, came up during the fieldwork of a study that was carried out in elderly residents of three nursing homes in the Metropolitan Area of Guadalajara (data not published). It was not possible to evaluate body weight in almost half (n = 28) of all residents (n = 61) because they could not move and special scales were not available. When we used Chumlea's equations to predict body weight, we found significant differences between actual and estimated body weights in women, but in men there were fewer differences. For that reason, we decided to analyze the utility of creating a specific equation for this population, especially for women.

Objectives

The aims of the study are: 1) to create an equation to estimate body weight for hospitalized elderly women; 2) to validate the equation in the same setting; and 3) to validate it in female nursing homes residents, in the Metropolitan area of Guadalajara, Mexico. Our hypothesis is that a new equation could estimate female older adults' body weight more accurately than equations created in another context.

Subjects

Convenience sample, divided into three different groups or sample, for this validation study.

Table I
Equations to predict body weight in elderly from anthorpometric variables (Chumlea, 1988)

	Equation	*Equations to predict body weight (kg)*
	Women	*Men*
Chumlea I	(MAC*1.63) + (CC*1.43)-37.46	(MAC*2.31) + (CC *1.50)-50.10
Chumlea II	(MAC*0.92) + (CC*1.50) + (SST*0.42)-26.19	(MAC*1.92) + (CC*1.44) + (SST*0.26)-39.97
Chumlea III	(MAC*0.98) + (CC*1.27) + (SST*0.40) + (KH*0.87)-62.35	(MAC*1.73)+(CC*0.98)+(SST*0.37)+(KH*1.16)-81.69

MAC = Mid-Arm Circumference; CC = Calf Circumference; SST = Subescapular Skinfold Thickness; KH = Knee-Height.

To create a new equation, we included all elderly women (60 years and older) admitted to the Geriatrics Service of the "Hospital Civil de Guadalajara Fray Antonio Alcalde", between February 1st and April 19th 2005 (sample 1). The second criterion of inclusion was that they had to be assessed during the first 72 hours after their admission. We excluded patients with edema, amputated limbs, severe fractures, fragile health status and those with cognitive disorders and whose information could not be confirmed by their caregiver or by a family member. A total of 43 elderly women were included (mean age: 84.3 ± 7.3 years; mean real weight: 48.2 ± 13.5 kg).

To validate the equation in the same setting, we assessed another group of hospitalized elderly women (sample 2), from April 20th to June 30th 2005, following the same inclusion/exclusion criteria. We included 29 elderly women (mean age: 84.4 ± 9.1; mean real weight: 48.1 ± 10.1 kg).

To validate the equation in another setting, we used data from a group of elderly women institutionalized in three nursing homes (private and semi-private) in Guadalajara city, assessed from June 2003 to June 2004 (sample 3). The same exclusion criteria were used. The sample included 23 subjects (mean age: 84.2 ± 8.5 years; mean real weight: 55.0 ± 12.3 kg).

Measurements

In the hospital setting, all eligible subjects were weighed in fasting conditions, with a dry diaper and wearing only a hospital gown. Weight was measured in supine position with a 100-kg capacity Iderna beam scale (0.125 kg of precision), hung from a 400-lb capacity Sunrise Medical lift (Series G33827, model C-H2A). Anthropometric variables were measured in the following order, using the procedures described in the literature: knee height (KH),[8] calf circumference (CC),[9] mid-arm circumference (MAC), tricipital skinfold thickness (TST) and subscapular skinfold thickness (SST).[10]

For the nutritional assessment of the institutionalized women, the same evaluator had filled out the identification sheets and measured the anthropometric variables of each subject as described before. In this stage, weight was measured following the technique described by Lohman[11] using a 160-kg capacity Torino scale (0.1 kg of precision).

Statistical analyses

To obtain the equation for estimating body weight, we began looking for simple linear regressions of each of the independent variables: age, KH, CC, MAC, TST and SST, against weight (the dependent variable). Then, we did a stepwise multiple linear regressions with weight as the dependent variable. We included the independent variables progressively, according to the association found in the simple linear regression (from greatest to least), in order to obtain the model which best predicted weight, and therefore, the equation to predict body weight. Once the equation was obtained, we estimated body weight of each subject with this equation and with those from Chumlea and colleagues[4] (table I). Mean differences between estimated and actual weight were calculated and a paired t-test was used to identify the significant differences between each pair of values.

In order to validate the new equation, both in sample 2 and 3, we first compared the anthropometric characteristics of the validation samples with the characteristics of the first group of hospitalized women, by an unpaired t-test. Then, body weights were estimated using our equation and Chumlea's equations, and these estimated body weights were compared with actual weights by a paired t-test. All statistical analyses were performed using SPSS version 10 for Windows. Level of significance was set at $p < 0.05$.

Ethical statement

Subjects and their families or caregivers were assured of the confidentiality of the data recorded from the study. They were also assured that if they decided not to participate, their hospital care would not be affected.

All procedures followed were in accordance with the Helsinki Declaration. For both studies (hospitalized and institutionalized women), ethical approvement was obtained from the local Ethical Committee *(Comités de Ética y Bioseguridad del Centro Uni-*

Table II
Simple linear regressions between actual weight and anthropometric variables in elederly women hospitalized from february to april 19th (n = 43)

Independent variables	*Regression coefficient (kg)*	*Standard error*	R^2	*p value*
MAC (cm)	2.408	0.187	0.803	< 0.001
TST (mm)	1.634	0.137	0.776	< 0.001
CC (cm)	2.943	0.333	0.660	< 0.001
SST (mm)	1.301	0.221	0.459	< 0.001
KH (cm)	2.208	1.172	0.080	0.067
Age (years)	-0.149	0.288	0.007	0.607

Weight as dependent variable.
MAC = Mid-Arm Circumference; TST = Tricipital Skinfold Thickness; CC = Calf Circumference; SST = Subescapular Skinfold Thickness; KH = Knee-Height.

versitario de Ciencias de la Salud, de la Universidad de Guadalajara). Subjects signed the consent form. To include subjects with cognitive disorders, we asked family members for their consent, and verified all information obtained with their family or caregivers.

Results

For generating the equation, we performed simple regressions between actual weight and each independent variable (table II). As seen in the table, the order of variables according to their association with weight is: MAC, TST, CC, SST, KH and age (the last two being non-significant).

Table III shows the results of the stepwise multiple linear regressions. The best prediction model included the variables MAC, KH, TST and CC ($R^2 = 0.896$, $p < 0.001$).

The resulting equation was:

Estimated weight = (1.599 x KH) + (1.135 x MAC) + (0.735 x CC) + (0.621 x TST)–83.123.

Table III
Multiple linear regressions model with "stepwise" method to estimate body weigh in hospitalized elderly women from february 1st to april 19th (n = 43)

Variables	*Regression coefficient (kg)*	*Standard error*	*p value*
Constant	-83.123		
MAC (cm)	1.135	0.358	0.003
KH (cm)	1.599	0.425	0.001
TST (mm)	0.621	0.254	0.019
CC (cm)	0.735	0.307	0.022

$R^2 = 0.896$; $p < 0.001$
Weight as dependent variable.
KH = Knee-Height; CC = Calf Circumference; MAC = Mid-Arm Circumference; TST = Tricipital Skinfold Thickness.

The difference between estimated and actual weights was statistically different when we used Chumlea's equations (between -3.7 and -5.4 kg), while with the equation generated in this context, the mean difference was -0.02 ± 4.2 kg (no statistically significant) (see Sample 1 in table IV).

For validation in the same setting, we show in table V, the comparison of anthropometric variables between both hospitalized samples. No statistically significant differences were observed, except in KH.

When we compared estimated-actual weight using Chumlea's equations, we found statistically significant

Table IV
Differences between estimated and actual weight in hospitalized (samples 1 and 2) and institutionalized (sample 3) elderly women

Equation	*Estimated body weight (kg)*[a]	*Difference between estimated-actual weight (kg)*	*p value*
Sample 1 (n = 43)[b]			
Chumlea I	44.6 (12.6)	-3.7 (5.3)	< 0.001
Chumlea II	44.4 (11.7)	-3.9 (5.6)	< 0.001
Chumlea III	42.8 (11.3)	-5.4 (5.1)	< 0.001
New equation	48.2 (12.7)	-0.02 (4.3)	0.976
Sample 2 (n = 29)[c]			
Chumlea I	41.5 (11.8)	-6.6 (4.5)	< 0.001
Chumlea II	42.4 (11.4)	-5.7 (4.6)	< 0.001
Chumlea III	41.7 (10.5)	-6.3 (3.6)	< 0.001
New equation	47.3 (11.2)	-0.7 (4.2)	0.352
Sample 3 (n = 23)[d]			
Chumlea I	50.8 (12.2)	-4.2 (3.5)	< 0.001
Chumlea II	50.7 (11.9)[e]	-4.0 (3.6)	< 0.001
Chumlea III	50.4 (11.6)[e]	-4.3 (3.5)	< 0.001
New equation	57.0 (11.8)	1.9 (3.2)	< 0.01

p values obtained by paired t-test.
[a]Mean (standard deviation).
Mean actual body weight (standard deviation):
[b]Sample 1: 48.2 (13.5) kg.
[c]Sample 2: 48.1 (10.1) kg.
[d]Sample 3: 55.0 (12.3) kg.
[e]Women n = 21, mean actual body weight = 54.7 (12.7) kg.

Table V
Comparison of anthropometric variables between the three samples

Variables	*Sample 1 (n = 43)*	*Sample 2 (n = 29)*	*Sample 3 (n = 23)*
Age (years)	84.3 (7.3)[a]	84.4 (9.1)	84.2 (8.5)
Weight (kg)	48.2 (13.5)	48.1 (10.1)	55.0 (12.3)
KH (cm)	45.7 (1.7)	46.5 (2.2)*	48.1 (1.6)
CC (cm)	27.4 (3.7)	26.7 (3.2)	31.4 (4.3)
MAC (cm)	26.3 (5.0)	25.0 (4.6)	26.6 (4.3)
TST (mm)	13.8 (7.2)	13.1 (7.3)	15.8 (5.9)
SST (mm)	12.6 (7.0)	13.1 (7.4)	12.4 (5.4)[b]

KH = Knee-Height; CC = Calf Circumference; MAC = Mid-Arm Circumference; TST = Tricipital Skinfold Thickness; SST = Subescapular Skinfold Thickness.
Unpaired-test Sample 1 *vs* Sample 2, and Sample 1 *vs* Sample 3: all p values are > 0.05, except for *.
*KH between Sample 1 and 2, $p < 0.05$.
[a]Mean (standard deviation).
[b]n = 21.

differences (between -5.7 and -6.6 kg). On the other hand, when we used the new equation, the mean difference between estimated-actual weights was -0.7 ± 4.2 kg. This difference was not statistically significant (see sample 2 in table IV).

For validation in the nursing homes, we compared the anthropometric characteristics of this sample with the characteristics of the first group of hospitalized women (table V), we did not find statistically significant differences (samples 1 and 3).

When actual and estimated weights were compared, the new equation suggested significantly overestimated weight by an average of 1.9 kg. However, this difference was smaller than those obtained with Chumlea's equations (between -4 and -4.3 kg) (see sample 3 in table IV).

Discussion

Equations to predict body weight in elders based on Caucasian populations in the USA, did not estimate accurately the weight of our hospitalized and institutionalized elderly women. They significantly underestimated weight, with mean differences between -3.7 and -6.6 kg. On the other hand, the new equation, when applied in a hospital setting (samples 1 and 2), estimated body weight quite closely to the actual values, with differences of less than 1 kg. However, when we applied our equation to institutionalized elderly women, we found that although weight was significantly overestimated by nearly 2 kg, this difference was less than those obtained using Chumlea's equations.

The methodology used in the present study, differs somewhat from the previous published studies on this topic.[4,6,7] We expose briefly, the only three previous studies found, including their methods in order to identify the processes used to accomplish these analyses, as well as their eventual attributes and limitations. In 1988, Chumlea and colleagues[4] generated equations for estimating body weight of the elderly in the USA, and these equations were later promoted widely in other countries. The sample used for generating the equations consisted of 105 men and 123 women living in Ohio, aged 65 to 104, who were able to walk unassisted. Anthropometric measurements were taken by two team members who had been trained in the technique. Equations were developed for men and for women using several multiple regression analyses. Weight was the dependent variable, and the independent variables were MAC and CC (Chumlea I); MAC, CC and SST (Chumlea II) and MAC, CC, ST and KH (Chumlea III). The authors suggested that the four-variable equation should be used as it had the best predictive value ($R^2 = 0.90$ for women, and $R^2 = 0.85$ for men).

To verify the validity and accuracy of their equations, they subsequently selected a cross-validation sample of 11 men and 9 women aged 65 to 99, institutionalized in four nursing homes in Ohio, unable to walk and with no cognitive deterioration. Anthropometric variables were measured by the same two members described before. The equation that best predicted body weight was Chumlea II (∅0.3 ± 4.9 kg, n = 5). Chumlea III estimated less accurately body weight (-1.9 ± 3.8 kgn n = 3).

The final sample (clinical-validation sample) consisted of 3 men and 14 women aged 62 to 99, institutionalized in five nursing homes in Texas, and bedridden. In this case, body weight was not measured, but requested from health professionals' last reports. The best prediction for these women was given by Chumlea I (4.6 ± 8.4 kg, n = 14), while Chumlea III was again the less accurate equation (5.1 ± 8.3 kg, n = 14). There are some methodological differences between Chumlea's study and ours: number of assessors, types of samples for validation, selection of variables for equation, and statistical analyses. It is important to notice that Chumlea's equations were an important scientific contribution to the clinical practice. Therefore, it is crucial to verify their precision in another context due to the anthropometric differences that may exist between elderly Americans and other populations. We are not questioning the validity of these equations; alternatively, we encourage re-analyzing and adapting them in different contexts.

However, we only found two studies that have generated specific equations for estimating weight in particular populations. In Italy, nine years after Chumlea's study, Donini and colleagues[6] verified the validity of these equations in an Italian population. These authors concluded that Chumlea's equations were inaccurate for the elderly Italian population. Later, they carried out another study[1] where they selected a random sample of ambulatory elderly people (60 and older) in the province of Rome (172 women aged 72.8 ± 8 years and

113 men aged 73.4 ± 8 years). They measured weight, height, KH, TST, SST, bicipital skinfold, suprailiac skinfold, waist circumference, MAC and CC. Then, they selected only those with a significant association for a stepwise multiple linear regression model (R^2 = 0.83 for women and 0.89 for men). The variables included in the model were the same as those included in Chumlea's study. Next, they estimated the weight of the subjects using the formula and applied a paired t-test to compare estimated and actual weight. Authors found that the differences between actual and estimated weights were 0.28 ± 0.04 kg in men (p = 0.41) and –0.09 ± 0.036 kg in women (p = 0.85).

In the present study, we followed approximately the same Donini and colleagues' methodological sequence for constructing an equation,[1] although they did found SST to have predictive value, as in Chumlea's study. Nevertheless, they also did further analyses to measure the precision of their equations, calculating the coefficient of variation, which measures the spread of the differences between estimated and actual weight (standard deviation of the difference between actual and estimated weight divided by mean difference). This coefficient was also calculated by Chumlea and colleagues in their study. Another measure of predictive value used, was pure error (PE) which measures the discrepancy between observed and estimated values in the dependent variable and which was then compared with squared residual error of the model.

In China, Jung and colleagues[7] found that the equations proposed by the American Dietetic Association for persons aged 60 to 80 which included only KH and MAC[11] were not applicable to a group of hospitalized and institutionalized elderly (200 women, 100 men). Therefore, they generated their own set of equations for men and women using multiple regression analysis, incorporating only KH and MAC (R^2 = 0.81 for men and 0.82 for women). However, the authors did not subsequently apply the equation in their population to analyze the differences between actual and estimated weight. There are several differences between our methodology and that used in the Chinese study: they did not explain how they had selected the variables included in their multivariate model. Their sample was larger than ours but they did not compare estimated vs. actual weights. On the other hand, the anthropometric characteristics of their population were somewhat similar to those of ours; however, KH mean value was slightly less in the Chinese women (45.75 ± 2.09 cm) so we can infer that our sample may have been somewhat taller.

It should be noted that the coefficients of the variables included in the models vary between equations. This is important, because it may be used to infer which body component (skeletal structure, given by KH; body fat, given by skinfolds and circumferences; lean body mass, also given by circumferences, especially of the calf) is most related to weight.[1,4] In the case of Jung and colleagues, the variable with the greater coefficient in their equation was MAC,[6] as in Chumlea I[4] and that proposed by Donini and colleagues.[1] CC had the greatest coefficient in the Chumlea II and III equations.[4] In contrast, in our equation, KH had the greater coefficient. Now, although Jung and colleagues proposed that age should be included in equations to estimate weight, because of changes in body composition at this stage of life,[6] neither our study nor the Donini study[1] found age to have a significant association with weight, whether independently or in interaction with other variables.

It is important to notice that we selected institutionalized and hospitalized elderly because they have particular health, socioeconomic and emotional status, which could have an impact on their nutritional status. Although the three samples did not show anthropometric differences between each other, institutionalized subjects showed greater mean anthropometric values. There are in this context, environmental differences (notably, in the socioeconomic level) between the hospitalized and the institutionalized elderly, which could explain why the equation was not as accurate in the latter group as in the former. The population used for generating the equation was hospitalized in a university charity hospital and had low socioeconomic and educational levels, according to their clinical record. This population could had been exposed in their past to food shortages, and probably also to nutrient deficiencies, so their anthropometric development may be different from a population with a higher socioeconomic status, such as older adults institutionalized in private and semi-private nursing homes as analyzed in the final validation group in the present study.

Also, the hospitalized group of elderly has probably different sociodemographic characteristics (very low income and education level, extreme poverty, lack of social security, among other things) from the rest of hospitalized elderly in Guadalajara, either in public or private hospitals.

The utilization of the new equation for clinical purposes should be validated in a representative sample. Nevertheless, this contribution proves that equations generated from a specific population are not always applicable to all contexts.

In addition, in spite of the lack of statistical representativeness, the characteristics of the settings from where the sample was obtained are worthy to be considered. They represent in fact, two different populations living in the same urban context: the hospital's patients are, as mentioned, people of few economic resources, which would represent the precarious conditions of a specific population in Guadalajara. On the other hand, the nursing homes, selected randomly from a list of elderly institutions, represent the living conditions from an average non precarious person in the same city.

We believe and suggest that different equations should be constructed for elderly patients in different settings: living in the community, institutionalized or

hospitalized, where there are, certainly, different socioeconomic characteristics.

It is important to mention that no more studies have been found in the literature that might question the validity of equations to estimate weight in the elderly in different countries for which they were created. Nevertheless, there are many studies that question the validity of equations to estimate height in different contexts with different populations, or that even propose their own equations.[7,12-25] It is surprising to find that these studies, which measure the validity of equations that compare the estimated height with a measured height used as a standard, have proliferated when it is well-known that there is not a reliable height measurement for an elderly subject due to the numerous spine deformities that a person can suffer with aging. It is more feasible and reliable to have a reference standard to compare the estimated weight, although there are few studies have questioned, in different contexts, the validity of equations to predict body weight.

Conclusions

The equation developed from a local population estimated the body weight of our hospitalized and institutionalized female Mexican elderly better than equations generated in a North American population, which are used around the world. This study illustrates the procedures and shows the importance and usefulness of generating equations for estimating body weight from anthropometric variables for elderly patients, in different settings and socioeconomic groups. As doing so, the precision of the estimates is improved, therefore, we can develop more accurate diagnoses, better nutritional interventions and improving the care's quality in elderly subjects.

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