THE RELATIONSHIP BETWEEN DIABETES AND DEPRESSIVE SYMPTOMS IN THE SOUTHERN COMMUNITY COHORT STUDY

By

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CHAPTER 1

INTRODUCTION

The association of depression and diabetes is a well-documented relationship (Gavard, Lustman and Clouse, 1993; Anderson, Freedland, Clouse & Lustman, 2001; Nichols & Brown, 2003). Gavard et al (1993) found a significantly higher rate of depression among diabetics than the general population. Subsequent meta-analyses showed that the odds of depression among diabetics can be up to twice that of non-diabetics (Anderson et al, 2001). Furthermore, comorbid depression in diabetics has been associated with adverse health outcomes, such as diabetes complications (de Groot, Anderson, Freedland, Clouse & Lustman, 2001), increased health care expenditures (Egede, Zheng & Simpson, 2002), and poor diabetes control (Vand Der Does et al, 1996; Lustman, Griffith, Clouse & Cryer, 1986; Lustman et al, 2000). However, the majority of studies to date have used primarily Caucasian populations. There is a lack of data examining the comorbidity of depression and diabetes among African Americans and other minorities (de Groot & Lustman, 2001).

Ethnic background is a known risk factor in the development of type 2 diabetes. African-Americans have an increased prevalence of type 2 diabetes when compared to Caucasian populations (American Diabetes Association [ADA], 1996, Carter, Pugh & Monterrosa, 1996), with African Americans being 1.6 times more likely to have diabetes than Whites (Center for Disease Control and Prevention [CDC], 2002). One in four African American women over 55 years of age has diabetes (CDC, 2002), and the rate of type 2 diabetes is growing fastest in ethnic minorities (ADA, 1996). African Americans have higher rates of complications of diabetes, such

as cardiovascular disease, blindness, kidney failure and amputation (ADA, 1996). African-Americans also have higher rates of morbidity and mortality associated with diabetic complications (ADA, 1996).

While there are clear ethnic disparities in diabetes prevalence, evidence of disparities in depression is not as conclusive. Ethnic differences in prevalence rates of depression have been found in several studies (Callahan & Wolinsky, 1994; Dunlop, Song, Lyons, Manheim & Chang, 2003), but not in others (Murrell, Himmelfarb, & Wright, 1983; Zung, MacDonald, & Zung, 1998). After controlling for sociodemographic, health and economic variables in a sample of pre-retirement adults, African-Americans were found to have significantly lower rates of depression than Whites (Dunlop et al, 2003). In a study of elderly adults, Caucasian subjects were more likely to have a prevalence of lifetime depression than African Americans (Blazer, Hughes, & George, 1987). However, other studies find no ethnic differences in rates of depression and depressive symptoms (Murrell, Himmelfarb, & Wright, 1983; Zung, MacDonald, & Zung, 1998). African-American ethnicity may be a risk factor for diabetes, but it does not appear to be a consistent risk factor for depression.

Socioeconomic status, however, has been shown to have a clear relationship with depression and depressive symptoms (Adler et al, 1994; Everson, Maty, Lynch & Kaplan, 2002; Lorant et al, 2003). Lorant et al's (2003) meta-analysis of socioeconomic inequalities in depression suggests that low SES may increase the risk for an episode of depression, and it may play a stronger role in the persistence of depression. Other studies have shown greater depressive symptomatology and prevalence of major depression at lower levels of SES (Bruce, Takeuchi, & Leaf, 1991; Stansfeld & Marmot, 1992). In addition to depression, low SES has been related to a higher risk of type II diabetes (Cowie & Eberhardt, 1995; Brancati, Whelton, Kuller, & Klag,

1996; Connolly, Unwin, Sherriff, Bilous, & Kelly, 2000). The relationship between health, depression and SES is not found in just the lowest social strata; there is evidence of a graded relationship along the entire socioeconomic continuum (Adler et al, 1994).

The Southern Community Cohort Study (SCCS) is a prospective cohort study examining racial disparities in chronic disease among Blacks and Whites in the Southeastern U.S. The study, consisting of primarily low-income participants, encompasses seven Southeastern states: Tennessee, Mississippi, Georgia, Alabama, South Carolina, Louisiana, and Florida. Approximately 21,000 participants are currently enrolled in Phase 1 of this multi-center investigation. Phase 2 will incorporate an additional population-representative sample using phone interviews as a means of recruitment (www.southerncommunitystudy.org).

The aim of the present study was to examine the relationship between diabetes and depressive symptoms in a large sample of low-income adults from phase 1 of the SCCS. From this analysis, we hypothesize that 1) the risk of depression will be significantly higher in participants with a diagnosis of diabetes; 2) the risk of depression or elevated depressive symptoms will increase as socioeconomic status decreases; and 3) depression and elevated depressive symptoms will be more prevalent among Whites than African-Americans, after controlling for socioeconomic status.

CHAPTER II

METHODS

Participants and Procedures

The sample used in the current study was from Phase 1 of the Southern Community Cohort Study and included baseline self-report data from 20,953 participants. During Phase I, SCCS participants were recruited through federally-funded community health centers. Patients and visitors to the health centers that are aged 40-79 and not currently diagnosed with a terminal disease were eligible for inclusion in the study. Participation initially involved a 30-40 minute computer-assisted personal interview. The baseline interview was conducted at the time of enrollment into the study. Informed consent was required, and participants also agreed to be contacted every other year to answer a follow-up questionnaire.

Measures

The SCCS baseline questionnaire collected information about participants' sociodemographic background, heath status, height and weight, psychosocial status, health behaviors other variables. Sociodemographic characteristics examined in the current study were ethnicity, age, gender and socioeconomic status. Ethnicity data were used to classify subjects into three categories: African-American only, White only (non-Hispanic), and other. Ethnicity data were recoded to include two variables in the statistical analyses: black (black versus not black) and white (white versus not white). Black was defined by participants identifying themselves as only African-American on the SCCS questionnaire, and white was defined by

participants identifying themselves as Caucasian. Black was coded "0" for being other than African-American, and "1" for being African-American. White was coded "0" for being other than Caucasian and "1" for being Caucasian.

Variables measuring socioeconomic status included household income reported as falling into a range (< $15,000, $15,000-$25,000, $25,000-$50,000, $50,000-$100,000, or > $100,000) and education (<9 years; 9-11 years; completed High School, or GED; Vocational, Technical, or Business training; Some college or Junior college; Graduated from college; Graduate school up to and including a Masters degree; Graduate school beyond a Masters degree. Education was converted to years of schooling finished and annual family income was converted to dollars per year using midpoints of the categories.

Health was also assessed via the structured SCCS interview. Diabetes status was based on participants' self report of "having been told by a doctor that you have diabetes" (coded "0" for no diabetes and "1" for diabetes). Diabetes was present in 21.1% of the cohort (16.1% AA males, 25.0% AA females, 19.0% White males, 21.1% White females; see Table 1). Body mass index (BMI=kg/m2) was computed from self-reported height and weight and a categorical variable was created to represent underweight (BMI < 20), optimal weight (20 < BMI < 25), overweight (25 < BMI < 30), obese (30 < BMI < 35), very obese (35 < BMI < 40), and extremely obese (BMI < 40). Health behaviors included reports of current smoking (coded "0" for non-smoking and "1" for smoking).

Depression was assessed using the short form Center for Epidemiological Studies Depression Scale (CES-D). The short form CES-D is a 10-item self-report measure of depressive symptoms (coefficient alpha = .80). The short form has been shown to have reliability and validity comparable to the long CES-D form, and it is considered a good instrument for

screening depression in older adults (Irwin et al, 1999). The measure uses a zero-to-three response scale, with total symptom severity scores ranging from 0 (no depression) to 30 (severe depression). A cutoff of 10 was used in this study, such that subjects with scores of 9 or less were not considered clinically depressed. Symptom severity scores of 10 or greater indicated a probable case of depression.

Statistical analyses

First, bivariate analyses were used to examine the relationship between diabetes, ethnicity, and depression. Hierarchical linear regression analyses were then used to predict depression scores. Finally, binary logistic regression was used to predict probable cases of depression. All regressions were conducted separately on males and females as previous literature suggests that there are important gender differences in the determinants of depression (Nolen-Hoeksema, 1990; Kessler, McGonagle, Swartz, Blazer & Nelson, 1993). The analytic strategy was to first control for demographic factors, then socioeconomic status, BMI, and smoking. Diabetes was entered into the model at the end of the analyses. The critical test was whether, after controlling for demographics, SES, BMI & smoking, the diagnosis of diabetes contributed to the prediction of depression. All analyses were conduced using SPSS version 12.0 (SPSS inc., Chicago, IL).

CHAPTER III

RESULTS

Description of sample

Characteristics of the study sample are presented by gender and ethnicity in Table 1. The sample consisted of both men (42.3%) and women (57.7%) and included Whites (14.9%), African-Americans (82.8%) and Other or mixed ethnicities (2.4%). Ages ranged from 40-79, with a mean age of 52.0 (SD ±8.9). Mean years of education in this sample was 11.6 (± 2.9), and the mean household income was $19,000 (± $14,000).

Tests on means were conducted using a two-way analysis of variance with two levels of gender (male, female) and three levels of ethnicity (White, African-American, Other). All significant results are denoted in Table 1.

Bivariate Analyses

In this sample, depression scores from the CES-D ranged from 0 to 30, with a mean of 9.0 (± 5.8). The sample distribution of CES-D scores are presented in Figure 1. Means and standard deviations for CES-D scores are shown in Table 2.

CES-D scores were subjected to a two-way analysis of variance having two levels of diabetes (not diabetic, diabetic) and three levels of ethnicity (White, African-American, Other). The main effect of diabetes yielded an F ratio of $F(1, 20952) = 8.163$, $p < .005$, indicating that mean CES-D scores were significantly greater for diabetics than for non-diabetics. The main effect of ethnicity yielded an F ratio of $F(2, 20952) = 27.26$, $p < .001$, indicating that CES-D

scores differed significantly between Whites, African-Americans and Others. The interaction effect of gender by ethnicity was also significant, $F(2, 20952) = 3.82$, $p < .05$. Post hoc analyses using the Fisher LSD post hoc criterion for significance indicated that African-Americans had lower CES-D scores than Whites ($p < .001$) or Others ($p < .005$).

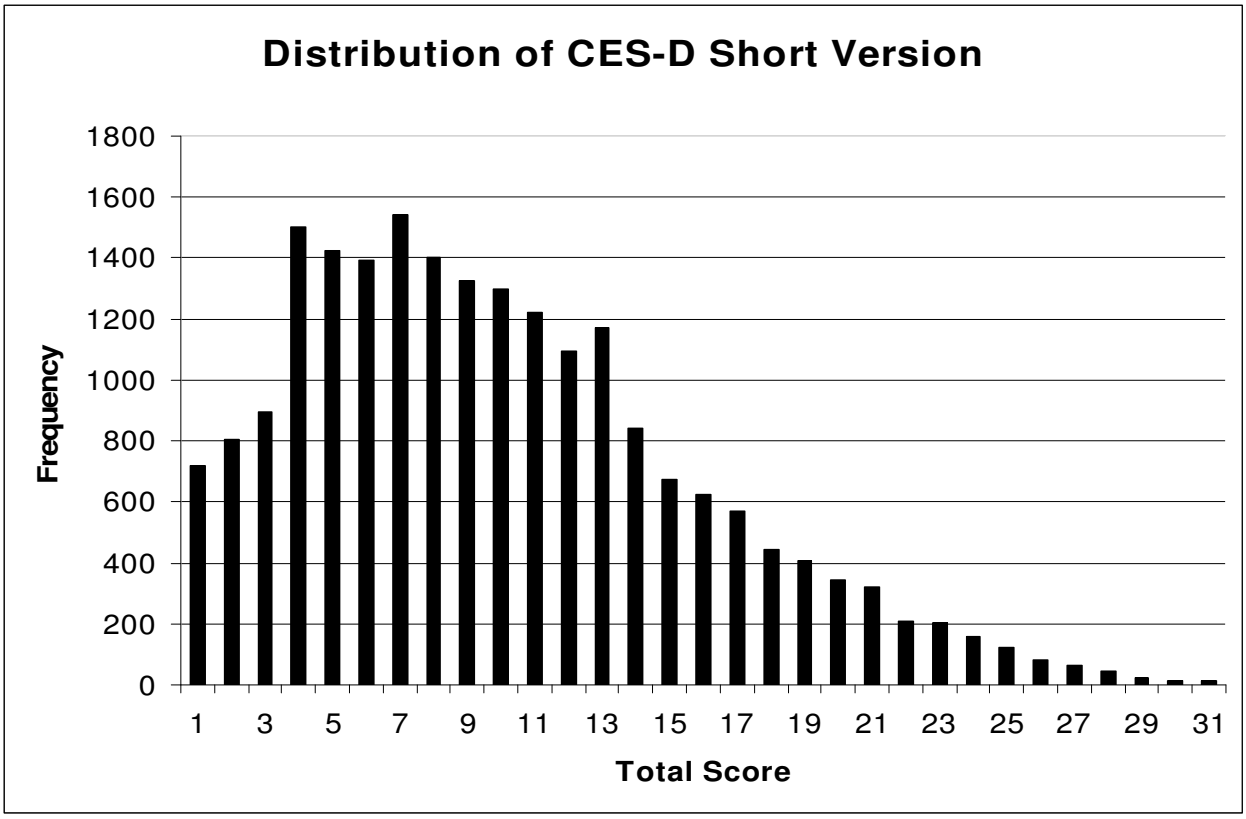

Figure 1. Distribution of Southern Community Cohort CES-D scores. The sample is comprised of 21,953 persons from seven southeastern states.

Table 1
Summary of SCSS characteristics

	White		Black		Other		Total
	n (%) or mean (sd)		n (%) or mean (sd)		n (%) or mean (sd)		
	Male (n = 1153)	Female (n = 1959)	Male (n = 7506)	Female (n =9835)	Male (n = 208)	Female (n =292)	N = 20953
Sociodemographics							
Age $_{G,E}$	53.0 (9.6)	54.6 (9.5)	50.7 (8.0)	52.3 (9.0)	50.6 (8.4)	52.9 (8.9)	52.0 (8.8)
Yrs of Education $_{E}$	11.7 (3.3)	11.7 (2.9)	11.5 (2.9)	11.7 (2.9)	12.2 (3.2)	12.2 (3.4)	11.6 (2.9)
Income $_{G,E}$	$21,179 (16,333)	$21,403 (16,377)	$18,944 (13,384)	$18,763 (12,844)	$23,076 (19,641)	$23,835 (19,258)	19,321 (13,839)
BMI $_{G,E,GxE}$	28.3 (6.4)	30.7 (7.9)	27.3 (5.9)	32.5 (8.0)	27.5 (7.0)	32.2 (8.3)	30.2 (7.8)
Sample Characteristics							
Diagnosis of diabetes $_{G,GxE}$	219 (19.0%)	413 (21.1%)	1206 (16.1%)	2460 (25.0%)	42 (20.2%)	79 (27.1%)	4419 (21.1%)
Currently smokes $_{G,GxE}$	656 (56.9%)	785 (40.1%)	4657 (62.0%)	3266 (33.2%)	124 (59.6%)	96 (32.9%)	9584 (45.7%)

G = Males and females differ, $p < .05$
E = Ethnic groups differ, $p < .05$
GxE = A significant gender by ethnicity interaction, $p < .05$

A Chi-square analysis revealed that the proportion of probable cases of depression (PCD) was significantly lower in female African-Americans than other female ethnic groups in comparison to their non-depressed counterparts, χ^2 (2, N = 12086) = 10.89, p < .001. Males, however, did not significantly vary in their proportion of probable cases of depression [χ^2 (2, N = 8867) = 2.32, ns]. Group size and percentages of probable depression by gender and ethnic group are also presented in Table 2.

Hierarchical regressions

Using hierarchal linear regression to predict depression scores for females, demographics (i.e. age, education, income) initially captured 8.4% of the variance in step 1 (p < .001). Added variance accounted for was 0.9% for ethnicity (p < .001), and 0.9% for smoking (p < .001). In males, demographics (i.e. age, education, income) initially captured 6.2% of the variance in step 1 (p < .001). Added variance accounted for was 0.3% for ethnicity (p < .001), and 0.3% for smoking (p < .001). After controlling for demographics, SES, ethnicity, BMI and smoking, a diagnosis of diabetes captured 0.3% of the variance in females (p < .001), and 0.2% of the variance in males (p < .001). Results of both regressions are presented in Table 3.

Table 2
CES-D scores and cases of probable depression by gender and ethnicity

Variable	White n(%) or Mean (sd)	Black n(%) or Mean (sd)	Other n(%) or Mean (sd)	Total n(%) or Mean (sd)
CES-D score				
Overall	9.6 (6.6)	8.8 (5.7)	9.7 (6.4)	9.0 (5.8)
Males	8.8 (5.9)	8.5 (5.2)	8.7 (5.8)	8.5 (5.3)
Females	9.7 (6.9)	9.0 (5.9)	10.3 (6.8)	9.3 (6.2)
Diabetes	10.5 (6.6)	9.1 (5.9)	10.1 (6.2)	9.3 (6.0)
No diabetes	9.4 (6.5)	8.8 (5.6)	9.6 (6.4)	8.9 (5.8)
Probable depression				
Overall	1357 (43.6%)	7059 (40.7%)	231 (46.2%)	8647 (41.3%)
Males	461 (40%)	2858 (38.1%)	86 (41.3%)	3405 (38.4%)
Females	896 (45.7%)	4201 (42.7%)	145 (49.7%)	5242 (43.4%)
Diabetes	306 (48.4%)	1551 (42.3%)	63 (52.1%)	1920 (43.4%)
No diabetes	1051 (42.4%)	5508 (40.3%)	168 (44.3%)	6727 (40.7%)

Table 3
Summary of Hierarchical Regression Analysis for Variables Predicting CES-D depression scores

Variable	R^2	ΔR^2	B	95% CI	β
		Males (n = 8867)			
Step 1	.062	.062			
Age			-0.113	-.127, -.099	-.176**
Income			0	.000, .000	-.118**
Education (yrs)			-0.206	-.246, -.167	-.113**
Step 2	.065	.003			
Black			-0.428	-1.137, .282	-.029
White			0.413	-.347, 1.174	.026
Step 3	.065	0			
BMI			.007	-.012, .026	.008
Step 4	.069	.003			
Smoking			0.731	.489, .972	.067**
Step 5	.07	.002			
Diabetes			0.587	.282, .891	.041**
		Females (n = 12086)			
Step 1	.084	.084			
Age			-1.32	-.145, -.120	-.196**
Income			0	.000, .000	-.143**
Education (yrs)			-0.265	-.304, -.225	-.125**
Step 2	.093	.009			
Black			-1.871	-2.554, -1.189	-1.18**
White			-0.53	-1.251, .191	-.032
Step 3	.093	0			
BMI			.021	.007, .035	.027**
Step 4	0.102	.009			
Smoking			1.349	1.110, 1.587	.104*
Step 5	0.105	.003			
Diabetes			0.879	.624, 1.135	.061**

*p < .005, **p < .001

Logistic regressions

Probable depression was analyzed separately by gender using binary logistic regression. Analyses are presented in table 4. All significant values are for $p < .001$.

Step 1 in the regression included age, income and education. The odds ratio in both males and females was .96 for age, 1.00 for income and .91 for education. Age and education appeared to have a protective effect, as the risk of being classified as depressed decreased as age and education increased in both genders. Step 2, including ethnicity, was only significant in females. The odds ratio for being African-American in females was .62, such that being African-American and female decreased the risk of a probable case of depression. However, the odds ratio for being White and female was not significant. Neither being African-American nor White had a significant effect in males. Step 3 included BMI, which was not significant for either gender. Smoking was included in Step 4. Smoking increased the odds ratio to 1.47 in females and 1.23 in males. This suggests that those who smoke have a higher risk of being classified as depressed than non-smokers.

Finally, after controlling for age, income, education, and smoking, diabetes was entered into the regression. The odds ratio for diabetes was 1.16 in males and 1.29 in females. These results indicate that diabetes increases the risk of a probable case of depression in both genders.

Table 4
Summary of Binary Logistic Regression Analysis for Variables Predicting Probable Depression

Variable	B	95% CI	Exp (B)
	Males (n = 8867)		
Step 1			
Age	-.04	.955, .967	.961**
Income	0	1.000, 1.000	1.000**
Education (yrs)	-.087	.901, .932	.916**
Step 2			
Black	-0.263	.575, 1.028	0.769
White	-.051	.696, 1.298	0.951
Step 3			
BMI	.004	.996, 1.012	1.004
Step 4			
Smoking	0.208	1.115, 1.361	1.232**
Step 5			
Diabetes	0.151	1.206, 1.319	1.163*
	Females (n = 12086)		
Step 1			
Age	-.038	.958, .967	.963**
Income	0	1.000, 1.000	1.000**
Education (yrs)	-.092	.899, .925	.912**
Step 2			
Black	-0.487	.480, .787	.615**
White	-0.209	.625, 1.054	0.812
Step 3			
BMI	.004	.999, 1.009	1.004
Step 4			
Smoking	0.383	1.348, 1.596	1.467**
Step 5			
Diabetes	0.251	1.173, 1.409	1.285**

*p < .005, **p < .001

CHAPTER IV

DISCUSSION

The results of the present study confirm a relationship between diabetes and depressive symptoms in this low-income cohort, but the strength of the association is relatively weak. Gender, SES, and smoking are more important risk factors for depression than knowing you have been diagnosed with diabetes. Despite the weak association, both males and females with diabetes in this study are more likely to be classified as a probable case of depression than non-diabetics in this sample. Furthermore, after controlling for age, education, income, race/ethnicity and smoking, diabetes is more of a risk factor for depression in females (28.5%) than males (16.3%).

Some research shows that diabetes may increase the risk of depression twofold (Anderson et al, 2001), while our results only show a 16-28% increased risk. There are several reasons why the relationship between diabetes and depression in the SCCS may not be as strong as in other studies. There are varying methods of recruiting subjects in the diabetes/depression literature, including relying on smaller samples from private hospitals instead of community health centers. Additionally, methods of identifying depression and depression severity (e.g. self-report versus a clinical diagnosis) vary from study to study, potentially affecting results.

However, perhaps the most important explanation lies in the sociodemographic makeup of the study participants. The majority of the Southern Community Cohort sample is comprised of a low socioeconomic group: 85.5% of the sample had a household income of less than $25,000 last year, and 69.1% of the sample had a high school education or less. Low educational

levels and economic distress may actually overshadow the effects of diabetes in this cohort. The prevalence of depression, as defined by a CES-D score greater than or equal to 10, is 41.3% in the SCCS sample. Even with a more sensitive cutoff point of 15, approximately 17.4% of the sample would qualify as a probable case of depression. Nationally, the prevalence rate of depression has been estimated to be about 9.5% (Robins & Regier, 1990). A high rate of probable depression in this study is consistent with previous studies showing a relationship between low SES and depression (Everson et al, 2002, Lorant et al, 2003).

Across all ethnic groups in this study, females had higher mean CES-D depression scores and had a higher risk of probable depression than males, confirming previous findings in the depression literature (Nolen-Hoeksema, 1990; Kessler, McGonagle, Swartz, Blazer & Nelson, 1993). Overall, African-Americans had lower depression scores and were less likely to be classified as a possible case of depression. However, examining these results by gender and after controlling for socioeconomic status and age, being classified as African-American only appeared to be a protective factor in females. Ethnicity did not play a significant role in depression among males in this sample.

Several limitations of the current study should be noted. First, the use of the short form CES-D may play a role in the high prevalence rates of probable depression in this sample. Using a self-report symptom scale to determine a probable case of depression may have inflated depression rates in comparison to a psychiatric diagnosis of depression. Second, while the CES-D has been shown to have adequate measurement adequacy among different ethnic groups (Radloff, 1977), there is some evidence that African-Americans have a skewed response distribution towards less symptomatology (Foley, Reed, Mutran & DeVellis, 2002). Additionally, one item in the 10-item version of the short form (‘mind’) has been shown not to

load on the four-factor structure among African-American women (Callahan & Wolinsky, 1994). The latter two methodological issues may help explain the difference in scores between ethnic groups, particularly among females, in this study. A factor analysis of the short form CES-D may be useful to determine if the four-factor structure holds up in this investigation.

Other limitations of the current study include the possibility of undiagnosed diabetes in the sample, the inability to distinguish between type 1 and type 2 diabetes in the SCCS questionnaire and the specific sample used in the Southern Community Cohort Study. Even though the sample (older, low SES African-Americans) that comprises the SCCS sample is large, it is also unique; the results from this study may not generalize to more diverse socioeconomic groups. Future research in this area should include members from a wide array of the socioeconomic strata in order to make more direct comparisons between groups.

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