

Pattern of Age-Related Changes in Body Composition: A Cohort Study in Older Hispanic Adults

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ABSTRACT

Background: Currently, the patterns of age-related body composition changes in older Hispanic adults are unknown. Furthermore, the effect of sex on changes in body composition has been reported by several cohort studies, but the results are controversial. **Objective:** This study assessed body composition changes at 4.6 years of follow-up in older Mexican adults and explored the effect of sex on the body composition changes. Also, described differences with respect to the pattern reported for, mainly, older Caucasian people assessed by Dual-energy X-Ray Absorptiometry (DXA). **Methods:** This is a cohort study that included a sample of 142 community-dwelling older subjects without chronic diseases. At baseline all volunteers underwent face to face interview to gather several socioeconomic, health and nutritional information, and underwent body composition assessment by DXA at baseline and follow-up. **Results:** Sixty-five men and 77 women were included for the analysis. There was a significant loss of body weight, total appendicular skeletal muscle (TASM), fat-free mass, and total lean tissue at 4.6 years of follow-up in both the men and women. The loss of fat mass was significant in women, and for the group as a whole. Multiple regression analysis showed only an effect of sex on the loss of TASM at follow-up after adjusting for body mass index, age, height, baseline TASM, and body weight. **Conclusions:** These older Mexican people lost body weight, lean tissue, and fat mass, forming a pattern distinct from the one reported for older Asian and several for Caucasian people. Specific nutritional interventions are needed to improve body composition in this age group.

Keywords: Cohort study, Body composition changes, Older Hispanic adults, Dual energy X-ray absorptiometry

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INTRODUCTION

Several changes in body composition during aging have been reported in many cohort studies. One cohort study showed an increase of fat mass (FM) in both sex after a follow-up period [1], but Fantine, et al's work, in contrast, did not find significant changes in older men and women subjects [2]. Other studies have shown an effect of sex on increases in FM [3-6] suggesting that these occur only in men, not in women [3-5]. However, there are reports of this phenomenon in women as well [6]. The studies just cited [1-6], and some others [7-8], have documented significant losses of lean tissue, defined as fat-free mass (FFM), total lean tissue, lean tissue mass (TLT), total appendicular skeletal muscle (TASM), or lean leg tissue mass [1-8]. With the exception of one study, exclusively of women, none of these works reported significant fat mass loss at follow-up [3]. Overall, aging is associated with significant loss of lean tissue, mainly TASM, and increases of fat mass compartment.

The clinical importance of the described age-related body composition changes in older adult populations lies in its association with morbidity, functionality, and mortality. Cross-sectional and cohort studies have reported a significant association between loss of muscle mass or lean tissue, and lower functionality and mortality [2,9,10], and high FM and low lean body mass with mortality [11,12]. In addition to age, sex and height, changes in body compositions may also be influenced by ethnicity. As has been reported previously by cross-sectional [13] and some cohort studies [3], the effect of ethnicity on body composition. Independent of ethnicity, the age-related body composition assessed by dual-energy X-ray absorptiometry (DXA) has been reported by several cohort studies, highlighting an increases of fat mass and loss of lean tissue [1-6]; however, in many of these studies changes in body composition has not been adjusted.

To the best of our knowledge, the pattern of age-related body composition changes in older Hispanic men and women in Mexico, however, currently unknown. Nor do we know if these changes differ from the pattern reported mainly in older adult Caucasian populations [1-4,6]. This study assessed body composition changes at 4.6 years of follow-up in older Mexican adults and explored the effect of sex on the body composition changes. Also, described differences with respect to the pattern reported for, mainly, older Caucasian people assessed by dual-energy X-ray absorptiometry (DXA). We hypothesized that all body composition compartments and components will decrease in the follow-up period in this group of older Hispanic adults.

METHODS

This is a secondary analysis of a cohort study conducted in northwest Mexico that included a sample of community-dwelling older men and women subjects who were recruited by visiting personal homes and clubs and mass media. The inclusions criteria for the present analysis at baseline: men and women subjects ≥ 60 years, free of diseases or conditions that could affect their body composition by medical examination such as type 2 diabetes by oral glucose tolerance test. The results of the urine analysis, lipid profile, hemoglobin and insulin levels, and blood pressure measurements were not exclusive. Also, volunteers at baseline were free of loss of skeletal muscle assessed by the residual method [14], and physical independent. All subjects were included in the study regardless of their socioeconomic and employment status, level of physical activity, and nutritional status as measured by the body mass index (BMI), and they must have anthropometry and body composition data.

Anthropometry and body composition were measured at baseline and follow-up. Whole body and regional composition was measured by DXA using DPX-MD+ model (GE Lunar Madison, WI). All DXA scans were edited and FM and FFM (bone mineral content (BMC) + TLT) compartments; and TLT, BMC, and TASM (the sum of TLT in arms and legs) components were obtained. DXA measurements were taken according to published protocols [13]. Those subjects with instable body weight (weight loss >10 kg or weight gain >5 kg) between baseline and follow-up were excluded in order to avoid that loss of body composition components and compartments were influenced by other factor such as recent changes in body weight [15]. At the time of follow-up, no volunteers had diseases or conditions that could affect their body composition. Since the beginning, volunteers included in the cohort were informed of the study protocol and signed the informed consent form. The protocol was approved by the Ethical Committee of CIAD, A.C.

The changes in body composition by sex and in the whole sample were assessed by a paired t-test. In addition, multiple regression analysis was used to test the effect of sex on several body composition changes at follow-up as reported by other researchers [4]. The adjusting models were constructed using univariate analysis, considering only variables with a p value ≤ 0.2 and applying the automated stepwise model selection option. The variables with p values ≤ 0.05 were selected to build the model. Several covariates reported previously [13] and some derived body composition covariates were considered in the model-building procedure. Each model was evaluated for multiple

lineal regression assumptions (i.e., normality, collinearity). The interaction of all the variables in the model with sex was tested at $p \leq 0.1$. Statistical analyses were performed using STATA version 12.0 (Stata Corp LP, College Station, Texas).

RESULTS

For this analysis, a cohort of 142 elderly subjects without diseases or conditions that could affect their body composition was analyzed, consisting of 65 men and 77 women. Overall, subjects were free of type 2 diabetes, physical disability, coronary heart disease, cancer, and

stroke, and had relatively stable body weight. Some of them had lipid profile abnormalities such as hypertriglyceridemia, and dyslipidemia and anemia. Also, at baseline subjects were free of loss of appendicular skeletal muscle defined by the residual method. Mean age at baseline was 68.5 ± 6.4 , years, but by follow-up it had risen to 73.0 ± 6.5 years. The mean time period from baseline to follow-up was 4.6 years. These older men and women were found to have lost significant body weight: 1.8 and 2.1 kg, respectively. In addition, BMI decreased significantly in both the men and the women, though more markedly in the women (Table 1).

Table 1: Age-related anthropometric and body composition changes by sex at 4.6 years of follow-up in older Mexican adults.

Variables	Men (n=65)			Women (n=77)			Both (n=142)		
	Baseline	Follow-up	P-value	Baseline	Follow-up	P-value	Baseline	Follow-up	P-value
Anthropometric variables									
Body weight, kg	77.5±11.9	75.7±11.6	<0.001	68.0±11.17	65.9±10.9	<0.001	72.4±12.4	70.4±12.2	<0.001
Height, cm	1.68±0.06	1.68±0.06	0.003	1.55±0.05	1.54±0.06	<0.001	1.61±0.09	1.60±0.09	<0.001
BMI, kg/m ²	27.1±3.3	26.7±3.3	0.009	28.2±4.1	27.5±4.07	<0.001	27.7±3.8	27.1±3.7	<0.001
DXA data									
DXA-body mass, kg	76.1±11.8	74.2±11.6	<0.001	66.4±11.09	64.2±10.9	<0.001	70.8±12.3	68.8±12.2	<0.001
FM, kg	22.8±7.0	22.4±7.0	0.205	29.0±8.1	27.5±8.0	<0.001	26.1±8.2	25.2±7.9	<0.001
TLT, kg	50.4±6.6	49.0±6.4	<0.001	35.3±3.9	34.7±3.8	<0.001	42.2±9.2	41.2±8.8	<0.001
BMC, kg	2.88±0.42	2.85±0.42	0.005	2.09±0.36	2.04±0.35	<0.001	2.45±0.55	2.41±0.56	<0.001
FFM, kg	53.3±6.9	51.8±6.7	<0.001	37.4±4.2	36.7±4.1	<0.001	44.7±9.7	43.6±9.3	<0.001
TASM, kg	23.1±4.2	22.2±4.1	<0.001	16.1±2.9	15.4±2.8	<0.001	19.3±5.0	18.5±4.8	<0.001

BMI: body mass index, DXA: dual energy x-ray absorptiometry, FM: fat mass, TLT: total lean tissue, BMC: bone mineral content, FFM: fat-free mass, TASM: total appendicular skeletal muscle.

Regarding the body composition changes documented at 4.6 years of follow-up, the women lost 1.5 kg of fat mass ($p < 0.001$), while the loss in the men was 0.4 kg ($p > 0.05$). The losses of FFM were 1.5 and 0.7 kg in men and women, respectively ($p < 0.001$). Measurements of the other components showed that both men and women significantly lost TLT (1.4 kg in the men, 0.6 kg in the women) and TASM (0.9 kg in men, 0.7

kg in women). The loss of BMC was also significant 0.03 kg in the men and 0.05 kg in the women (Table 1). The results of unadjusted body composition data found in the present analyzed cohort of older Hispanic men and women in Mexico, show similar losses in lean tissue, with additional losses of fat mass compartment as compared with those reported in Caucasian older adult populations (Table 2).

Table 2: Summary of the age-related body composition changes at follow-up reported by various authors according to sex in older adult populations.

General characteristics					FM			TASM			FFM			TLT		
Ref	N	Follow-up, Yrs	Sex	Age range, Yrs	Change, Kg	Change, Kg/Yrs	p-value	Change, Kg	Change, Kg/Yrs	p-value	Change, Kg	Change, Kg/Yrs	p-value	Change, Kg	Change, Kg/Yrs	p-value
1	130	3	Both	>65	0.6	0.2	0.0006	-0.2	-0.06	0.005	-0.3	-0.1	0.01	-	-	-
2	62	5.5	Men	68-78	-0.93	-0.16	0.71	-1.3	-0.23	0.001	-0.14	-0.02	0.001	-	-	-
	97	5.5	Women	68-78	0.53	0.1	0.063	-0.44	-0.08	0.001	-0.39	-0.07	0.047	-	-	-
3	1014	2	Men	70-79	0.39	0.2	<0.01	-0.2	-0.1	<0.01	-0.63	-0.3	<0.01	-	-	-
	1026	2	Women	70-79	-0.04	-0.02	>0.05	-0.04	-0.02	>0.01	-0.26	-0.13	<0.01	-	-	-
4	24	4.7	Men	60-90	1.2	0.3	0.03	-0.8	-0.2	0.002	-1.4	-0.3	0.002	-	-	-
	54	4.7	Women	60-90	-0.8	-0.2	0.12	-0.4	-0.1	0.006	0.02	0	0.93	-	-	-
5	310	6	Men	60-69	1.3	0.21	<0.0001	-	-	-	-	-	-	0.2	0.03	0.08
				70-79	1	0.16	<0.0001	-	-	-	-	-	-	-	-	-0.5
	252	6	Women	60-69	0.3	0.05	0.06	-	-	-	-	-	-	0.2	0.03	0.008
				70-79	0.02	0	0.95	-	-	-	-	-	-	-	-	-0.1
6	60	2	Men	>70	0.2	0.1	0.385	-0.61	-0.3	0.001	-	-	-	-0.31	-0.15	0.148
	101	2	Women	>70	0.49	0.24	0.012	-0.27	-0.13	0.001	-	-	-	-0.19	-0.09	0.167
Present Study	65	4.6	Men	60-90	-0.42	-0.09	0.205	-0.93	-0.2	<0.0001	-1.44	-0.31	<0.0001	-1.4	-0.3	<0.0001
	77	4.6	Women	60-90	-1.44	-0.31	<0.0001	-0.71	-0.15	<0.0001	-0.67	-0.14	<0.0001	-0.62	-0.13	<0.0001

Ref: reference number, N: sample number, yrs: years, kg: kilograms, FM: fat mass, TASM: total appendicular skeletal muscle, FFM: fat-free mass, TLT: total lean tissue.

Importantly, multiple regression analysis showed a significant effect of sex only for the loss of the TASM component at 4.6 years of follow-up. In this analysis some covariates that may be involved in changes in body composition were included in this analysis (age, body weight, BMI, baseline body composition component, smoking, drug use, and HOMA-IR). During this period, the average loss of TASM in the men was 0.25 kg higher than in

the women ($\beta=-0.25$ $p=0.05$), and this result remained significant after adjusting for BMI and age. Results for the other components were not statistically significant ($p>0.05$): FM ($\beta=-0.71$ kg; $p=0.122$), FFM ($\beta=0.45$; $p=0.274$), CMO ($\beta=0.02$; $p=0.216$), and TLT ($\beta=0.45$; $p=0.276$), even after adjusting for their corresponding covariates (baseline body composition component, age and BMI).

DISCUSSION

To the best of our knowledge, this is the first study to assess body composition changes in well-functioning older adults and without cognitive impairment and with stable body weight. Also, all subjects were free of the mayor diseases such as cancer, kidney disease, arthritis, and heart failure. None volunteers were on androgen and estrogen drugs therapy. Therefore, our results can be comparable with those published studies using the same DXA methodology for body composition assessment [1-6]. In the present study, the weight loss is accompanied by a loss of both fat mass and lean tissue. All the compartments and components of body composition evaluated showed losses as compare with those reported in other population (Table 2). It is probable that the body composition phenotypes that result from the aging process will define specific health risks for elderly populations. Significantly, we observed that the pattern of the body composition changes in the sample analyzed (Tables 1 and 2) differed from the pattern reported in other published cohort studies that focused mainly on older Caucasian and Asian people in similar age ranges but using the same body composition methodology.

Overall, men and women separately, and as a group, presented significant losses not only of fat mass but also in all lean tissue compartments and components, and these results are contrasting with the gains and losses reported for these body composition compartments and components at follow-up. In addition, the reported changes in body composition are not homogeneous among older people or across sex and different ethnic groups [1-6], though most related studies have reported significant gains of FM in both sexes [1], and in men and women separately [3-6], while others observed stability, losses in fat mass compartments, or results that are not statistically significant [2]. The present study found a significant loss of fat mass in both groups, men and women using a paired t-test analysis. However, multiple regression analysis showed no sex differences in fat mass even after adjusting for their corresponding covariates.

With respect to lean tissue loss, it seems that this is a universal phenomenon [1-8]. Specifically, all published studies have reported consistent, significant losses of TLT, leg lean tissue mass, and TASM in men and women both as a group and separately. In our work, however, only TASM showed this on the basis of a paired t-test (Table 2) in men and women, both separately and taken together. The multiple regression analysis showed significant loss of TASM, but only in the men after adjusting for the corresponding covariates. This result

agrees with the findings published in a report on older U.S. adults [5]. The average estimated loss of TASM annually is around 0.12 kg [1-4,6]. Regarding the clinical consequences of the loss of TASM, cohort studies have defined several health risks, as this effect has been associated with loss of functionality [2,9] and mortality [10], while high fat mass and low lean body mass have been associated with a higher risk of specific mortality [11,12]. In the short term, it is likely that the significant loss of TASM, FFM, and TLT in our sample may lead to sarcopenia and loss of physical independence, while the loss of lean tissue plus fat mass could result in malnutrition. The gains in fat mass and the loss of TASM in some older Caucasian people could, with time, translate into sarcopenic obesity [4]. It may well be that men will be more seriously affected by malnutrition, sarcopenia, and physical dependency due to their greater loss of TASM, according to the results of the regression analysis performed in the present study.

CONCLUSION

The community-dwelling older Hispanic men and women subjects included in our sample lost significant body weight, and unadjusted both lean (TASM, FFM, TLT) and fat mass at 4.6 years of follow-up. This pattern contrasts with the one reported mainly for older Caucasian people. However, unadjusted, and adjusted data of TASM showed significant losses at follow-up period. It is clear that different patterns exist, so distinct intervention approaches may need to be implemented in order to decrease the possible health risks associated with the body composition phenotypes that result from the normal aging process. Our results should be observed with caution, this is not randomized and representative sample; however, the size of the sample had sufficient power to detect significant differences at follow-up and by the multiple lineal regression analysis. More studies are encouraged to support or reject the body composition changes reported in the present study in order to strength or not the opportune intervention in this vulnerable age group.

CONFLICT OF INTEREST

Authors does not have any competing or conflicting interest. All data referenced in the present paper is available under request.

ETHICAL APPROVAL

The study was conducted in accordance with the Helsinki Declaration and was approved by the Ethics Committee of the Research Center for Food and Development

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