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Depression and body composition among older adults

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Abstract

Objectives—Recent investigations have reported an association between depression and geriatric syndromes associated with low body mass, including frailty and osteoporosis. The objective of this study was to explore the relationship between depression and body composition among older adults.

Methods—Data were from a case-cohort study (n = 98) of adults aged 60 and older nested within the Baltimore Epidemiologic Catchment Area Study. Lifetime depression syndrome was assessed using the Diagnostic Interview Schedule. Body composition (total and central lean and fat mass) was assessed by dual-energy x-ray absorptiometry (DEXA). The association between depression and body composition was evaluated using linear regression with bootstrap standard errors.

Results—Overall, there was no association between depression and total fat or total lean body mass. Among women, a depression was associated with reduced central fat (B = −3.6kg, p<0.06) and lean (B = −3.3kg, p<0.04) mass adjusting for age, race, smoking status, and physical activity. Depression was unrelated to total or central fat or lean mass among men.

Conclusions—Depression is associated with significantly lower central fat and lean mass among older women. These findings are consistent with the hypothesis that depression and frailty are interrelated in later life, particularly among women.

Keywords

frailty; body composition; metabolic risk; depression

INTRODUCTION

Recent evidence has suggested a link between depression and frailty, a syndrome characterized by fatigue, slowness, weakness and weight loss and/or low body mass (Park-Lee et al. 2009; Bandeen-Roche et al. 2006). However, previous studies have reported conflicting results regarding the relationship between depression and overall body fat as measured by body mass index (BMI) among older adults (Koster et al. 2010; Sachs-Ericsson et al., 2007). One source of these discrepancies may be the reliance on BMI as an indicator

of body composition. Global measures such as BMI do not account for the location of body fat (e.g., abdominal versus peripheral) and BMI is also only a proxy measure of the degree of fat mass. The distribution and relative amounts of fat and lean mass may be more strongly indicative of metabolic and inflammatory processes, including risk factors for frailty, than simply body size (Hubbard et al. 2010; Everson-Rose et al. 2009). Thus, the relationship between depression and body composition may be a more specific indicator of the shared physiologic correlates between depression and geriatric syndromes like frailty, particularly for older adults who are at higher risk for developing such conditions.

The aim of this study was to examine the associations between depression and body composition (fat and lean mass) among a sample of older community-dwelling adults. We evaluated whether these relationships were consistent with those derived using anthropomorphic measures of BMI and waist circumference. Finally, because both frailty and depression are more common among women, we assessed whether these relationships varied by sex.

METHODS

Sample

The Baltimore Epidemiologic Catchment Area (ECA) Study is an on-going, longitudinal population-based sample of adults originally interviewed in 1981 (N = 3481) and followed-up in 1982 (N = 2768), 1993 (N = 1920) and 2004 (N = 1071). Details of the study design have been described elsewhere (Eaton et al. 2007). Recruitment for this study of body composition was connected to participating in the Mood and Memory Project (MMP) at Johns Hopkins Hospital (JHH), a study of older surviving ECA participants interviewed in 2004. In total, there were 398 ECA participants aged 60 and older interviewed in 2004, of which 107 participated in the MMP at JHH during the enrollment period for the DEXA study. Of these, 98 (92%) agreed to the dual-energy x-ray absorptiometry (DEXA) scan. Two-thirds ($n = 66$) of the sample were women; all women in were post-menopausal and 36% had used hormone replacement therapy. The DEXA sample was representative of all ECA participants aged 60 and older in terms of age, race, sex, smoking status, alcohol use, and history of depression (see Supplemental Table 1) (Mezuk et al. 2008).

Study procedures were approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board. All participants provided informed written consent.

Depression

Major depression was assessed using the Diagnostic Interview Schedule (DIS) at all ECA interviews, a fully-structured instrument administered by lay interviewers. The validity and reliability of the DIS has been investigated in the ECA specifically and it has moderate concordance with clinical examinations (Eaton et al. 2000). Measures summarizing lifetime major depression (MD, ever/ever), lifetime depressive syndrome (which includes MD, minor depression, and bereavement), recency of depressive episodes (past year versus more than a year ago), and number of depressive episodes were generated by merging DIS responses from all four ECA interviews. At the time of the DEXA scan participants also completed the Geriatric Depression Scale (Yesavage et al., 1983) to assess concurrent depressive symptoms.

Body Composition

Body composition, indicated by lean and fat mass (in kilograms, (kg)) was assessed via whole-body DEXA scan (Hologic QDR 4500W (S/N 49694); Hologic Inc., Waltham, MA) and analyzed by a registered nurse using Hologic software v.12.3:5 at Johns Hopkins

General Clinical Research Center Outpatient Clinic. The nurse was blinded as to the depression case status of the participants. Both total body and trunk region (central) fat and lean body mass (in kilograms) were assessed. Trunk region fat mass from whole body DEXA has good concordance with visceral fat mass among older adults ($r^2 = 0.606 - 0.835$) (Snijder et al. 2002).

Other covariates

Covariates were selected based on previous research demonstrating a correlation between depression and body composition. Demographic characteristics (age, sex, race), smoking status, BMI and waist circumference were assessed at the 2004 ECA interview. BMI (kg/m^2) was calculated from participants' measured weight and height while wearing light clothing. Waist circumference was assessed using a flexible tape measure around the iliac crest. Age was centered on the sample mean. We examined two health behaviors that are associated with both depression and body size: smoking status and physical activity. Smoking status dichotomously coded as current smoker versus former/never. Physical activity was assessed at the time of the DEXA scan using a modified version of the Physical Activity Scale for the Elderly (PASE), a self-report measure that includes items on exercise, housework, and leisure activities which has been validated in older populations (Washburn et al. 1993).

Analysis

Differences in mean total and central fat and lean mass for respondents with and without a history of depression were assessed using Students t-tests. The distributions of fat and lean mass were approximately normally distributed, and therefore multiple linear regression models with total and regional body fat mass and lean mass measurements as the outcome were fit using ordinary least squares (OLS). Because standard OLS estimates of precision are dependent on the assumption of a large number of observations ($n > 50$), standard errors were obtained using the bootstrap method (replications: 1000) (Efron & Tibshirani, 1986). Participants with medical devices in relevant body regions (e.g., all regions for the outcome of total fat and lean mass, and pelvis and both chest regions for the outcome of trunk fat mass and trunk lean mass) that could have affected the body composition measurements were removed from analysis. We also conducted a series of sensitivity analyses to examine whether the relationship between depression and body composition was non-linear (e.g., U-shaped). The moderating influence of sex was assessed with interaction terms and stratified analysis. All analyses were conducted using STATA (v.9) software. Statistical significance was defined as a two-sided $\alpha=0.05$.

RESULTS

The sample was 67% women and approximately 10% of the sample (7 women and 3 men) had a lifetime history of MD. Thirteen had a lifetime history of depression syndrome. The average number of depressive symptoms at the MMP visit as measured by the Geriatric Depression Scale was 5.2 and only two participants had moderate/severe (21 – 30) depressive symptomatology, indicating that the majority of the sample was not currently depressed at time of the DEXA scan (data not shown). Median BMI was $28.6 \text{ kg}/\text{m}^2$ (interquartile range (IQR): $25.1 - 35.6 \text{ kg}/\text{m}^2$) for women and $31.2 \text{ kg}/\text{m}^2$ (IQR: $26.0 - 34.5 \text{ kg}/\text{m}^2$) for men. Total lean and fat mass were moderately correlated ($r^2 = 0.4$, $p < 0.01$), as were central lean and fat mass ($r^2 = 0.6$, $p < 0.01$). BMI was strongly correlated with total fat mass ($r^2 = 0.87$, $p < 0.01$) and waist circumference was strongly correlated with central fat mass ($r^2 = 0.80$, $p < 0.01$). As shown by Table 1, overall there was no significant difference in either total or central lean or fat mass comparing respondents with and without a history of depression in crude analyses (all $p > 0.10$).

In sex-stratified linear regression analyses adjusting for age, race, smoking status and physical activity (Table 2), a lifetime history of major depression was associated with lower central fat mass ($\beta = -3.6\text{kg}$, $p < 0.06$) and lower central lean mass ($\beta = -3.3\text{kg}$, $p < 0.04$) among women. Together the variables in Table 2 explained 18% of the variance in central fat and central lean mass, respectively, among women. There was no association between depression and central fat or lean mass among men. However, the interaction terms between sex and depression on central lean mass ($\beta = -4.2$, $p < 0.16$) and central fat mass ($\beta = -3.2$, $p < 0.35$) did not reach statistical significance. History of major depression was unrelated to total fat or lean mass among either men or women. Older age was consistently associated with lower fat and lean mass among women but was unrelated to either among men. Number of depressive symptoms was not significantly correlated with either central lean ($r^2 = -0.09$, $p = 0.40$) or central fat ($r^2 = -0.102$, $p = 0.32$) mass in the sample overall, or within sex-stratified groups, and in regression models number of symptoms was not significantly associated with any of the four measures of body composition. Number of depressive episodes was marginally correlated with central lean ($r^2 = -0.17$, $p = 0.09$) but not central fat ($r^2 = -0.12$, $p = 0.23$) mass in the sample overall, however after adjustment in regression models it was no longer significantly associated with any indicator of body composition.

We then examined whether these results were consistent with those obtained using BMI and waist circumference as proxies for total and central fat mass, respectively. As with the analyses using body composition from the DEXA scan, lifetime history of depression was not related to total fat as indicated by BMI among either men ($\beta = 1.43\text{ kg/m}^2$, 95% CI: $-3.23 - 6.11$, $p = 0.547$) or women ($\beta = -3.62\text{ kg/m}^2$, 95% CI: $-7.72 - 0.48$, $p = 0.084$). However, contrary to the analyses using DEXA-assessed central fat, depression was not significantly to waist circumference among either men ($\beta = -0.65\text{ inches}$, 95% CI: $-4.84 - 3.54$, $p = 0.762$) or women ($\beta = -1.54\text{ inches}$, 95% CI: $-5.12 - 2.04$, $p = 0.399$), although these point estimates were in the same direction as those obtained in the DEXA analyses.

We conducted several sensitivity analyses to examine the possibility that the association between depression and body composition was non-linear, including visual inspection of predicted probability and residual plots and excluding participants in the upper and lower quartiles of the body composition distributions and re-fitting the models. There was no evidence of a non-linear relationship between depression and either lean or fat mass.

CONCLUSIONS

The primary finding from this study is that a history of major depression is associated with reduced central, but not total, fat and lean mass among older women as measured by DEXA. There was no association between depression and fat or lean mass among men. The degree of difference in central fat and lean mass was approximately seven pounds each (a total of approximately 14 pounds), an amount of weight that may have clinical implications depending on overall body size (Koster et al. 2010). In contrast to studies that utilize global measures of body mass, we were able to examine the relationship between depression and both lean and fat mass. The analysis comparing these results to body composition as assessed by BMI and waist circumference suggests that these anthropomorphic measures do not capture the same elements of fat and lean body composition as the DEXA measurements. This distinction has potential relevance for studies that aim to understand the physiologic processes that underlie geriatric syndromes such as frailty. These results are consistent with the hypothesis that depression is associated with alterations in body composition that are correlated with geriatric syndromes such as frailty and osteoporosis (Park-Lee et al. 2009; Hubbard et al. 2010; Mezuk et al. 2008). In particular, the finding that the relationship between depression and body composition was stronger in the analyses of trunk fat and lean mass relative to overall fat and lean mass is consistent with other studies

that have found that centralized fat is more strongly correlated with depression than overall obesity (although in many of these reports found that depression was associated with higher rather than lower centralized body mass) (Volgenzangs et al. 2008; Marijnen 2011).

Strengths of this study include the population-based sample which minimizes selection bias, utilization of a diagnostic measure of depression, and the long follow-up period over which depression was assessed. Limitations include the relatively small sample size, particularly of older men, which limited our ability to account for a large number of confounders. As such, these findings should be considered preliminary in nature and need to be replicated using larger samples.

A recent meta-analysis suggested that depression is associated with increased risk of obesity (Luppino et al. 2010), however in general these studies were not focused on older adults, suggesting that the relationship between depression and body composition may vary over the life course. Indeed, some studies have reported an inverse association between depression and body mass among older adults (Ho 2009). Evidence from longitudinal studies of older adults suggests that the relationship between depression and weight change is bi-directional (that is, weight loss has been associated with heightened depressive symptoms, and weight loss is also a common symptom of depression syndrome) (Ho 2009; Koster et al. 2010; Luppino et al. 2010; Forman-Hoffman et al. 2007). There is also suggestive evidence that the relationship between depression and body mass – at least as measured by BMI – may be U-shaped (de Wit 2009; Zhao 2009). We ran several sensitivity analyses to examine whether the largely null associations between depression and body composition were due to nonlinearity. We found no evidence of a U-shaped relationship between depression and any measure of body composition in this sample. Additional prospective studies of the relationship between depression and body composition are necessary to understand the specific mechanisms of this association (e.g., health behaviors such as dietary intake (Carty et al. 2011), physiologic alternations including hypercortisolism (Weber-Hamann et al. 2002; Fernandez-Rodriguez, Stewart & Cooper, 2009)). This study adds to the growing body of research on the interrelationships between depression, frailty and related conditions among older adults (Schillerstrom, Royall & Palmer, 2008; Katz 2004).

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Table 1

Depression and body composition among ECA participants aged 60 and older.

	Lifetime major depression	Never major depression	<i>p</i> -Value
<i>N</i>	10	87	
Number of episodes (mean, SD)	14.8 (29.1)	2.7 (14.6)	< 0.001
Lifetime antidepressant use	6 (60.0)	22 (25.6)	0.023
Age (mean, SD)	69.1 (5.7)	71.7 (6.7)	0.268
Female	7 (70.0)	58 (67.4)	0.870
White	7 (70.0)	56 (65.1)	0.758
Current smoker	3 (30.0)	14 (16.3)	0.282
PASE score (mean, SD)	3.4 (2.7)	3.1 (3.3)	0.577
BMI, kg/m ² (mean, SD)	28.7 (4.6)	30.5 (6.5)	0.566
Waist circumference, inches (mean, SD)	37.9 (4.3)	39.5 (6.2)	0.405
Total lean mass (mean, SD)	46029.3 (13155.6)	48517.6 (10827.0)	0.717
Total fat mass (mean, SD)	27170.0 (7028.5)	30738.9 (10954.5)	0.429
Central lean mass (mean, SD)	23606.7 (6107.0)	25395.3 (5600.4)	0.447
Central fat mass (mean, SD)	14000.8 (2960.1)	16224.6 (6339.7)	0.348
Has any medical device	2 (20.0)	16 (18.4)	0.915

Notes: Values are *N*(%) unless otherwise noted. Number of depressive episodes > 0 for never MD group because this includes episodes of bereavement.

Total *N* = 84 for central mass and total *N* = 78 for total mass due to excluding participants with medical devices in the trunk region or any region, respectively.

PASE: Physical Activity Scale for the Elderly, BMI: Body Mass Index.

p-Values derived from Mann-Whitney tests for continuous variables and chi-squared tests for categorical variables.

Table 2

Association between major depression and body composition among older community-dwelling adults.

	Total fat mass (kg)		Central fat mass (kg)		Total lean mass (kg)		Central lean mass (kg)	
	B (95% CI)	p-Value	B (95% CI)	p-Value	B (95% CI)	p-Value	B (95% CI)	p-Value
Women								
Lifetime history of depression (ref. never)	-5.3 (-16.4, 5.8)	0.35	-3.6 (-7.3, 0.2)	0.06	-6.4 (-14.5, 1.7)	0.12	-3.3 (-6.3, -0.2)	0.04
Race (ref. White)	2.6 (-3.3, 8.6)	0.39	-0.6 (-3.8, 2.7)	0.74	0.1 (-4.2, 4.3)	0.97	-1.0 (-3.4, 1.4)	0.41
Age (years)	-0.8 (-1.2, -0.4)	50.01	-0.5 (-0.7, -0.2)	50.01	-0.6 (-0.9, -0.4)	50.01	-0.3 (-0.5, 0.2)	50.01
Current smoker (ref. no)	-8.2 (-17.1, 0.5)	0.07	-4.5 (-8.4, -0.7)	0.02	-3.6 (-10.9, 3.6)	0.33	-1.9 (-5.7, 1.9)	0.34
PASE activity score	-0.3 (-1.2, 0.6)	0.54	-0.3 (-0.8, 0.2)	0.32	-0.1 (-0.7, 0.5)	0.77	-0.1 (-0.4, 0.2)	0.39
Total N	52		57		52		57	
Men								
Lifetime history of depression (ref. never)	0.4 (-8.2, 8.9)	0.93	-0.3 (-5.2, 4.6)	0.92	3.7 (-4.5, 11.8)	0.38	1.9 (-3.5, 7.4)	0.48
Race (ref. White)	-1.5 (-14.0, 11.0)	0.81	-1.7 (-8.2, 4.9)	0.62	6.4 (-4.7, 17.6)	0.27	2.3 (-3.5, 8.1)	0.43
Age (years)	0.1 (-1.0, 1.2)	0.90	-0.1 (-0.5, 0.4)	0.80	-0.1 (-1.1, 0.8)	0.80	-0.1 (-0.4, 0.3)	0.78
Current smoker (ref. no)	-2.6 (-12.4, 8.3)	0.70	-0.9 (-6.4, 4.6)	0.76	-1.9 (-12.2, 8.3)	0.71	-0.1 (-5.1, 5.0)	0.98
PASE activity score	-0.4 (-2.0, 1.3)	0.65	-0.4 (-1.2, 0.5)	0.39	-0.1 (-1.5, 1.4)	0.97	-0.1 (-0.8, 0.7)	0.89
Total N	26		27		26		27	

Notes: Values are beta coefficients (95% confident intervals) derived from 1000 bootstrap iterations.

Coefficients are adjusted for all variables in the table.

Excludes 12 participants with medical devices in the trunk region (central lean and fat mass) and 18 participants with devices in any region (total fat and lean mass).

PASE: Physical Activity Scale for the Elderly.