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MATERNAL DEPRESSIVE SYMPTOMS IN CHILDHOOD AND OPENNESS TO EXPERIENCE IN ADULTHOOD*

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Abstract

We examined the role of maternal depressive symptoms reported during childhood as a predictor of an important personality trait, Openness to Experience (O), in middle adulthood. Participants were 95 adults (38 previously malnourished, 57 control, mean age 42.1 years) who had been followed longitudinally since childhood by the Barbados Nutrition Study. Maternal depressive symptoms had been measured when the participants were 5–11 years of age by the General Adjustment and Morale Scale; O was measured in adulthood by the Revised NEO-Personality Inventory (NEO-PI-R). Multiple regression analyses, adjusted for childhood household standard of living, showed a significant main effect on O of maternal depressive symptoms ($p < 0.01$). Maternal depression also attenuated the significant effect of childhood malnutrition by 14%. Maternal depressive symptoms in childhood may therefore play a causal role in adult personality, in particular Openness to Experience, with implications for creativity.

INTRODUCTION

Openness to Experience (O), is one of the five well-accepted dimensions of the Five-Factor Model (FFM) of personality (Digman, 1989; Goldberg, 1990; McCrae & Costa, 1997). O is

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a potentially significant outcome in the life-span context, not only because of its potential links to cognitive style and intelligence, but also because of its predictive associations with a wide range of important life outcomes, including creativity (Ozer & Benet-Martinez, 2006). The Openness to Experience (O) dimension reflects active imagination, aesthetic sensitivity, attentiveness to inner feelings, preferences for variety, intellectual curiosity, and independence of judgment (McCrae & Costa, 2010).

We recently evaluated the association between malnutrition in the first year of life and personality profile at mid-life in the context of the Barbados Nutrition Study (BNS), a 40-year longitudinal study that has followed a cohort who experienced moderate-severe malnutrition in the first year of life in tandem with a cohort of matched controls (Galler, Bryce, Waber, Hock, Exner, Eaglesfield, et al., 2010). Within the framework of the five major dimensions of personality, the previously malnourished participants had higher scores on Neuroticism and lower scores on Extraversion, Openness to Experience, and Conscientiousness than did the healthy controls despite long-term nutritional rehabilitation of the study participants.

Furthermore, we have previously reported that mothers of the malnourished children experienced more depressive symptoms than did mothers of the control children during childhood and adolescence (Salt, Galler, & Ramsey, 1988; Waber, Eaglesfield, Fitzmaurice, Bryce, Harrison, & Galler, 2011). These symptoms were associated with adverse child outcomes, such as lower school grades and teacher reports of impaired hygiene (Salt et al., 1988). Moreover, as adolescents, the previously malnourished children self-reported more symptoms of depression than their adequately nourished peers, and maternal depressive symptoms predicted adolescent depression (Galler, Bryce, Waber, Hock, Exner, Eaglesfield, et al., 2010). Maternal depression has salient impacts on child outcomes, including cognition and mood (England & Sim, 2009; Hammen & Brennan, 2003; Luoma, Tamminen, Kaukonen, Laippala, Puura, Salmelin, et al., 2001; Wachs, Black, & Engle, 2009). Importantly, maternal depression most likely modifies parenting behaviors, of relevance because of known relationships between these behaviors and personality traits in adulthood (Reti, Samuels, Eaton, Bienvenu, Costa, & Nestadt, 2002). Moreover, maternal depression can adversely affect child nutrition by reducing the frequency of breast feeding and contributing to the initial episode of malnutrition (Galler, Ramsey, Harrison, Brooks, & Weiskopf-Bock, 1998; Wachs, 2008).

Previous investigations of the developmental origins of general or universal personality traits have focused, to a large extent, on heritability (Bouchard & Loehlin, 2001; Jang, McCrae, Angleitner, Riemann, & Livesley, 1998), with estimates that up to 50% of the variation in adult personality traits may be attributable to genetic factors. Little longitudinal data are available, however, to provide estimates of the role of contextual factors in the evolution of adult personality profiles. The associations between maternal depressive symptoms and multiple areas of child development raise the question of whether these symptoms can have a long-term impact in terms of personality development.

Within the particular setting of the BNS, relationships among maternal depressive symptoms, infantile malnutrition, and adult personality are relevant. Maternal depressive

symptoms and infantile malnutrition may function as independent influences on adult personality. Alternatively, because of the known associations of childhood malnutrition and maternal depressive symptoms and between maternal depression and increased behavior problems in these children, maternal depressive symptoms could also contribute to the associations between infantile malnutrition and adult personality indirectly. If so, the association between childhood malnutrition and adult personality should be attenuated when maternal depressive symptoms are taken into account.

In the current study, therefore, we evaluated the association between maternal depressive symptoms in childhood and adult personality traits, with a focus on Openness to Experience, using data from the Barbados Nutrition Study. Openness to Experience was chosen as the focus because of its relevance to creativity. *The primary hypothesis is that maternal depressive symptoms in childhood predict a reduction in Openness to Experience in adulthood.* Openness to Experience was assessed by the NEO Personality Inventory Revised (NEO-PI-R) (Costa & McCrae, 1992), and maternal depressive symptoms by the General Adjustment and Morale Scale (Rundquist & Sletto, 1936; Salt et al., 1988).

METHODS

Design

The original case control design of the BNS, from which data for the current study were derived, was implemented as a group comparison. There were three waves of data collection during childhood and adolescence, and now a fourth in mid-life. Although measurement invariance has been demonstrated for the NEO-PI-R for individuals of differing levels of IQ within the normal range, such invariance is not assured for individuals with very low IQ scores. We therefore excluded any individuals whose estimated IQ's were < 70 for purposes of the present study.

Participants

The index group in the current report had been clinically diagnosed with Grade II-III protein-energy malnutrition (marasmus) and subsequently admitted to the Queen Elizabeth Hospital in Bridgetown, Barbados, at a median age of 7 months. Inclusion criteria were normal birth weight (> 2268 g), absence of pre- or post-natal complications, good Apgar scores, the absence of encephalopathic events during childhood and no further malnutrition or serious medical illness after the initial episode. These children were subsequently enrolled in a government--supported intervention program at the Barbados Nutrition Centre that followed them from infancy to 12 years old. The program provided nutrition education, subsidized milk, routine health care, and regular home visits (Ramsey, 1980, 2006). The control group was comprised of classmates of the index children who were matched by age (within 3 months), sex, and handedness. They met the same inclusion criteria and had no histories of malnutrition or other serious childhood diseases (based on obstetric and birth records, growth charts from birth onward, and childhood medical records). Study participants were studied up to three times during childhood and adolescence and again as adults.

Although they were recruited from the same neighborhoods and classrooms, the previously malnourished and control groups differed socioeconomically in childhood (Galler, Bryce, Waber, Zichlin, Fitzmaurice, & Eaglesfield, 2012; Galler & Ramsey, 1985). We therefore adjusted all analyses for potential effects of childhood standard of living. We did not adjust for adult socioeconomic status since we reasoned that it could reflect in part the effects of the primary outcomes being measured.

One hundred and twelve adults (54 from the index group and 58 from the healthy control group), totaling 43% of the original sample, participated in the adult wave of data collection and had been raised by their biological mothers, all of whom had provided self-reports of depressive symptoms during the first wave of data collection when these individuals ranged in age from 5 to 11. To assure representativeness of the sample, these 112 participants were compared with 146 individuals who had participated as children but not as adults. Even though they were no longer matched, there were no differences between participants and non-participants in the proportion of individuals who were malnourished versus controls, ages, childhood IQ, childhood standard of living, or maternal depressive symptoms in the first wave. Of these 112, 17 ($N = 16$ malnourished; $N = 1$ control) had estimated IQs in the range of intellectual disability and were thus excluded from the analyses, resulting in a final sample of 95 individuals, 38 from the previously malnourished group and 57 from the control group.

After complete description of the study to the subjects, written informed consent was obtained under the oversight of the Judge Baker Children's Center Human Research Review Committee (Assurance No. FWA 00001811). The Ethics Committee of the Barbados Ministry of Health also provided study approval.

MEASURES

Primary Outcome

The primary outcome was the score on the O domain, as assessed by the NEO-PI-R (Costa & McCrae, 1992), a 240-item self-report questionnaire that operationalizes the five factor model. Each of the five major domains is composed of six lower order "facets," each having eight items, roughly balanced as positive and negative items. Responses are based on a 5-point Likert-type scale, ranging from *strongly disagree* to *strongly agree*. Internal consistency (Cronbach's alpha) based on normative populations was 0.87 for the O domain; consistencies for the O facet scores range from 0.58 (O4:Actions) to 0.87 (O5:Ideas) (Costa & McCrae, 1992). Additional information regarding test-retest reliabilities and construct and predictive validity are available in the Professional Manual (Costa & McCrae, 1992). We scored the NEO-PI-R according to the protocol described in the manual (Costa & McCrae, 1992).

Because of possible cultural issues and variation in reading levels, questions were read to the participants by a single trained psychiatric nurse who clarified the question content, as needed. Three items, in particular, were modified to make them relevant to this sample.¹ To address potential fatigue, participants were given breaks and provided with juice and snacks. To assess cross-cultural applicability in the Barbadian cohort, raw domain scores were

converted to T-scores using United States normative means for adult males and females from the NEO-PI-R Professional Manual. The internal consistency was 0.65 for the O domain scale. The O T-score was 45.1 and facet T-score means ranged from 45.1 (O6) to 52.2 (O4), close to the means based on samples of US adults.

Maternal Depressive Symptoms

Maternal depressive symptoms during childhood were measured by the 24-item General Adjustment and Morale Scale (Rundquist & Sletto, 1936; Salt et al., 1988). The data were submitted to a factor analysis, and the first unrotated principal component appeared to represent depressive symptoms (Armor theta = 0.72). This factor showed high concurrent validity with the Zung Depression and Anxiety Scales in an independent sample of healthy Barbadian women (Galler, Harrison, Biggs, Ramseys, & Forde, 1999). Factor scores (mean = 0, $SD = 1$) were used in the analyses.

Socioeconomic Status

Childhood standard of living was obtained from the archival data in order to validate the representativeness of the sample relative to the original BNS sample. Childhood standard of living had been assessed by the 50-item *Barbados Ecology Questionnaire* (Galler et al., 2012; Galler & Ramsey, 1985), which elicited information on ecological conditions in the home, the educational level and employment history of the parents. This questionnaire was administered to parents of the participants and supplemented by home visits. Factor analysis yielded a household standard of living factor ($\theta = 0.86$) that included the following items (factor loading > 0.45): having or not having a refrigerator, bath, television, electricity, running water, closet, gas, or electric cooking fuel; number of bedrooms; number of rooms; weekly household food expenditure; type of toilet, and weekly household income. This factor was a salient discriminator among Barbadian households.

Statistical Analysis

Data were analyzed using SAS statistical software, version 9.2 (SAS 9.2 Intelligence Platform: System Administration Guide, Second Edition, 2010). Group differences between the previously malnourished group and comparisons were assessed by F tests from linear models implemented using PROC GLM in SAS. The effects of maternal depression and the history of malnutrition were assessed using multiple regression analyses (MRA), implemented using SAS PROC REG in SAS. We adjusted for childhood standard of living in all models. The significance level was set at $p < 0.05$ and we did not control for experiment-wise error in the analyses of the facet scores because they were viewed as exploratory.

RESULTS

As shown in Table 1, mothers of the previously malnourished individuals reported a higher level of symptoms of depression, and the previously mal-nourished individuals had lower

¹Three questions were not understood to the locals, and had to be modified, as follows: 52: I wouldn't enjoy vacationing in Las Vegas [a place where you do a lot of gambling, casinos]; 105: Sometimes I cheat when I play Solitaire [which we call Patience]; 119: I have no sympathy for panhandlers [whom we call beggars].

scores on O and on the component O5 facet. The previously malnourished individuals also had lower household standards of living during childhood.

The MRAs (see Table 2) indicated that maternal depressive symptoms documented in childhood were a significant predictor of O at age 42; adults whose mothers had self-reported higher levels of depression had lower levels of O. History of malnutrition was also a significant predictor of O, consistent with our prior report (Galler et al., 2013). When both maternal depression and the history of childhood malnutrition were included in the MRA, the effect of maternal depression remained significant. Comparison of the parameter estimates indicates that the effect of maternal depression was only minimally attenuated in this model, by approximately 10%. The effect of the malnutrition history was also reduced (by 14%) but now only approached significance in this model. The effect of sex was not significant, nor was the interaction between maternal depression and nutrition history ($p > 0.2$).

For the six facets comprising the O domain, maternal depressive symptoms were significantly associated only with O5, Openness to Ideas (Beta = -2.4 , SE = 0.8 , $p < 0.01$), as was the history of malnutrition (Beta = -4.6 , SE = 2.0 , $p < 0.05$). With both maternal depression and the history of malnutrition in the model, the effects of maternal depression was attenuated by 11% (Beta = -2.2 ; SE = 0.8 ; $p < 0.01$) and the malnutrition effect by 16% (Beta = -3.9 ; SE = 2.0 ; $p < 0.05$).

To illustrate the relationship between maternal depressive symptoms and O, individuals were classified as low or high on maternal depression by a median split calculated for the sample as a whole. Within the malnourished group, 61% of mothers reported high levels of depressive symptoms compared with 39% of mothers from the control group. Conversely, within the control group, 39% of mothers reported high levels of depressive symptoms with the majority (61%) reporting low levels of maternal depression. The difference in level of maternal depressive symptoms between previously malnourished and comparison groups was significant ($\chi^2 = 4.40$; $p < 0.05$). Figure 1 shows the mean O scores for the previously malnourished and comparison groups further stratified by level of maternal depression. O scores are higher in the comparison group than in the previously malnourished group. In the comparison group, O scores were higher in the low maternal depression group vs. the high depression group, whereas in the malnourished group, O scores were only slightly higher in the low depression group. As noted earlier, however, these trends were not discernible in terms of a test of interaction between maternal depression and nutrition history ($p > 0.2$).

To summarize, maternal depressive symptoms predicted reduced levels of O in adulthood, with Openness to Ideas (O5) being the only significant facet. The history of malnutrition was also associated with Openness scores in adulthood, but this effect was no longer significant when maternal depression was entered into the model.

DISCUSSION

In the current study, we report that maternal depressive symptoms in childhood predicted reduced levels of the broad domain of Openness to Experience in adulthood. This reduction

was independent of childhood socioeconomic characteristics and a history of childhood malnutrition, known to have significant effects on adult personality (Galler et al., 2013). Moreover, the significant effect of malnutrition on O scores was no longer present after maternal depression was added to the analysis. At a more specific facet level, O5: Openness to Ideas scores were reduced in adult participants whose mothers had reported high levels of depressive symptoms. This facet is indicative of limited intellectual curiosity and a reduction in “an active pursuit of intellectual interests for their own sake as well as a willingness to consider new, perhaps unconventional, ideas” (McCrae & Costa, 2010). As one of the five major adult personality traits, Openness to Experience (Costa & McCrae, 1992; McCrae & Costa, 1985) has been described as “the breadth, depth and permeability of consciousness, and in the recurrent need to enlarge and examine experience” (McCrae & Costa, 1997).

A significant asset of the Barbados Nutrition Study is its prospective design and the availability of detailed archival data, including maternal depressive symptoms, offering the rare opportunity to link childhood experiential variables to personality outcomes in middle age. However, the present study also has potential limitations. First, the adult sample includes just under half of the participants identified in childhood, raising questions about representativeness. We did not document meaningful differences, however, between those who participated as adults and those who did not on key childhood measures. Sample size may have limited power to detect associations in this study; in particular, the power to detect interactions was low. Second, reported associations while significant may not necessarily demonstrate causality. For example, common genetic factors might explain both maternal depression and reduced openness in the adult cohort.

Although childhood antecedents of adult personality have been largely unexplored, there is some evidence for contextual or environmental influence. There is currently empirical support, for example, for childhood antecedents of adult antisocial personality disorder (Cohen, Crawford, Johnson, & Kasen, 2005; Widiger, De Clercq, & De Fruyt, 2009). Parenting characteristics have also been linked to adult personality traits, using the NEO-PI-R (Reti et al., 2002). In a low socioeconomic group in Baltimore, Maryland, modest correlations between parenting and adult Neuroticism, Agreeableness, Conscientiousness, and Openness were reported. In this latter study, maternal restrictive behavior was the singular parental dimension associated with reduced Openness to Experience (versus other aspects of maternal care).

Maternal restrictive behaviors are common in the English-speaking Caribbean (Morrissey, 1998) and may be associated with higher levels of maternal depressive symptoms, a relationship which is yet to be confirmed in this setting. Importantly, as we reported previously (Salt et al., 1988; Waber et al., 2011)—and confirmed in the present study—maternal depressive symptoms in childhood and adolescence are increased in mothers of postnatally malnourished children from the Barbados Nutrition Study and are associated with poor school performance and poor attendance by their children. Maternal depression may also have antedated the malnutrition episode, and reduced the duration of breastfeeding, contributing to the original episode of malnutrition in the first year of life (Galler et al., 1998; Wachs, 2008). To our knowledge, there are no other reports describing the

relationship between early childhood malnutrition, maternal depressive symptoms, and adult personality.

In conclusion, maternal depressive symptoms in childhood appear to play a causal role in adult personality, in particular limiting Openness to Experience in adulthood, with implications for creativity.

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Figure 1.
Mean Openness T-scores classified by level of maternal depressive symptoms (median split) and history of infant malnutrition.

Table 1
Comparison of Participants Who Had a History of Malnutrition versus Those Who Did Not

	Comparisons <i>N</i> = 57	History of malnutrition <i>N</i> = 38	<i>F</i> -value	<i>p</i>
Males (%)	31 (54.39)	18 (47.37)	0.45 ^a	NS
Age (years)	42.09 ± 1.94	42.18 ± 1.96	0.05	NS
Maternal Depressive Symptoms (factor scores)	-0.23 ± 1.17	0.26 ± 1.06	4.29	< 0.05
O: Openness Total Score (T-scores)	47.60 ± 9.00	44.04 ± 6.24	4.48	< 0.05
OS: Openness to Ideas Score (T-scores)	48.11 ± 9.30	43.14 ± 8.42	7.00	< 0.01
Standard of Living in Childhood (factor scores)	-0.26 ± 0.81	-0.80 ± 0.90	9.36	< 0.01

^a χ^2 Analysis; all other analysis based on F-tests using PROC GLM in SAS.

Table 2

Summary of Multiple Regression Analyses Showing Contribution of Maternal Depression and a History of Malnutrition on Adult Openness Scores ($N = 95$)^a

	Beta	SE	<i>p</i>
<i>Model: Effect of Maternal Depressive Symptoms</i>			
Maternal Depression , uncorrected	−1.7	0.8	< 0.05
Maternal Depression , corrected for Malnutrition History	−1.6	0.7	< 0.05
<i>Model: Effect of Malnutrition History</i>			
History of Malnutrition , uncorrected	−3.5	1.8	< 0.05
History of Malnutrition , corrected for Maternal Depressive Symptoms	−3.0	1.8	0.05 < <i>p</i> < 0.10

^a All MRAs shown are corrected for household standard of living in childhood.