# The Effects of Family Functioning on Infant Birthweight

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A prospective cohort study was undertaken to evaluate the relationship of family functioning to infant birthweight adjusted for length of gestation. The mother's perception of family functioning was assessed at the initial prenatal visit using the Family Adaptability and Cohesion Evaluation Scales (FACES II). All obstetric patients at four family medicine clinics from April 1984 through April 1987 whose initial prenatal visits occurred by the 28th week of gestation were invited to participate; 95% chose to do so. Information was obtained on 833 mother-infant pairs. Listwise deletion on any one variable reduced the sample to 772 with no apparent bias in the dependent or predetermined variables. Twelve percent of the families were considered to be dysfunctional by scoring on the extremes of both the cohesion and adaptability continua of the self-report FACES II questionnaire. Infant birthweight was regressed on length of gestation and other known biomedical, anthropometric, risk-behavior, and sociodemographic determinants, as well as family functioning. Women who perceived their families as dysfunctional were delivered of infants who weighed on the average 126.4 g (95% CI 37.4, 215.4) less than infants born to women from functional families ($P = .0055$), after adjusting for other known determinants. Family functioning also was found to modify the effects of prepregnancy weight and infant sex on infant birthweight. *J Fam Pract 1991; 32:37-44.*

Low birthweight, intrauterine growth retardation (IUGR), and prematurity continue to be the most important determinants of survival of the newborn.[1–3] These factors account for 70% of all perinatal deaths in the United States that are not caused by severe congenital malformations.[2] There is strong evidence that low birthweight infants and infants suffering from IUGR are at considerably higher risk of morbidity during the first year of life[4,5] and of impaired physical and cognitive development well into childhood.[6,7] In the United States in 1979, low birthweight infants accounted for 7.4% of all live births,[1] with the proportion among nonwhites being 12.8%.[8]

In 1986 data were published showing an association between family functioning and infant birthweight adjusted for other known determinants,[9] with those women who perceived their families as "enmeshed" giving birth to infants weighing less than infants born to women from families with normal family functioning. Although the association was quite strong, it was based on a pilot study of only 102 mother-infant pairs.

Other researchers have reported the effects of various psychosocial factors on five different pregnancy outcomes: (1) overall pregnancy complications and adverse outcome, (2) perinatal death, (3) infant Apgar scores, (4) preterm delivery, and (5) infant birthweight, including low birthweight infants. These studies can be classified into three groups: studies of maternal anxiety and depression (usually based on psychoanalytic theory); studies of pregnancies that were planned or unplanned, wanted or unwanted; and studies of stress and social support. Overall pregnancy complications and adverse outcome have been associated with life stress,[10] a combination of high life stress and low social support,[11] and poor family functioning.[12] Perinatal death (but not infant birthweight) was correlated with negative maternal attitudes toward the pregnancy.[13] Low infant Apgar scores have been found to be related to maternal anxiety during the pregnancy.[14,15] Preterm delivery has been associated with negative maternal attitudes toward the pregnancy[16] and stressful life events.[17,18] Low birthweight has been associated with desire for the pregnancy,[19] major life stresses,[20] and a combination of family dysfunction and late prenatal care.[21]

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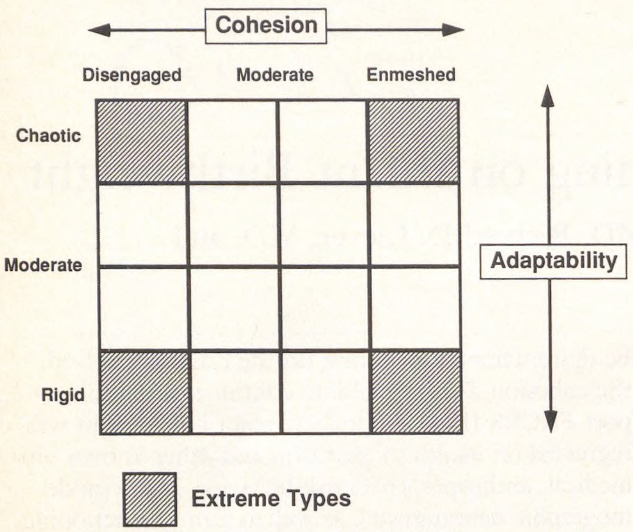


Figure 1. Circumplex model of marital and family systems. Adapted from Olson et al[28]

Previous studies have produced estimates of the effects of psychosocial factors on pregnancy outcome; these estimates have differed according to maternal sample characteristics: age, ethnicity, nationality, public or private clinic, and tertiary or primary care clinic. Though these studies have identified isolated variables that are important to explore, they have not yet advanced a theoretical understanding of pregnancy as a biopsychosocial process; instead, they address psychosocial issues from a rather narrow individualistic point of view.

There is a need to examine more closely the whole system of relationships that brings a baby into the world. Many of the predictor variables in the existing literature suggest a wider family context. Maternal anxiety and depression, pregnancy planning, and stress and support are all circumscribed by family relationships. The family environment is the context of the pregnant woman's nutrition, her compliance with prenatal health care, and other health-risk behaviors such as smoking, substance abuse, and exercise.

Ramsey[22] has presented a review of psychosocial influences on reproduction, including biologic pathways (via the nervous, immune, and endocrine systems) by which the family system may have an impact on fetal growth. Clover and colleagues[23–25] and Borysenko[26] have elaborated on the complex and delicate processes by which psychosocial events can affect the immune system.

Among the number of theories of family functioning that have been used to relate the family system to health,[27] the Circumplex Model of Marital and Family Systems[28] was chosen (Figure 1). The circumplex model posits that cohesion and adaptability are two of the most important dimensions of family systems. Cohesion is defined as "the emotional bonding that family members have toward one another," while adaptability is defined as "the ability of a marital or family system to change its power structure, role relationships, and relationship rules in response to situational and developmental stress."[28] These two dimensions are hypothesized to be related curvilinearally to family health; that is, the extremes of cohesion—termed *enmeshment* and *disengagement*—are theorized to be unhealthy, while the midrange is thought to be healthy. The same is hypothesized for adaptability, with the extreme ends of the continuum being labeled as *rigid* and *chaotic*.

The circumplex model posits 16 types of family functioning based on the cohesion and adaptability continua. There are three levels of family functioning—balanced, midrange, and extreme—diagrammed by concentric circles; the four extreme family types that make up extreme family dysfunction are labeled *chaotically disengaged, chaotically enmeshed, rigidly disengaged,* and *rigidly enmeshed.*

Pregnancy can be seen as a time when the family's boundaries are shifting (or are failing to shift) to accommodate a new member. According to the circumplex model, one would hypothesize that families at either extreme of cohesion or adaptability would not do well at navigating the transition of pregnancy and the birth of a child. If the family's cohesion is too weak, the mother and other family members may experience too much aloneness at a time when they need contact. On the other hand, if the cohesion is excessive, the anticipated presence of a new member may produce tension, discomfort, or lack of appropriate role shifts. Social support literature focuses on the lack of involvement of family members as being harmful to a pregnant mother. The family functioning literature attests that overinvolvement, or enmeshment, can also be dysfunctional.[29–31] With regard to adaptability, family life that is rigid may not allow for the many changes that need to occur, while chaos at home might not provide adequate structure to define clearly the emerging boundaries and roles. In addition, extremely rigid or chaotic families may hamper the accomplishment of special tasks during pregnancy such as prenatal care, extra rest, and nutrition.

In addition to family functioning, clearly there are other known biomedical, anthropometric, behavioral, and sociodemographic determinants of infant birthweight: maternal age,[32–34] maternal height,[34] prepregnancy weight and weight gain during pregnancy,[35,36] parity,[32,33] prior pregnancy history,[32,37,38] maternal health,[34] ethnicity,[9,33,35] socioeconomic status,[32–34] consumption of alcohol and other drugs,[39,40] and marital status.[9,41,42]

One of the major weaknesses of most of the studies cited above focusing on psychosocial factors is their lack of adjusting for the other known determinants of pregnancy outcome. This issue was a major critique in Campbell's 1986 work entitled "Family's Impact on Health: A Critical Review."[43]

Based on pilot data[9] and on a review of the studies cited above, two hypotheses are set forth. First, family functioning is associated with infant birthweight and preterm delivery after adjusting for other known determinants. More specifically, women from dysfunctional families manifesting the extremes of family functioning—chaotic disengagement, chaotic enmeshment, rigid disengagement, and rigid enmeshment—will tend to deliver infants that (1) weigh less per length of gestation, and (2) have shorter lengths of gestation, on the average, than infants born to women from families manifesting more moderate functioning. Second, family functioning is a modifier of the other major known determinants of infant birthweight. Specifically, (1) the positive effects of length of gestation, prepregnancy weight, and weight gain on infant birthweight will be lower, (2) the negative effects of highest systolic blood pressure and smoking on infant birthweight will be higher, and (3) the differences in birthweight due to sex and ethnicity will be less among women from dysfunctional families manifesting the four extremes listed above when compared with women from functional families.

## Methods

### *Subjects and Research Design*

Eight hundred thirty-three (833) patients were recruited at their initial prenatal visit at one of four University of Oklahoma Family Medicine clinics in Oklahoma City, Enid, and Shawnee, Oklahoma, from April 1984 through April 1987. All obstetric patients whose initial pregnancy visits took place by the 28th week of gestation were invited to participate in this prospective cohort study. Interviews were conducted at the first prenatal visit and again at approximately the 32-week visit. Data from each subsequent prenatal visit were abstracted from the medical record. Anthropometric measurements of the infant, including a Dubowitz[44] assessment of gestational age, were performed within 12 to 24 hours following delivery.

### *Statistical Analyses*

Infant birthweight (grams) was regressed on the gestational age of the infant (weeks), maternal ethnicity (African-American = 1, Anglo-American = 0), maternal prepregnancy weight (pounds), maternal weight gain (pounds), maternal height (inches) and age (years), parity, prior pregnancy history, sex of the infant (female = 1, male = 0), maternal highest systolic blood pressure during pregnancy (mm Hg), maternal smoking status, maternal socioeconomic status, maternal marital status, maternal consumption of alcohol and other drugs, and family functioning (dysfunctional family = 1, functional family = 0). When infant birthweight was regressed on length of gestation, the focus became not crude birthweight, but birthweight adjusted for gestational age. Alpha was set at .05.

Consistent with previous large studies,[45,46] women were classified as nonsmokers if they gave up smoking by the end of the first trimester of the current pregnancy. Smoking status was operationalized by a four-group classification distinguishing (1) nonsmokers, (2) smokers of 1 to 9 cigarettes per day, (3) smokers of 10 to 19 cigarettes per day, and (4) smokers of 20 or more cigarettes per day.

Family functioning was operationalized by a binary (1,0) classification of dysfunctional (extreme) and functional families based on scores from both the cohesion and adaptability dimensions of the Family Adaptability and Cohesion Evaluation Scales (FACES II).[47] The initial classification was to distinguish disengaged, moderate, and enmeshed families on the cohesion dimension, and chaotic, moderate, and rigid families on the adaptability dimension. Following the lead of Olson and colleagues,[48,49] adolescents and adults were normed separately. The lowest 15% of the scores on the cohesion dimension were classified as disengaged, the highest 15% were labeled as enmeshed, and the midrange scores were categorized as moderately cohesive. The lowest 15%, highest 15%, and midrange scores on the adaptability dimension were classified as rigid, chaotic, and moderately adaptable, respectively.

Families were classified as dysfunctional if scores were extreme on both the cohesion and adaptability subscales—the extreme types in the circumplex model (Figure 1). Thus, families were labeled as dysfunctional whose scores were any of the following four extremes: (1) enmeshed and chaotic, (2) enmeshed and rigid, (3) disengaged and chaotic, and (4) disengaged and rigid. This classification of extreme, dysfunctional families followed directly from the Circumplex Model of Marital and Family Systems.[28]

After the independent effect of family functioning on infant birthweight was seen, the sample was divided into functional and dysfunctional family groups, and infant birthweight was regressed on the major determinants. The resulting two equations allowed direct com-

Table 1. Sample Characteristics (Crude and Unadjusted)

| Characteristic | Total Sample (N = 772) Mean or Proportion | SD | Dysfunctional Family (n = 89) Mean or Proportion | SD | Functional Family (n = 683) Mean or Proportion | SD |
|---|---|---|---|---|---|---|
| Birthweight (g) | 3287.5 | 590.6 | 3275.1 | 516.3 | 3289.1 | 600.0 |
| Length of gestation (wk) | 39.0 | 2.1 | 39.3 | 1.8 | 39.0 | 2.1 |
| Ethnicity | | | | | | |
| Black = 1 | 0.41 | 0.49 | 0.36 | 0.48 | 0.42 | 0.49 |
| White = 0 | | | | | | |
| Prepregnancy weight (lb) | 137.1 | 34.4 | 144.7 | 38.7 | 136.1 | 33.7 |
| Weight gain (lb) | 34.0 | 15.5 | 35.1 | 21.5 | 33.8 | 14.5 |
| Sex | | | | | | |
| Female = 1 | 0.51 | 0.50 | 0.45 | 0.5 | 0.52 | 0.5 |
| Male = 0 | | | | | | |
| Highest systolic blood pressure (mm Hg) | 127.5 | 12.4 | 129.4 | 11.4 | 127.2 | 12.5 |
| Nonsmoker (1,0) | 0.68 | 0.47 | 0.72 | 0.45 | 0.66 | 0.47 |
| Smoke cigarettes | | | | | | |
| 1–9/d (1,0) | 0.11 | 0.32 | 0.08 | 0.27 | 0.12 | 0.32 |
| 10–19/d (1,0) | 0.12 | 0.35 | 0.13 | 0.34 | 0.12 | 0.32 |
| 20+/d (1,0) | 0.09 | 0.29 | 0.07 | 0.25 | 0.10 | 0.30 |
| Dysfunctional family (1,0) | 0.12 | 0.32 | | | | |

parison of the effects of each predetermined factor on infant birthweight by family functioning group; such a comparison provided estimates of the modifying effects of family functioning on the relationship between each predetermined factor and infant birthweight.

## Results

Ninety-five percent of the women invited to participate chose to do so. Information was obtained on 833 mother-infant pairs. The average levels found for infant birthweight and length of gestation (Table 1) are similar to those found in large studies focusing on low- and middle-income mothers giving birth at a public obstetric service.[34,35] A description of the mother-infant pairs in terms of key biomedical characteristics (Table 1) provides a foundation for decisions concerning generalizability.

One infant of the 833 was extremely heavy (6040 g) and was excluded as an outlier, as was one woman who lost 36 pounds during pregnancy. Listwise deletion of subjects resulting from missing data on any one variable reduced the sample from 831 to 772. It was assumed that missing variables were normally distributed; a comparison of the variables in the initial sample and the revised listwise-deletion sample revealed no detectable bias in the latter with regard to the dependent variable itself or to the variables determinant of infant birthweight.

There was no statistically significant difference in this study between the average infant birthweight of nonsmokers (3337 g) and smokers who quit during the first trimester (3298 g) of pregnancy ($P$ = .67); these latter women are classified as nonsmokers in this analysis.

The crude or unadjusted means (or proportions) presented in Table 1 are informative. Women who perceived their families as dysfunctional gave birth to infants who weighed, on the average, 14 g less (3289 g minus 3275 g) than women who perceived their families as functional. Clearly, when viewed in this manner, family functioning appears to make only a small difference. A view of the other characteristics pointed to potential confounders of this 14-g estimate. Women who perceived their family situation as dysfunctional when compared with women who perceived their families as functional were (1) able to carry their fetuses as long (39.3 vs 39.0 weeks of gestation, respectively), (2) less likely to be African-American (0.42 vs 0.36, respectively), (3) 8.6 pounds heavier at conception, (4) able to gain 1.3 pounds more during pregnancy, (5) less likely in this study to deliver a female infant (0.52 vs 0.45, respectively), and (6) more likely to be a nonsmoker (0.72 vs 0.66, respectively) (Table 1). Each of these potentially confounding factors was an advantage to the women from dysfunctional families, as each factor was positively associated with infant birthweight.

Women from dysfunctional families manifested a highest systolic blood pressure during pregnancy that was 2.2 mm Hg above those women from functional families. This elevated blood pressure was disadvantageous to the women living in dysfunctional family settings.

The small crude differences in birthweight between

Table 2. Major Biopsychosocial Determinants of Infant Birthweight

| Characteristic | Total Sample (N = 772) Regression Coefficient | SE | *P* | Dysfunctional Family (n = 89) Regression Coefficient | SE | *P* | Functional Family (n = 683) Regression Coefficient | SE | *P* |
|---|---|---|---|---|---|---|---|---|---|
| Infant birthweight (g) regressed on: | | | | | | | | | |
| Intercept | −3117.0 | 302.6 | .0001 | −2632.9 | 960.4 | .0076 | −3181.2 | 321.0 | .0001 |
| Length of gestation (wk) | 165.0 | 7.1 | .0001 | 154.5 | 22.3 | .0001 | 165.8 | 7.5 | .0001 |
| Black | −338.7 | 30.8 | .0001 | −368.3 | 92.3 | .0001 | −336.1 | 32.9 | .0001 |
| Prepregnancy weight (lb) | 3.7 | .5 | .0001 | 2.2 | 1.2 | .0670 | 3.9 | 0.5 | .0001 |
| Weight gain (lb) | 7.2 | 1.0 | .0001 | 7.0 | 2.0 | .0007 | 7.3 | 1.2 | .0001 |
| Highest systolic blood pressure | −4.1 | 1.3 | .0019 | −4.4 | 4.2 | .2943 | −4.0 | 1.4 | .0045 |
| Female sex | −108.1 | 28.9 | .0002 | 41.8 | 83.0 | .6162 | −124.2 | 31.2 | .0001 |
| Smoke cigarettes 1–9/d | −101.4 | 46.4 | .0291 | 16.3 | 161.5 | .9199 | −109.3 | 49.1 | .0262 |
| 10–19/d | −182.3 | 45.2 | .0001 | −208.7 | 123.7 | .0950 | −184.5 | 49.0 | .0002 |
| 20+/d | −206.4 | 50.9 | .0001 | −313.8 | 163.2 | .0581 | −193.3 | 54.0 | .0004 |
| Family functioning | −126.4 | 45.4 | .0055 | | | | | | |

*Note: Adjusted* $R^2$*: column 1, .53; column 2, .49; column 3, .55.*

family functioning groups must be interpreted cautiously given the large number of potential confounders. It is pertinent that the stress inherent in family dysfunction was neither interfering with proper weight gain during pregnancy nor leading to increased maternal smoking.

Infant birthweight was regressed on the known determinants to provide individual estimates of the contribution of each factor to infant birthweight while adjusting for the effects of the other factors. Infant birthweight, as can be seen from the total sample (N = 772) in Table 2, was positively associated with length of gestation (165.0 g/wk), prepregnancy weight (3.7 g/lb), and weight gain (7.2 g/lb). Infant birthweight was negatively associated with highest systolic blood pressure during pregnancy (−4.1 g/mm Hg). African-American infants weighed 338.7 g less than Anglo-American infants, and female infants weighed 108.1 g less than male infants, after adjusting for other known determinants. Women who reported that they were light, moderate, or heavy smokers during the last two trimesters of pregnancy gave birth to infants who weighed on the average 101.4 g, 182.3 g, and 206.4 g less, respectively, than infants born to nonsmoking women. Several maternal factors that have been associated with infant birthweight in various studies were not statistically significant in these data: age, height, parity, prior pregnancy history, socioeconomic status, marital status, changes in life events, and consumption of alcohol and other drugs. It was not surprising in a study of this size, given the large number of known determinants of infant birthweight, that some factors would not be associated with outcome.

Family functioning, after adjusting for the other factors presented in Table 2, was significantly ($P$ = .0055) associated with infant birthweight. Women who perceived their families as dysfunctional, based on a self-report questionnaire completed at the first prenatal visit, gave birth to infants who weighed 126.4 g (95% CI 215.4, 37.4) less on the average than women who lived in functional families. The adjusted $R^2$ for this biopsychosocial model presented in column 1 of Table 2 was .53.

Length of gestation was regressed on the biopsychosocial determinants presented in Table 2. There was no association between family functioning and length of gestation.

Regressing infant birthweight on the same key determinants for each of the two family functioning groups (columns 2 and 3 in Table 2) allowed for estimates of the modifying effects of family functioning on the other key determinants of infant birthweight. The independent contribution of each week of gestation on infant birthweight was 165.8 g for women from functional families and 154.5 g for women from dysfunctional families; that is, each week of gestation contributed more to fetal weight gain among women from functional families. Eleven (11) grams per week may be clinically important; however, a Student's $t$ test evaluating the differences between the two regression slopes did not reveal a $P$ value smaller than the alpha of .05. As can be seen in Table 2, the standard error of the dysfunctional family regression slope (22.3 g) is quite large in comparison with the standard error of the functional family regression slope (7.5 g); this artifact results from the relatively small sample size of 89 dysfunctional families.

African-American infants weighed, on the average, 336.1 g less than Anglo-American infants among the functional family group and 368.3 g less among the dysfunctional family group. This difference in slope was not statistically significant. Again there was a large standard error in the smaller dysfunctional family group.

Prepregnancy weight contributed to infant birthweight at a rate of 3.9 g/lb among those women who perceived their families as functional, and only 2.2 g/lb among those women who perceived their families as dysfunctional. This difference of 3.9 g/lb vs 2.2 g/lb was statistically significant and clinically and biologically important.

Maternal weight gain converted to infant birthweight similarly among functional and dysfunctional groups: 7.3 g and 7.0 g per pound of weight gain, respectively. Apparently the assumed stress underlying family dysfunction was not affecting the contribution of maternal weight gain on infant birthweight.

The detrimental effect of each millimeter of mercury, as measured by highest systolic blood pressure during pregnancy, on infant birthweight was slightly less so among functional compared with dysfunctional families, −4.0 g vs −4.4 g/mm Hg. This difference is not statistically significant, but is in the hypothesized direction.

Family functioning appears in these data to have masked the differences between male and female infant birthweight. In the total sample (see column 1 in Table 2) female infants weighed on the average 108.1 g less than male infants, an expected difference. Among women who perceived their families as functional, female infants weighed 124.2 g less than male infants. Female infants actually weighed 41.8 g more than male infants in the dysfunctional family group. The difference between −124.2 g and 41.8 g was statistically significant.

The effects of smoking on infant birthweight were more pronounced among those persons who perceived their families as dysfunctional in both the moderate (10 to 19 cigarettes per day) and heavy (20+ cigarettes per day) smoking groups: −208.7 g vs −184.5 g and −313.8 g vs −193.3 g, respectively. These differences were not statistically significant.

In summary, two of the seven determinants of infant birthweight were modified in a statistically significant manner by family functioning and in the hypothesized direction: prepregnancy weight and sex of the infant. Three factors—length of gestation, highest systolic blood pressure, and smoking—were modified in the hypothesized direction, but the differences were not statistically significant. Maternal weight gain was not modified. The effect of ethnicity, instead of being masked as hypothesized, was increased, but not at a statistically significant level.

## Discussion

The data presented here supported the hypothesis that family dysfunction as perceived by the mother is associated with reduced infant birthweight independent of other key known determinants. Given a relatively precise estimate of length of gestation (Dubowitz assessment), these analyses make it clear that this reduction in infant birthweight is independent of length of gestation.

The focus has been on reduced birthweight for length of gestation, a continuous as opposed to a dichotomous approach. There are scientific reasons for this focus. The average birthweight in this study was 3337 g; low birthweight is defined as less than 2500 g; no study has ever shown the independent effect of maternal smoking, for example, to be greater than 800 g. Neither would it be expected that family dysfunction would have such a large negative effect. It is true that family functioning groups may differ in the incidence of newborns weighing less than 2500 g, or less than the tenth percentile of weight for gestational age.

These differences, however, are due to a combination of factors. Whether women from dysfunctional families also have other risk factors is both (1) a scientific and (2) an historical issue. If women from dysfunctional families cannot convert their maternal fat stores into nutrients for fetal growth, the issue is a scientific one. If, however, women from dysfunctional families in some parts of the country smoke more and in other regions smoke less, then this difference is an historical issue. In those studies where the women from dysfunctional families smoke more, the unadjusted estimates between family dysfunction and low birthweight (or a dichotomous IUGR/non-IUGR outcome) will be much higher than in studies where women from dysfunctional families smoke less. Dichotomizing infants as low birthweight or IUGR has appropriate clinical and public policy uses. There are scientific disadvantages to such binary approaches, however. For the goals of this study, focusing on a binary outcome of infant birthweight clouded unnecessarily the relationship between family functioning and decreased fetal growth.

Family functioning modified the effects of two key determinants of infant birthweight in the hypothesized direction: prepregnancy weight and sex. Prepregnancy weight did not convert into infant birthweight as well among women in dysfunctional families as among women from functional families; the effect of sex on infant birthweight was masked among women from dysfunctional families. The modifying effects of family dysfunction on the association of infant birthweight with (1) length of gestation, (2) highest systolic blood pressure, (3) moderate smoking, and (4) heavy smoking were not statistically significant. These estimates, however, were in the hypothesized direction and large enough to be of clinical concern. It is noteworthy that the birthweight effects of heavy smoking were 120.5 g (313.8 g minus 193.3 g) more detrimental among the dysfunctional family group. These potential synergistic effects are worthy of further study. A study is currently underway to test this modifying hypothesis on a larger sample.

The prospective cohort design of this study provides a strong basis for concluding that a negative association exists between family dysfunction (as operationalized by FACES II)[47] and infant birthweight adjusted for length of gestation. Regression analysis allowed for statistical adjustment for other known determinants that could be potential confounders. Given that over 95% of eligible women participated in this study, selection bias can be refuted as a serious threat to the internal validity of these estimates.

Generalization from some measurements of this study to other slightly different operationalizations seems not to be a major problem. These measurements of infant birthweight, length of gestation, maternal ethnicity, sex, prepregnancy weight, weight gain, and blood pressure are generalizable. Self-report smoking status, although not so precise a measure as serum cotinine,[50] is applicable to other clinic situations; it is reasonable to conclude that self-reported smoking status is a relatively valid surrogate measure for true smoking status.

Self-report responses to questions on FACES II are more difficult to generalize to the concept of family functioning. A questionnaire obviously is not based on observations of the family's interaction; it is the perception of one individual about her family, albeit the key biologic figure in the pregnancy under study.

Campbell[43] reminds us that the "mechanisms by which psychosocial factors affect health are poorly understood" and suggests that "[n]ew techniques in psychoimmunology and neuroendocrinology should be incorporated into family studies." More work needs to be done to study the interactive, simultaneous processes of family development and fetal development. Current research has established an immune and neuroendocrine laboratory to explore potential biologic pathways by which the family and other larger systems are affecting fetal growth.

As a step toward better understanding of the role of the biopsychosocial determinants of infant birthweight, these estimates are presented as worthy of consideration and debate, and as hypotheses for future studies: women who perceive their families as dysfunctional give birth to infants that weigh on the average 126 g less, after adjusting for the effects of other determinants, than infants born to women who perceive their families as functional. In addition, family functioning is a biologically important modifier of the contribution of other key known determinants of infant birthweight.

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