A Prospective Study of Parentally Bereaved Youth, Caregiver Depression, and Body Mass Index

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ABSTRACT

Objective: To examine the relationship between body mass index (BMI) in bereaved youth and nonbereaved controls 5 years after a parent's death. The study was conducted from August 9, 2002, through December 31, 2013.

Design: A prospective, longitudinal, controlled study of the effects of sudden parental death on youth.

Setting: Bereaved families were recruited through coroner records and by advertisement. Nonbereaved families were recruited using random-digit dialing and by advertisement.

Participants: 123 parentally bereaved offspring were compared with 122 nonbereaved control offspring, all of whom were aged 11–25 years at the 5-year assessment.

Main Exposure: Bereavement status, type of parental death (accident, suicide, or sudden natural death), and history of depression in caregivers prior to parental death.

Outcome Measures: BMI categories (normal, overweight, and obese), according to International Obesity Task Force guidelines for adults and Centers for Disease Control and Prevention guidelines for children, and *DSM-IV* psychiatric disorder in offspring and caregivers before and after time of parental death.

Results: Bereaved offspring were more likely to have a BMI in the obese range compared to nonbereaved controls ($\chi^2_2 = 7.13$, $P < .01$). There were no differences in BMI category by death type among bereaved offspring. Caregiver history of depression was a significant correlate of offspring obesity in nonbereaved youth but had a protective effect on the BMI of bereaved youth.

Conclusions: Bereaved youth were more likely to be obese than nonbereaved youth 5 years after parental death, and caregiver history of depression was associated with increased risk for obesity in nonbereaved youth only. Future studies are necessary to identify mechanisms that increase risk for obesity in parentally bereaved youth.

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Approximately 4% of US children (2.5 million) will experience the death of one of their parents by the age of 18 years,[1] an experience consistently rated as one of the most stressful life events for children[2,3] and one associated with a number of adverse psychosocial sequelae. Retrospective, record-linkage, and prospective studies all show a significant relationship between parental death and internalizing and externalizing symptoms, impaired school performance, and sexual-risk behavior in children.[4–12] The few prospective studies examining the impact of parental loss on children have found heightened risk for psychiatric disorder, most notably depression, posttraumatic stress disorder, alcohol or substance use, and prolonged grief disorders and impairment 5–12 years after the death.[13–16] Family adversity, including parental bereavement, has been associated with health-risk behaviors and an abnormal physiologic response to stress.[17,18] However, there are no retrospective or prospective studies that have examined the associations between parental bereavement and obesity.[19]

Parental bereavement may confer risk for obesity through several pathways. First, bereaved youth have an increased risk for depression, which in turn has been associated with a higher risk for obesity,[20,21] particularly for females.[22,23] Second, parental bereavement puts the surviving caregiver at increased risk of depression, complicated grief, and functional impairment.[14–16] These conditions could lead to lower parental monitoring, which in turn has been associated with a range of poor health outcomes, including obesity.[24–26] Because obesity is partially genetically determined, the type of parental death may also increase risk for obesity in bereaved offspring[27] whose parents died by cardiac events.

This study investigated the association between body mass index (BMI) and parental bereavement in a sample of 123 bereaved offspring and in 122 nonbereaved offspring. It was hypothesized that bereaved offspring would be more likely to have a BMI in the obese range compared to their nonbereaved counterparts. Exploratory analyses were conducted within the bereaved group to investigate differences in BMI by parental death type (parental death due to suicide [n = 45], accident [n = 27], or sudden natural death [n = 51]). Analyses were also conducted to examine whether offspring or caregiver depression moderated the effect of bereavement on offspring BMI. We predicted that bereaved offspring who experienced depression before or after parent death or who had caregivers with depression before or after parent death would be more likely than bereaved offspring without these psychiatric risks to have a BMI in the obese range.

METHOD

Study Sample

This report examines 245 bereaved and nonbereaved offspring, 57.4% of youth originally recruited for a longitudinal study of the

effect of parental bereavement on offspring psychiatric outcomes,[14,15] who completed psychiatric interviews and health measurements at the 5-year assessment. These offspring were from 86 parentally bereaved families and 70 nonbereaved families and were between the ages of 11 and 25 years at the 5-year assessment (offspring aged 6–20 years living with primary caretakers were enrolled into the original study). Deceased parents (probands) were between the ages of 28 and 63 years, were predominantly male (83%), and died within 24 hours of definite verdicts of suicide (n = 30), accidental death (n = 20), or sudden natural death (n = 36). The nonbereaved offspring had 2 living biological parents, lived in the home of at least 1 parent (82.8% lived with both parents), and had no first-degree relatives who had died within the 2 years prior to recruitment.

Offspring who participated in this study (N = 245) were similar to those lost to follow-up (n = 182) on baseline demographic and psychiatric characteristics, except that those lost to follow-up were more likely than those retained to be parentally bereaved (65.4% vs 50.0%), to be older (13.8 years vs 12.9 years), to be female (55.5% vs 45.3%), to have a history of abuse (9.9% vs 2.9%), and to have a proband with a lifetime history of alcohol or substance disorder (59.3% vs 49.2%). However, bereavement status was the only variable of the 5 identified that was related to BMI in the current report. Next, we examined differences in demographic and psychiatric characteristics between bereaved offspring included in this report and those lost to follow-up. Those bereaved offspring who were lost to follow-up were more likely than those retained to have a caregiver with a history of alcohol or substance disorder (32.1% vs 16.7%), to have a caregiver of minority status (28.4% vs 11.7%), and to have had a proband with a history of an anxiety disorder (28.3% vs 16.4%). Again, none of these variables were related to BMI in the overall sample or in the bereaved offspring included in the current report.

Participant Recruitment

Probands were identified from the coroner's office or via advertisement, with an overall acceptance rate of 71%.[14] Families in which there were multiple deaths or injuries, or ambiguous accidents, such as single-passenger vehicular accidents, were excluded. Control probands were recruited through random-digit dialing or newspaper advertisement with an overall acceptance rate of 55%[14] and were frequency-matched to the deceased probands by neighborhood, age, and gender. The caregivers of bereaved offspring were the surviving parents, while the caregivers of the nonbereaved offspring were self-identified as the primary caregiver. This study was approved by the University of Pittsburgh Institutional Review Board, and all participants and parents/legal guardians gave written informed consent or assent.

Procedure

Offspring and caregivers completed a structured diagnostic interview and questionnaires assessing psychiatric symptoms, health-risk behaviors, and other measures of well-being at the 5-year assessment. Offspring height and weight were directly measured by a same-sex interviewer.

Clinical Points

- Physicians should be aware that bereaved children may be at increased risk for obesity.
- Bereaved youth may benefit from closer monitoring of diet and physical activity to prevent excessive weight gain.
- Bereaved youth and their caregivers may benefit from psychoeducation about the association between negative emotions, stress, and eating behavior.

Measures

Psychiatric diagnostic status. Psychiatric disorders in adult offspring and caregivers were assessed using the Structured Clinical Interview for *DSM-IV* Axis I Disorders (SCID-I).[28] Offspring younger than 18 years were interviewed using the Schedule for Affective Disorders and Schizophrenia for School-Age Children–Present and Lifetime Version.[29] At study entry, caregivers and offspring reported on their history of psychiatric disorders prior to the time of proband death. All psychiatric and physical health information before proband death was based on retrospective report. Psychiatric assessment of the proband was conducted using a psychological autopsy procedure[30] and the caregiver's retrospective report on the SCID-I.[28] The course of disorders after proband death in the offspring and caregivers was documented using the Longitudinal Interval Follow-Up Evaluation.[31] High interrater reliability was maintained on psychiatric diagnoses ($\kappa = 0.74–0.85$).

Diagnostic data were collapsed into 2 time periods: (1) offspring, proband, and caregiver psychiatric disorders before proband death and (2) offspring and caregiver psychiatric disorders after proband death. Four categories of psychiatric disorders were investigated in offspring and caregivers: depression (major depressive disorder, dysthymia, and depressive disorder not otherwise specified), anxiety (generalized anxiety disorder, social phobia), posttraumatic stress disorder, and alcohol or substance use disorders. Table 1 outlines the demographic characteristics of offspring and caregivers in the 5 years after proband death, and Table 2 outlines the psychiatric and physical health characteristics of offspring and caregivers in the 5 years after proband death. Because the psychiatric characteristics of the offspring, caregivers, and probands before death have been presented in previous articles,[14,15] these data are included as supplemental material (see Supplementary eTable 1 at PSYCHIATRIST.COM).

Body mass index. Offspring height was obtained using the Seca 214 portable stadiometer, and offspring weight was measured using the Seca 813 physician floor scale (Seca Corp; Hanover, Maryland). Height and weight measurements were obtained in stocking feet (without shoes). Body mass index was calculated, using weight in pounds and height in inches, as $[(\text{weight} \times 703)/\text{height}^2]$.[32] The BMI for adult offspring (≥ 21 years of age) was classified as normal weight (BMI of 18.5 to < 25), overweight (BMI of 25 to < 30),

Table 1. Demographic Characteristics of Bereaved and Nonbereaved Offspring and Surviving Caregivers in the 5 Years After Proband Death (N = 245)

Demographic Characteristic	Families With Parental Death	Comparison Families	Statistic
Caregivers	(n = 84)	(n = 72)	
Sex, female, % (n/n)	86.7 (72/83)	75.0 (54/72)	$\chi^2_{1,155} = 3.50$
Age, mean (SD), y	43.8 (8.2)	42.9 (6.1)	$F_{1,155} = 0.53$
Minority status, % (n/n)	14.5 (12/83)	13.9 (10/72)	$\chi^2_{1,155} = 0.01$
Socioeconomic status, mean (SD)[a]	47.0 (10.3)	43.2 (12.3)	$F_{1,99} = 2.59$
Offspring	(n = 123)	(n = 122)	
Sex, male, % (n/n)	56.1 (69/123)	53.3 (65/122)	$\chi^2_{1,245} = 0.20$
Age, mean (SD), y	18.3 (3.8)	17.4 (3.1)	$F_{1,241} = 3.91$*
Minority status, % (n/n)	17.1 (21/123)	15.6 (19/122)	$\chi^2_{1,245} = 0.10$
History of abuse, % (n/n)	15.4 (18/117)	3.5 (4/115)	$\chi^2_{1,232} = 9.58$**
Body mass index, % (n/n)			$\chi^2_{2,245} = 7.13$**
Normal	47.2 (58/123)	63.1 (77/122)	
Overweight	21.1 (26/123)	18.0 (22/122)	
Obese	31.7 (39/123)[b]	18.9 (23/122)	

[a]According to the Hollingshead Four Factor Index of Social Status.
[b]Post hoc analyses indicate significantly more bereaved offspring in the obese category compared to nonbereaved offspring: normal versus obese ($\chi^2_{2,245} = 6.76$**), normal versus overweight ($\chi^2_{2,245} = 1.79$), overweight versus obese ($\chi^2_{2,245} = 0.85$).
*$P = .05$. **$P < .01$.
Abbreviation: SD = standard deviation.

Table 2. Psychiatric and Physical Health Characteristics of Bereaved and Nonbereaved Offspring and Surviving Caregivers in the 5 Years After Proband Death (N = 245)

Clinical Characteristic	Families With Parental Death, % (n/n)	Comparison Families, % (n/n)	Statistic
Caregivers	(n = 84)	(n = 72)	
Depression	67.5 (54/80)	27.9 (17/61)	$\chi^2_{1,141} = 24.75$***
Anxiety	38.5 (30/78)	14.8 (9/61)	$\chi^2_{1,139} = 9.83$**
Alcohol/substance disorder	15.8 (12/76)	6.6 (4/61)	$\chi^2_{1,137} = 2.80$
Posttraumatic stress disorder	35.9 (28/78)	4.9 (3/61)	$\chi^2_{1,138} = 18.96$***
Chronic illness	46.1 (35/76)	45.0 (27/60)	$\chi^2_{1,136} = 0.02$
Offspring	(n = 123)	(n = 122)	
Depression	51.6 (63/122)	18.2 (22/121)	$\chi^2_{1,243} = 29.90$**
Anxiety	28.1 (34/122)	15.8 (19/121)	$\chi^2_{1,243} = 5.28$*
Alcohol/substance disorder	19.0 (23/121)	8.3 (10/120)	$\chi^2_{1,241} = 5.81$*
Posttraumatic stress disorder	17.4 (21/121)	0.8 (1/120)	$\chi^2_{1,241} = 19.83$***
Chronic illness	19.2 (23/122)	13.9 (17/120)	$\chi^2_{1,242} = 1.20$

*$P < .05$. **$P < .01$. ***$P < .001$.

or obese (BMI ≥ 30), in accordance with the International Obesity Task Force recommendations.[33] The BMI classification for child offspring (< 21 years of age) was based on their BMI percentile, which was adjusted for age and sex in accordance with the Centers for Disease Control and Prevention guidelines.[34] Normal weight was indicated by a BMI of less than the 85th percentile, overweight was indexed by a BMI in the 85th to < 95th percentile, and obese was indicated by a BMI ≥ 95th percentile. One participant in the nonbereaved group had a BMI in the underweight range and was not included in the analyses.

Covariate Measurements

Age, sex, minority status (ie, nonwhite), socioeconomic status (as indexed by the Hollingshead Four Factor Index of Social Status),[35] and history of physical or sexual abuse were assessed via interview concurrent with the weight and height measurements. Offspring and caregivers also completed a health history questionnaire[36,37] that assessed chronic medical illness. Chronic illness was operationalized as the presence of 1 of the following: epilepsy, asthma, diabetes, cardiac problems, hypertension, renal disease, thyroid problems, rheumatologic problems, and pulmonary problems.[38,39]

Analytic Strategy

Univariate analyses were conducted to compare bereaved and nonbereaved offspring on BMI, a dummy-coded variable with 2 categories: overweight versus normal weight and obese versus normal weight. A χ^2 test or analysis of variance was conducted to examine associations between BMI category and (1) demographic variables; (2) psychiatric histories of offspring, caregivers, and probands prior to time of death; (3) presence of chronic medical illness in offspring and caregivers; and (4) psychiatric disorders in offspring and caregivers after proband death. Multinomial logistic regression was used to evaluate differences in BMI categories between bereaved and nonbereaved offspring, while controlling for other significant covariates. This study was powered to detect a small effect size ($d = 0.36$) between bereaved and nonbereaved groups. We used the mlogit procedure (multinomial logistic regression) in Stata 12.0,[40] with subjects nested within families. Variables that were associated with offspring BMI category were included as covariates. Age and sex of offspring were not significantly associated with BMI category; however, these variables were accounted for when BMI percentiles were determined for offspring less than 21 years of age. Secondary analyses examined (1) differences in BMI category among the bereaved offspring based on proband death type with statistical power to detect a medium effect size ($d = 0.65$) and (2) the association between BMI and caregiver depression.

Multivariate analyses were conducted using an imputed data set. The Stata ICE command-line package[41] was used to generate an imputed dataset for the 245 participants by the chained equations method, with unique equations generated for each variable using all significant correlates of the variable to be imputed.

RESULTS

Table 1 illustrates the significant difference between bereaved and nonbereaved offspring for BMI category. Post hoc comparisons indicate that bereaved offspring were more likely than nonbereaved offspring to have a BMI in the obese rather than the normal weight category (31.7% vs 18.9%; $\chi^2_2 = 7.13$, $P < .01$). Among bereaved offspring, no significant differences in BMI categories based on proband death type were found ($\chi^2_3 = 2.88$, $P = .58$).

Table 3 presents the demographic, psychiatric, and physical health characteristics of offspring by BMI category, and Table 4 outlines these characteristics in the probands and

Table 3. Demographic, Psychiatric, and Physical Health Characteristics of Offspring Shown by Body Mass Index Category (N = 245)

Characteristic	Normal-Weight Offspring (n = 135)	Overweight Offspring (n = 48)	Obese Offspring (n = 62)	Statistic
Demographic				
Sex, male, % (n/n)	56.3 (76/134)	52.1 (25/48)	53.2 (33/62)	$\chi^2_{2,245} = 0.33$
Age, mean (SD), y	17.5 (3.22)	18.0 (3.34)	18.5 (4.07)	$F_{2,241} = 1.75$
Minority status, nonwhite, % (n/n)	15.6 (21/134)	22.9 (11/48)	12.9 (8/62)	$\chi^2_{2,245} = 2.12$
Clinical				
Before proband death, % (n/n)				
Depression	11.1 (15/135)	13.0 (6/46)	11.3 (7/62)	$\chi^2_{2,243} = 0.13$
Anxiety	7.4 (10/135)	8.5 (4/47)	8.1 (5/62)	$FET_{2,244} = 0.22$
Alcohol/substance disorder	0.0 (0/134)	0.0 (0/46)	1.6 (1/62)	$FET_{2,242} = 2.67$
Posttraumatic stress disorder	0.0 (0/135)	4.3 (2/47)	1.6 (1/62)	$FET_{2,244} = 4.90$[a]
Chronic illness	17.9 (24/134)	18.8 (9/48)	27.4 (17/62)	$\chi^2_{2,244} = 2.46$
After proband death, % (n/n)				
Depression	29.9 (40/134)	38.3 (18/47)	43.5 (27/62)	$\chi^2_{2,243} = 3.78$
Anxiety	21.1 (28/133)	19.1 (9/47)	26.2 (16/61)	$\chi^2_{2,241} = 0.93$
Alcohol/substance disorder	14.3 (19/133)	14.9 (7/47)	11.5 (7/61)	$\chi^2_{2,241} = 0.35$
Posttraumatic stress disorder	7.5 (10/133)	8.5 (4/47)	13.1 (8/61)	$FET_{2,241} = 1.65$
Abuse	9.4 (12/128)	4.3 (2/46)	13.8 (8/58)	$FET_{2,232} = 2.56$
Chronic illness	14.3 (19/133)	14.6 (7/48)	23.0 (14/61)	$\chi^2_{2,242} = 2.44$

[a]The *P* value for this analysis was *P* = .051, but, because of the low number of cases in the analysis, it was discounted.
Abbreviations: FET = Fisher exact test, SD = standard deviation.

Table 4. Psychiatric and Physical Health Characteristics of Probands and Caregivers Shown by Offspring Body Mass Index Category (N = 245)†

Characteristic	Normal-Weight Offspring (n = 135), % (n/n)	Overweight Offspring (n = 48), % (n/n)	Obese Offspring (n = 62), % (n/n)	Statistic
Probands				
Depression	39.4 (52/132)	27.1 (13/48)	37.1 (23/62)	$\chi^2_{2,242} = 2.33$
Anxiety	23.7 (32/135)[a,b]	33.3 (15/45)[b]	11.5 (7/61)[a]	$\chi^2_{2,241} = 7.41$‡
Alcohol/substance disorder	43.9 (58/132)	53.2 (25/47)	54.8 (34/62)	$\chi^2_{2,241} = 2.51$
Posttraumatic stress disorder	10.4 (14/135)	10.4 (5/48)	6.6 (4/61)	$FET_{2,244} = 0.76$
Caregivers				
Before proband death				
Depression	38.0 (46/121)	37.8 (17/45)	45.0 (27/60)	$\chi^2_{2,226} = 0.91$
Anxiety	20.2 (25/124)	33.3 (15/45)	33.3 (20/60)	$\chi^2_{2,229} = 5.10$
Alcohol/substance disorder	19.7 (24/122)	27.9 (12/43)	17.2 (10/58)	$\chi^2_{2,223} = 1.87$
Posttraumatic stress disorder	8.5 (6/71)	5.9 (2/34)	12.2 (5/41)	$FET_{2,146} = 0.93$
After proband death				
Depression	45.4 (54/119)[b]	40 (18/45)[a,b]	66.7 (38/57)[a]	$\chi^2_{2,221} = 9.15$*
Anxiety	18.8 (22/117)	34.1 (15/44)	30.4 (17/56)	$\chi^2_{2,217} = 5.21$
Alcohol/substance disorder	9.6 (11/115)	20.5 (9/44)	5.5 (3/55)	$FET_{2,214} = 5.51$
Posttraumatic stress disorder	13.8 (16/116)[a]	17.8 (8/45)[a,b]	32.1 (18/56)[b]	$\chi^2_{2,217} = 8.24$‡
Chronic illness	37.5 (42/112)[a]	54.5 (24/44)[a]	54.7 (29/53)[a]	$\chi^2_{2,209} = 6.16$*

†Items with different superscripted letters (a or b) are statistically different from each other at the *P* = .05 level.
‡*P* < .10. **P* < .05.
Abbreviation: FET = Fisher exact test.

caregivers of offspring on the basis of offspring BMI category. Two covariates, history of chronic illness in caregivers ($\chi^2_2 = 6.16$, *P* = .045) and caregiver depression after proband death ($\chi^2_2 = 9.15$, *P* = .010), were associated with offspring BMI category. Post hoc pairwise comparisons indicated that caregiver chronic medical illness ($\chi^2_2 = 6.11$, *P* = .004) and caregiver depression after proband death ($\chi^2_2 = 7.00$, *P* = .003) were significantly related to offspring obesity. Contrary to our hypotheses, offspring depression after bereavement was not related to BMI category ($\chi^2_2 = 3.78$, *P* = .151). Proband, offspring, and caregiver history of depression before proband death were not significantly related to BMI category, but these variables were included in the final model because of the well-documented relationship in the literature between depression and obesity[21] and between parental depression and child obesity.[42,43]

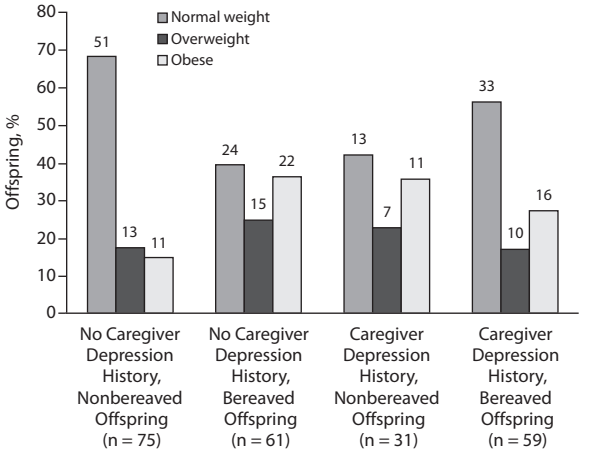
A multinomial logistic regression that included bereavement status, covariates (history of offspring, caregiver, and proband depression prior to proband death; history of chronic illness in caregiver; caregiver depression after proband death), and interaction terms for bereavement status and each of the covariates was conducted. Backward stepwise regression was

Table 5. Results From Multinomial Logistic Regression With the Final Parsimonious Model Predicting Body Mass Index Categories[a] Within the Bereaved and Nonbereaved Groups

Predictor	RRR (95% CI)	*t*	*P*
Overweight			
Bereavement status[b]	2.61 (1.07–6.38)	1.19	.035
Caregiver history of depression before proband death	1.92 (0.55–6.66)	1.03	.303
Bereavement status × caregiver history of depression before proband death	0.26 (0.05–1.28)	−1.66	.098
Obese			
Bereavement status[b]	4.78 (2.12–10.80)	3.77	.000
Caregiver history of depression before proband death	3.88 (1.35–11.16)	2.52	.012
Bereavement status × caregiver history of depression before proband death	0.14 (0.04–0.57)	−2.77	.006

[a]The outcome variable, body mass index category, was dummy-coded into 2 categories, overweight and obese, with normal weight as the referent condition.
[b]Bereavement status served as the independent variable and was introduced as a dummy variable, with nonbereaved offspring as the referent condition.
Abbreviation: RRR = relative risk ratio.

Figure 1. The Relationship of Offspring Bereavement Status and Incidence of Surviving Caregiver History of Depression to Body Mass Index Categories in the Offspring



utilized to identify the most parsimonious set of correlates of offspring BMI category. In the final model, bereavement status continued to be significantly associated with offspring obesity (Table 5). Caregiver history of depression was also significantly related to offspring obesity for the entire sample, indicating that offspring whose caregiver had a history of depression were more likely to have a BMI in the obese compared to normal category.

A significant interaction between bereavement status and caregiver history of depression before proband death was related to offspring obesity, although not in the expected direction (see Table 5). The relative risk ratio (RRR) < 1 suggests that bereaved offspring with caregivers who had a history of depression before proband death were more likely to have a BMI in the normal versus obese category. Conversely, nonbereaved offspring with caregivers who had a history of depression were more likely to have a BMI in the obese as compared to normal category. These differences are illustrated in Figure 1. Post hoc logistic regression also confirmed that, among nonbereaved offspring, caregiver age at first onset of depression was negatively associated with offspring obesity (RRR = 0.996, $z = -2.53$, $P = .01$), suggesting that nonbereaved offspring with caregivers who experienced depression at younger ages were more likely to have a BMI in the obese as compared to normal category.

DISCUSSION

Parentally bereaved offspring were more likely to be obese compared to nonbereaved offspring. Within the bereaved group, there were no differences among BMI categories between offspring whose parent died by sudden natural death, accident, or suicide. In the overall sample (bereaved and nonbereaved), offspring whose caregiver had a history of depression prior to proband death were more likely to have a BMI in the obese compared to normal category. Unexpectedly, bereaved offspring with caregivers who had a history of depression before proband death were more likely to have a BMI in the normal versus obese category. Nonbereaved offspring with caregivers with a history of depression, however, were more likely to have a BMI in the obese rather than normal range.

This study is limited by having an assessment of youth BMI only at 5 years after parental death. Therefore, it is unknown which youth were obese prior to parental death, what was the extent of change in BMI after parental death, and whether stressors leading to a parent's sudden death (psychiatric or chronic illness) were more important determinants of future obesity in offspring than the traumatic experience of parental sudden death. Future studies that examine changes in offspring BMI after bereavement are necessary to validate the findings in this report. Similarly, this study did not collect information about caregiver BMI, parenting style, parental monitoring, diet, physical activity, or food preferences, all of which are implicated in the development of obesity.[26,44–48] Results from this study need to be interpreted cautiously because a high percentage of bereaved offspring were lost to follow-up. However, none of the variables that differentiated those lost to follow-up from those retained in the current study were related to BMI, except bereavement status. As such, it is possible that our results may underestimate the association between parental bereavement and obesity.

In this study, parentally bereaved offspring were more likely to be obese than nonbereaved offspring. Importantly, the relationship between bereavement and obesity remained significant even after controlling for offspring and caregiver psychiatric history before and after proband death. This finding suggests that psychiatric disorders occurring in offspring and in their caregivers after parental death did not account for the relationship between bereavement and obesity. However, the specific pathways by which bereaved youth are at risk for obesity remain unclear. Other factors such as parenting style and parental monitoring of diet, physical activity, or screen time may be important to consider since caregivers of parentally bereaved youth are

often single parents. Future studies that explore parenting style and parenting behavior, such as preparing healthful meals, monitoring children's screen time and activity level, and setting limits on children's consumption of high-fat low-nutrient food, may elucidate the pathway between parental bereavement and obesity.

It is well established in the literature that parental depression has a negative impact on a broad range of child outcomes.[42,43] Indeed, the current study found a relationship between caregiver history of depression and offspring obesity in the overall sample, and it found that caregiver history of depression was associated with increased risk for obesity in nonbereaved youth. However, it was surprising to find that having a caregiver with a history of depression increased the likelihood among bereaved offspring of having a BMI in the *normal* rather than obese range. One interpretation is that a history of caregiver depression may be associated with increased social support and/or increased use of psychiatric services that may subsequently decrease the risk for negative health outcomes in bereaved offspring. In control families, caregiver history of depression may not be related to increased social support or service utilization in the absence of an acute negative life event, such as the death of a spouse. With the data available to us, we conducted post hoc analyses to test the hypothesis regarding whether bereaved families with caregivers with a history of depression may have more social support than those with caregivers with no history of depression. In the bereaved offspring group, caregivers with a history of depression reported higher levels of social support than caregivers with no history of depression before proband death ($F_{1,117} = 2.71$, $P = .005$). However, there was no significant interaction between caregiver history of depression and social support in predicting offspring BMI category. As expected, there were no differences in social support between caregivers with or without a history of depression in the nonbereaved group. Although future studies are necessary to identify the pathways by which caregiver history of depression may promote normal weight in bereaved offspring, these data suggest an association between social support and caregiver history of depression in the families of parentally bereaved youth.

This study supports parental bereavement and caregiver depression as potential risk factors in the development of childhood obesity. Because of the lack of information about prebereavement BMI and consideration of parental monitoring of food and physical activity, it is possible that parental bereavement is not causally associated with youth obesity. Future studies are necessary to replicate our findings. Still, physicians should be aware that bereaved children may be at increased risk for obesity and may benefit from closer monitoring of diet and physical activity. Similarly, bereaved youth may benefit from support groups that focus on the associations between negative emotions, stress, and eating behavior. Caregivers of bereaved youth may also benefit from psychoeducation regarding physical activity as a coping strategy for bereaved children and suggestions for monitoring bereaved children's daily caloric intake.

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Supplementary material: Supplementary eTable 1 is available at PSYCHIATRIST.COM.

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Supplementary Material

Article Title: A Prospective Study of Parentally Bereaved Youth, Caregiver Depression, and Body Mass Index

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List of Supplementary Material for the article

1. eTable 1 — Psychiatric and Physical Health Characteristics of Parents, Caregivers, and Offspring in Families before Proband Death and of Nonbereaved Comparison Families

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Supplementary eTable1. Psychiatric and Physical Health Characteristics of Parents, Caregivers, and Offspring in Families before Proband Death and of Nonbereaved Comparison Families

Proband Characteristics	**Families with Parental Death (n=86)**	**Comparison Families (n=70)**	**Statistic**
Depression (%, n)	40.7% (35)	27.9% (19)	X^2 (n = 154, df = 1) = 2.71
Anxiety (%, n)	18.8% (16)	27.9% (19)	X^2 (n = 153, df = 1) = 1.78
Alcohol/ Substance Disorder (%, n)	58.3% (49)	41.4% (29)	X^2 (n = 154, df = 1) = 4.37*
PTSD (%, n)	11.6% (8)	7.0% (6)	X^2 (n = 155, df = 1) = 0.99
Caregivers Characteristics	**Families with Parental Death (n=84)**	**Comparison Families (n=72)**	**Statistic**
Depression (%, n)	48.2% (40)	29.0% (18)	X^2 (n = 145, df = 1) = 5.43*
Anxiety (%, n)	33.7% (28)	14.3% (9)	X^2 (n = 146, df = 1) = 7.16**
Alcohol/ Substance Disorder (%, n)	20.5% (16)	23.8% (15)	X^2 (n = 141, df = 1) = 0.22
PTSD (%, n)	9.6% (8)	7.9% (5)	X^2 (n = 145, df = 1) = 0.13
Chronic Illness (%, n) TP0	50% (41)	42.9% (27)	X^2 (n = 145, df = 1) = 0.73
Offspring Characteristics	**Families with Parental Death (n=123)**	**Comparison Families (n=122)**	**Statistic**
Depression (%, n)	14.8 % (18)	8.3% (10)	X^2 (n = 243, df = 1) = 2.51
Anxiety (%, n)	9.8 % (12)	5.8% (7)	X^2 (n = 244, df = 1) = 1.34
Alcohol/ Substance Disorder (%, n)	0% (0)	0.8% (1)	FET (n = 242, df = 1) = 0.50
PTSD (%, n)	1.6% (2)	0.8% (1)	FET(n = 244, df = 1) = 1.00
Chronic Illness (%, n) TP0	18.9% (23)	22.1% (27)	X^2 (n = 244, df = 1) = 0.40

* p<0.05

** p<0.01