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Chaos as a Social Determinant of Child Health: Reciprocal Associations?

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Abstract

This study informs the social determinants of child health by exploring an understudied aspect of children's social contexts: chaos. Chaos has been conceptualized as crowded, noisy, disorganized, unpredictable settings for child development (Evans et al., 2010). We measure chaos at two levels of children's ecological environment - the microsystem (household) and the mesosystem (work-family-child care nexus) – and at two points in early childhood (ages 3 and 5). Using data from the Fragile Families and Child Wellbeing Study ($N=3288$), a study of predominantly low-income women and their partners in large US cities, we develop structural equation models that assess how maternal-rated child health (also assessed at ages 3 and 5) is associated with latent constructs of chaos, and whether there are important reciprocal effects. Autoregressive crosslagged path analysis suggest that increasing chaos (at both the household and maternal work levels) is associated with worse child health, controlling for key confounders like household economic status, family structure, and maternal health status. Child health has little effect on chaos, providing further support for the hypothesis that chaos is an important social determinant of child health in this sample of relatively disadvantaged children. This suggests child health may be improved by supporting families in ways that reduce chaos in their home and work/family environments, and that as researchers move beyond SES, race, and family structure to explore other sources of health inequalities, chaos and its proximate determinants may be a promising avenue for future research.

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Child development researchers have become increasingly concerned about escalating levels of chaos, or the lack of order and routine in modern family life, and its consequences for child well-being (Bronfenbrenner, 2001). Family diversity, income inequality, and labor market instability in the U.S. have contributed to disorder and instability in households, families, and the workplace with potential implications for children's health (Lichter & Wethington, 2010). Research on the social determinants of child health has neglected this potentially important aspect of children's social contexts, focusing largely on SES, race, and family structure effects (Carr & Springer, 2010). Chaos in children's social contexts, which operates at multiple ecological levels through daily processes and interactions, may be an important determinant of child health.

Recently, Evans and his colleagues identified chaos, conceptualized as crowded, noisy, disorganized, unpredictable settings for child development, as an important risk factor for poor child outcomes (Evans, 2004; Evans et al., 2010) and as a potential mediator of the link between socioeconomic status and child outcomes (Evans et al., 2005). A chaotic environment is associated with poor child socioemotional outcomes (Evans & English, 2002; Evans et al., 2005). Children's physical health has been linked to indicators of instability or routines in the household (S. E. Anderson & Whitaker, 2010; Hammons & Fiese, 2011), but no study to date has assessed how chaos at the household or other ecological levels is associated with child health.

Our goal is to examine chaos as a social determinant of child health using data from the Fragile Families and Child Wellbeing Study. In doing so, we focus on early childhood, a key stage in the life course when poor health can affect cognitive growth (Basch, 2011) and have long-term implications for health and SES later in the life course (Haas, 2008).

Using longitudinal data and multiple measures of chaos, we ask: in early childhood, does chaos decrease child health? We also consider reciprocal effects - whether children with poor health may increase chaos. Poor families may be exposed to relatively high levels of chaos (Evans, 2004), thus our data from a study of predominantly low-income women and their partners (Reichman et al., 2001) are ideal for exploring chaos as a determinant of child health.

Chaos and the Bioecological Model

The bioecological model suggests that healthy child development requires that children engage in predictable, complex, reciprocal interactions with their environment over an extended period of time (Bronfenbrenner & Ceci, 1994). A child's environment is not limited to the home environment, but also includes other settings the child interacts within, such as school, and the interplay between home and related social environments, such as parental work contexts. The immediate home environment of the child is the microsystem, while the interactions between the home environment and the social contexts in which the family and its members function are the mesosystem. Chaos can occur at both levels.

Wachs and Evans (2010), drawing on Fiese (2006) and Wachs (1989), recently defined chaos as "environments that are characterized by high levels of noise, crowding, and instability, as well as a lack of temporal and physical structuring (few regularities, routines,

or rituals; nothing has its time or place)” (pp. 5). Although chaos is associated with lower socioeconomic status (Brody & Flor, 1997; Evans & English, 2002; Moore et al., 2000), chaos is a construct distinct from SES. Chaos is associated with poor child development 1) even after SES is accounted for (Dumas et al., 2005; Hart et al., 2007), 2) in samples that are largely homogenous with regard to SES (Brody & Flor, 1997), and 3) in natural experimental conditions (Evans et al., 1998). Further, chaos may be a mechanism linking SES and poor child development (Brody & Flor, 1997; Evans et al., 2005).

Chaotic environments provide the opposite of what young children need for their development. Chaos in the home environment is often characterized as noise, crowding, and general confusion in the household (Evans et al., 2010). The most commonly used measure of chaos, the “Confusion, Hubbub, and Order Scale” (Matheny et al., 1995), includes items such as: “The children have a regular bedtime routine”; “You can’t hear yourself think in our home”; and “There is usually a television turned on somewhere in our home”. Children in more chaotic households tend to have lower cognitive and verbal abilities (Asbury et al., 2005; Hart et al., 2007) and more behavior problems (Coldwell et al., 2006; Dumas et al., 2005). Further, parents are also affected by chaos; in more chaotic homes, parents of infants had less responsive and stimulating parenting (F. Corapci & Wachs, 2002) and parents of 4 to 8 year old children were less warm and more hostile (Coldwell et al., 2006).

Because parents of young children often work, chaos operates not only in the household, but at the mesosystem as well - at the intersection of work, childcare, and family. R. Repetti and Wang (2010) recently argued that chaos in the mesosystem is marked by work stress, inflexible and unsupportive work environments, nonstandard work schedules, and working multiple jobs. Further, Feyza Corapci (2010) and Bradley (2010) both suggested that childcare is a source of chaos for many families, and that childcare multiplicity (having multiple childcare arrangements) and unreliable childcare are two important sources of chaos that families of young children must cope with.

Little work has examined mesosystem level indicators of chaos though Evans and Wachs (2010) highlighted chaos at the mesosystem in their recent edited volume. Marcynyszyn et al. (2008) found that mesosystem chaos, as measured by change in parental intimate partners, work hours, residences, and schools, was associated with poorer socioemotional wellbeing and increased risky behaviors among adolescents. Moore et al. (2000) found that mesosystem chaos was associated with greater emotional problems in school-age children, but they included a significant child or parental health problem as an indicator of chaos.

Chaos Effects on Child Health

This study furthers research on the social determinants of child health by examining chaos in children’s lives in both the home environment and mesosystem. Figure 1 depicts our theoretical framework of how chaos may affect children’s health status. We aim to capture the disorder and instability that children experience through their interactions at these levels. Chaos is expected to influence child health through several pathways: increasing exposures to toxins, pollutants and germs; increasing parental and child stress and reducing emotional support; reducing parents’ ability to prevent and effectively treat illnesses; and, reducing the

quantity and quality of parental supervision needed to reduce illness, avoid accidents, and encourage healthy behaviors.

Research suggests that crowding (Solari & Mare, 2012) and unorganized household environments (Suglia et al., 2010) are associated with worse child health outcomes, while regular routines may support better child health (S. E. Anderson & Whitaker, 2010; Hammons & Fiese, 2011). Indirect evidence suggests that ambient noise (F. Corapci & Wachs, 2002; Kirkorian et al., 2009) and the Matheny et al. (1995) measure described above are associated with lower- quality parenting and increased child stress (Coldwell et al., 2006; Dumas et al., 2005), which have been suggested to have lifelong consequences for child health (R. L. Repetti et al., 2002).

Thus, chaos in the household, which in our study includes physical disorder, social disorder, and ambient noise/distractions, may have important implications for children's health. Using latent variable constructs allows us to capture the chaotic nature of the multiple elements in children's household contexts beyond what can be gleaned from any one item. No study to date has considered the association between a broad construct of household chaos that incorporates these multiple elements of children's household environments with children's overall health status.

Our second major concept is chaos in the mesosystem (work-family-child care nexus). We conceptualize this level of chaos in two ways: maternal work chaos and childcare chaos. Maternal work chaos represents the instability and unpredictable nature of mothers' work, which can translate into more maternal stress and less predictable interactions with children. Childcare chaos reflects the instability of children's childcare arrangements, which creates a less stable care environment outside of the home.

Empirical research supports the proposition that maternal work has a negative impact on child health in the U.S. (Gennetian et al., 2010; Morrill, 2011). Several aspects of work have been suggested as important predictors of child developmental and health outcomes (R. Repetti & Wang, 2010). A lack of control over work schedules is associated with increased distress and more health problems among parents which may in turn affect children (Fenwick & Tausig, 2001; Thomas & Ganster, 1995) through reduced supervision, increasing the risk of accidents and injuries, and less time to plan for and prepare healthful meals, increasing the risk of obesity-related health problems. Job instability, net of maternal work status, is associated with worse child behavioral outcomes, particularly when associated with low-wage work (Johnson et al., 2012).

Even under conditions of job stability, maternal work place conditions may impact children's health status. Many mothers work in hostile work environments and often face discrimination in the form of a "motherhood penalty" (Correll et al., 2007); these mothers may be more likely to avoid missing work to treat childhood illness or take their children to well-visits. Further, a study of physiological stress in children found low job role quality and emotional exhaustion among mothers to be associated with higher levels of stress among children (Chryssanthopoulou et al., 2005), with implications for their physical and mental health.

Difficulty balancing work with childcare is another regular challenge that may increase chaos in children's lives. The number of hours mothers worked (P. M. Anderson et al., 2003; Morrissey et al., 2011) and the amount of time children spend in child care centers (Beijers et al., 2011; Gordon et al., 2007) were associated with children's health. Most relevant to this study is the frequency of childcare falling through and changes in childcare (Henly & Lyons, 2000), which may increase instability and unpredictable environments for children.

Although there has been attention to the effects of maternal work on child health, no study to date has conceptualized and measured the association between work-family-child care chaos and overall child health. Our study aims to capture the unpredictable and unstable nature of maternal work and childcare to better understand how these aspects of children's mesosystem environment are associated with their health. We posit that the maternal work conditions that are more unstable and unpredictable represent higher levels of work chaos, and that chaos in mothers' work will reduce mothers' time and emotional energy needed to provide adequate care and supervision, obtain needed health resources, and prevent or treat child illness. Further, childcare chaos, as indicated by multiple and changing childcare arrangements, may also reduce child health due to the constant change in exposures and injury hazards in the care environment, and less regular and stable supervision. The changing care context may also increase child stress, leading to mental and physical health problems. Although we expect both maternal work and childcare chaos to be associated with child health, we expect a stronger association between household-level chaos and child health given the more proximal location of the household (microlevel) environment in the bioecological framework of child development.

Child Health Effects on Chaos

This study considers possible reciprocal relationships between child health and chaos, because less healthy children may require more parental time and resources (Cohen, 1999), potentially leading to less time for household organization and problems at the intersection of work and family. Parents of ill children work less (Noonan et al., 2005; Powers, 2003), miss more work when employed (Lukemeyer et al., 2000; Smith et al., 2002), have little available time for cleaning and organizing family life (Brust et al., 1992), and often need assistance finding childcare (Garwick et al., 1998). Poor child health is also associated with an increased risk of residential crowding and poor housing quality (Curtis et al., 2010). Reciprocal pathways are noted at the bottom of Figure 1, with a feedback arrow from reduced child health to chaos.

Study Goals

The goal of this paper is to examine whether chaos is a social determinant of child health in early childhood. Further, because an unhealthy child could exacerbate chaos, we also examine potential reciprocal associations between chaos and child health. Using longitudinal data from the Fragile Families and Child Wellbeing Study, we conduct autoregressive crosslagged path analysis to test reciprocal associations between chaos at both the household and mesosystem levels and maternal-rated child health. Given that this is an initial

exploration of the association between both household and mesosystem chaos and child health, we used a global measure of child health rather than a specific indicator such as disability or illness. We expected that 3-year old children residing in chaotic settings would be in poorer health two years later. We also expected that lower child health at age 3 would be associated with more household and mesosystem chaos at age 5.

Method

We used data from the Fragile Families and Child Well-being Study, a study of mothers ($N = 4898$) and fathers who had children in the US between 1998 and 2000 in US cities; the sample for this paper was limited to those mothers who completed an in-home assessment when their children were 3 years old ($N = 3288$). Both parents were interviewed in the hospital shortly after their child's birth with follow-up interviews when the child was one, three, five years old, and nine years old. We focus on data from ages 3 and 5 because the measures needed to define chaos at multiple levels were only available from data collected in the home at these ages. Less educated, unmarried, older, Hispanic mothers and mothers of low birthweight children were more likely to attrit between birth and age 3; 14% were lost between birth and age 3. Further, older mothers and mothers who had no health insurance at age 3 were more likely to be missing from the in-home assessment at age 3; 22% of mothers did not participate in the in-home assessment.

Because our modeling techniques account for missingness (see Analytic Plan), we retain those individuals who attrit between ages 3 and 5, or are missing item-level data. Table 1 shows the sample size for each variable. For child health, 204 individuals were missing between ages 3 and 5, just 6% of the sample. Because the percentage missing was low, we retained individuals in the analyses if they had reports on the outcomes of interest at age 3.

Variables

Household chaos—Following Matheny et al. (1995), household chaos was operationalized as a latent variable measured at ages 3 and 5. The measurement models indicated an adequate fit (Wave 3: RMSEA = .03, CFI = .97; Wave 4: RMSEA = .05, CFI = .94) and all variables loaded significantly (marginally significantly for bedtime routines at age 5) on the factor at each age. Six indicators were included in the measurement model: 1) crowding, greater than 1 person per room, constructed from maternal reports (U.S. Department of Housing and Urban Development Office of Policy Development and Research, 2007); 2) mother reported TV background noise (TV on 5 or more hours a day); 3) interviewer-rated household as noisy; 4) interviewer-rated household as unclean; 5) interviewer-rated household as cluttered; 6) mother reported that child lacked regular bedtime.

Mesosystem chaos—Building on a cumulative chaos variable developed by Kamp Dush (2011), we conducted structural equation measurement models to determine latent variables that best captured chaos at the mesosystem. Measurement models indicated that two latent variables best captured chaos at the mesosystem; measurement models loading all items on a single latent variable were a poor fit to the data (age 3: RMSEA = .12, CFI = .26; age 5: RMSEA = .09, CFI = .47).

Maternal work chaos was a latent variable with four maternal-rated indicators. The measurement models indicated an excellent fit (age 3: RMSEA = .00, CFI = 1.00; age 5: RMSEA = .02, CFI = 1.00) and all variables loaded significantly on the factor at each age ($p < .01$ for all variables). The indicators included answering always or often to 1) “My shift and work schedule (cause/caused) extra stress for me and my child always, often, sometimes, or never”, and 2) “Where I (work/worked) it (is/was) difficult to deal with child care problems during working hours always, often, sometimes, or never?”. Two additional indicators included answering sometimes or never in response to “In my work schedule I (have/had) enough flexibility to handle family needs always, often, sometimes, or never” and reporting yes to “At your primary job, (do/did) you regularly work different times each week?”. Each of these variables were asked of mothers who had held any job since the birth of her child (n missing = 477 at age 3; n missing = 347 at age 5). In addition, maternal employment variables were treated as missing if the mother was not working when the child was 5 years old. Supplementary analyses were conducted using unemployed mothers' reports of these maternal employment variables, although these may have simply been delayed and additional measures of maternal employment when the child was 3 years old. No substantive differences between the models presented here and the supplementary analyses using these mothers' reports of the maternal employment variables were found (see Appendix A, Table A1).

Childcare/overwork chaos was a latent variable of three maternal-rated indicators. The measurement models indicated an excellent fit (age 3: RMSEA = .00, CFI = 1.00; age 5: RMSEA = .00, CFI = 1.00) and all variables loaded significantly on the factor at each age ($p < .04$ for all variables). Multiple jobs was coded as an affirmative answer by the mother to “Was there ever a time in the last 12 months that you worked more than one regular job at the same time?”. Change in childcare was recorded as answering nonzero to “How many times have you changed your childcare arrangements since (the previous wave)?” Childcare fell through was recorded as answering nonzero to “Approximately how many times in the past month did you have to make special arrangements because your usual child care arrangement fell through?”

Child health—Child health was measured at ages 3 and 5. Mothers reported on the general health status of her child: excellent (age 3: 61.25%, age 5: 61.54%), very good (age 3: 26.34%, age 5: 26.56%), good (age 3: 10.04%, age 5: 9.63%), fair (age 3: 2.16%, age 5: 2.17%), or poor health (age 3: 0.21%, age 5: 0.10%). The variable was coded continuously from 1 (excellent health) to 5 (poor health). The mean and standard deviation for child health are reported in Table 1; child health did not change significantly between ages 3 and 5 ($t = 0.64$, $p = \text{ns}$). Maternal-reported child health has the advantage of capturing child health issues that are apparent to the mother but have not been diagnosed by a physician. This is particularly important in a disadvantaged sample, such as this one, where mothers have limited access to medical care and health conditions may go undiagnosed. Parental reported child health has been linked with multiple social and economic status indicators (Larson et al., 2008; Yoo et al., 2008).

Covariates—Parental union status at birth was a dummy variable where 1 = in a union with the biological father and 0 = not in a union with the biological father. Maternal and paternal age was measured in years. Maternal education at birth was coded as less than high school compared to anything greater. Maternal race/ethnicity was coded as Black/Hispanic and non-Black/non-Hispanic. Mother's higher order birth was measured as a dummy variable indicating whether the mother had an older child at the time of the birth. Child characteristics included child gender and child low birth weight (< 2500 grams). Maternal and paternal employment status at age 3 was coded as parent was working and/or in-school in the week prior to the interview, and parent was not working or in-school. The income-to-poverty ratio was measured at age 3 as the ratio of all household income to the definition of poverty in that time period. Hence, a ratio of 1.00 or greater indicated income above the official poverty level, while a ratio of less than 1.00 indicated that the household was impoverished according to official definitions.

Maternal self-rated health at age 3 was coded continuously from 1 (excellent health) to 5 (poor health). The number of maternal union changes occurring between birth and age 3 was a count of the number of union entrances and exits during that time period. The lack of health insurance was a dichotomous variable.

Analytic Plan

We examined chaos and child health measures at ages 3 and 5 in an autoregressive crosslagged path analysis (Curran & Bollen, 2001), a stringent, within-person method to examine whether there was a reciprocal relationship between multiple forms of chaos and child's health over time. In the autoregressive crosslagged model, chaos and child health at age 3 were regressed on the covariates. These estimates helped us understand how social risk factors impacted both multiple forms of chaos and child's health, which means that covariate effects can be understood as impacting each type of chaos at age 3 independent of their effects on other types of chaos and independent of their effects on child health. Although we present the final model with all crosslagged effects included, we built these models in a stepwise fashion. We tested the effects of chaos on child health in one model and effects of child health on chaos in a separate model before running the full model. All coefficients presented in our final model were similar to those run in the stepwise models. Because the overall chi-square fit statistic is known to be biased by sample size, we used multiple fit indexes to establish adequate model fit. These included the comparative fit index (CFI; Bentler, 1990) which should be .90 or greater, and the root mean square error of approximation (RMSEA; Steiger, 1990) which should be .05 or lower.

All endogenous variables (the chaos latent variables and the child health observed variable) were assumed to be continuous in analyses. We ran sensitivity analyses modeling these as count variables (for example, as poisson models) with no substantive difference; therefore we report the continuous models for ease of interpretation. All analyses were performed using Mplus Version 4.21 (Muthén & Muthén, 2004). Missingness was handled with the use of Full Information Maximum Likelihood (FIML) estimation that allows the likelihood to be computed for each individual given all available information for that individual. Therefore individuals missing on a variable or dropping out of the sample between ages 3 and 5 due to

attrition were retained in the analyses. The FIML estimator is preferable over multiple other methods of handling missing data as it maintains the asymptotic properties of maximum likelihood estimators under the less restrictive assumption of missing at random (Bollen & Curran, 2006).

Results

Table 1 reports the descriptive statistics for all covariates, child health, and the chaos indicators along with the sample size for each variable. The means of the latent chaos variables could not be reported because they are set to zero by default in Mplus. Therefore we present descriptive statistics on their observed indicators here. Mean maternal-rated child health (1.5) was similar at both time points, illustrating that on average, children were rated by their mothers between excellent and very good health, though there was substantial variation. Roughly 75% of the mothers were Hispanic or Black and 34% had less than a high school degree. Parents were in their mid-twenties at birth. At age 3, the mean income to poverty ratio was 1.88 and over half of parents were employed. A majority of the sample was either married or cohabitating with the biological father at birth and there were relatively few union changes by age 3. A majority of mothers had older children, half of children were male, and about 10% were low birth weight. Maternal health at age 3 was good on average with a mean of 2.26.

The most common source of household chaos was television noise, as more than 60% of mothers had the television on more than 5 hours a day at both ages. Bedtime routines became more regular over time, with only 8% of mothers reported no bedtime routine at age 5. Between 15% and 20% of households reported crowding, noise, and unclean and cluttered rooms. Between 14 and 7% of mothers reported work stress and work/childcare problems. About a third of mothers had inflexible work schedules, and about a quarter had nonstandard work schedules. About 11% of mothers worked multiple jobs. Over time, childcare problems declined; less than 2% of mothers reported that childcare fell through or changed at age 5, down from 8% and 16% respectively at age 3.

Autoregressive crosslagged model results

The results of the autoregressive crosslagged model are presented in Figure 1 and Table 2 (main effects) and Table 3 (covariate effects). The model provided adequate fit ($CFI=.90$, $RMSEA=.02$). In examining the longitudinal and independent effects of chaos on child health (net of covariate and reciprocal effects), household chaos at age 3 significantly increased poor child health at age 5 such that each unit increase in the latent variable of household chaos was associated with a 0.68 increase in poor child health. Maternal work chaos had a similar negative effect, with each unit increase in the latent chaos variable associated with a 0.39 unit increase in poor child's health at age 5. Only the effect of childcare/overwork chaos did not significantly predict poor child's health longitudinally. When examining the predictive impact of child health on later chaos, we found that poorer child health did not significantly increase any of the latent chaos variables and that the magnitudes of the coefficients were very low or zero.

We also discuss the standardized coefficients (see Table 2) because unstandardized coefficients based on different metrics cannot be directly compared. Although standardized coefficients do not have a meaningful unit of analysis for interpretation (they are interpreted as a unit increase in the standard deviation of an outcome), they are useful in comparing the magnitude of coefficients for different variables. In examining the effects of chaos at age 3 on child health at age 5, as compared to child health at age 3 on chaos at age 5, all standardized coefficients suggested a substantially greater impact of chaos on child health with these coefficients ranging from roughly two to six times as large in magnitude as compared to the child health on chaos coefficients.

The covariate effects from the autoregressive crosslagged model are reported in Table 3. Mothers who were Black or Hispanic had more household chaos, and rated their children in poorer health, compared to non-Black/non-Hispanic mothers. Further, low maternal education was significantly associated with elevated household chaos but lower childcare/overwork chaos. Mothers with less than high school education also rated their children's health as significantly worse than mother's with higher levels of education. Mothers who were older reported less household chaos, but mothers who had children with older fathers reported more maternal work chaos. Children who were male and who were low birth weight had poorer child health. Mothers with older children reported greater household chaos compared to those with for whom the focal child was their first birth. Mothers who were in a union with the biological father at birth reported significantly less childcare/overwork and household chaos.

Poor maternal self-rated health at age 3 was associated with significantly higher household, maternal work, and childcare/overwork chaos, as well as poorer child health. Employed mothers at age 3 reported significantly less household and maternal work chaos, but greater childcare/overwork chaos. Paternal employment at age 3 was significantly associated with less household chaos. Mothers who were less impoverished reported significantly lower household chaos.

Sensitivity analyses

Several sets of sensitivity analyses were run to check the robustness of these results (see Appendix A for details). Overall, the autoregressive crosslagged model and its overall pattern of results were robust to (a) different specifications of family structure; (b) separate models for each latent indicator of chaos; (c) the exclusion of each indicator (in turn) of the latent variables of household chaos and maternal work chaos; (d) the exclusion of the interviewer-reported indicators of household chaos; (e) listwise deletion as an alternate to the FIML estimator; (f) several subsamples based on maternal employment; and (g) controls for maternal employment at both ages 3 and 5. Tables A2 – A8 present these results.

Discussion

Developmental psychologists have identified chaos as a critical determinant of child socioemotional development (Evans et al., 2005), and our results suggest that chaos is also an important determinant of overall child health in early childhood. When children's home environments were marked by noise, crowding, clutter, dirt, and a lack of routine, children's

health was worse two years later, even after taking into account initial health levels and other important covariates. Further, the negative impact of chaos was not limited to the immediate household environment; chaos measured at the mesosystem as an unsupportive, inflexible work environment and nonstandard work schedule was also associated with decreased child health at age 5.

We also explored reciprocal associations between child health and chaos. Given the literature on the toll of having a child with a chronic health problem on families (Cohen, 1999; Powers, 2003), we expected that child health would exacerbate both household and mesosystem chaos. Our models did not support this hypothesis; rather, our results suggest that chaos is associated with child health independent of a reciprocal effect of health on chaos. A larger sample or a sample with more children with chronic health conditions may have yielded associations from child health to chaos. Future research on the association between chaos and other measures of child health, such as chronic illness, disability, or asthma, may find that chronic child health problems do exacerbate chaos. Because chaos is associated with socioeconomic disadvantage (Evans & English, 2002), these findings should be replicated with a more SES-diverse sample.

Contrary to our expectations, we found that one aspect of work/family chaos, childcare/overwork chaos, was not associated with overall child health. Because many of the children were enrolled in school at age 5, childcare instability may have played a less important role in children's lives at that point. Indeed, the proportion of mothers reporting that they had experienced childcare-related sources of chaos dropped over time such that by age 5, less than 2% of mothers reported they had changed childcare in the past year or had their childcare arrangement fall through. Childcare/overwork chaos at age 3 (when children still needed nonschool care) may have been too distal to impact child health at age 5. Future studies should explore the links between childcare-related chaos and health in the preschool years, and observe chaos in the actual child care setting (Feyza Corapci, 2010).

This study had limitations. Child health prior to age 3 could have exacerbated chaos at age 3, and families may have been selected into chaos. However, our control for low birth weight, a crude indicator of initial poor child health, did not account for these associations. Further, our measure of child health was limited to maternal report which is a subjective measure. Parental-rated child health measures have been found to be biased; mothers in poor health are more likely to report her own child in poor health (Waters et al., 2000). Though we control for maternal self-rated health, these findings should be replicated with data on child health from multiple reporters, as well as more objective measures of child health such as injuries or illnesses. For those children living with a father, whether a biological father or cohabiting or married stepfather, or those children living part-time or in contact with a nonresident father, paternal chaos may also impact family life and child health. Paternal chaos could negatively impact father involvement, which has implications for child health.

Our measure of chaos was not exhaustive. Psychologists often point out the importance of various family routines, such as family meals, and rituals (Fiese, 2006). We were only able to assess bedtime routines. We were not able to assess individual experiences of chaos as scholars such as Matheny et al. (1995) have done with questions that ask parents' perception

of disorder. The role of chaos in child health should be examined using multiple methods, including interviewer ratings, childcare provider or teacher report, parent report, and when children are old enough, child report as well. The childcare variables were not continuous. Hence, measurement error may have biased our results related to overwork/childcare chaos.

Finally, as in any study, there are potential third-variables that might account for these associations that we were not able to account for. Our use of cross-lagged models to examine change in child health and chaos over time do an above average job accounting for time-invariant sources of third-variable bias as the outcome is essentially a measure of within-person change in chaos (or child health) over time. However, time-variant sources of omitted variable bias remain a threat to the validity of these findings. For example, a simultaneous change in mental health across the same time period could potentially account for the observed associations between chaos and child health. Potential mediators of these associations, such as parental mental health, would be an interesting next step for this line of research.

Understanding chaos as a social determinant of child health is becoming increasingly relevant in both research and policy arenas. This study advanced the literature by identifying family chaos, particularly household and maternal-work related chaos, as a potentially important social determinant of poor child health. The American Academy of Pediatrics recently released a policy statement on early childhood adversity and toxic stress and the resultant lifelong negative health implications of both (Committee on Psychosocial Aspects of Child and Family Health et al., 2012). The report highlighted the importance of the social and physical environments of child development for life long health and well-being. Our findings support this notion and further underscore the importance of the social environment for overall child health. It is likely that interventions targeted at improving the health of US children could be improved with attention to the ecology of child health and social environments.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Research Highlights

- We used longitudinal data from primarily low-income mothers to assess how chaos is associated with young children's health
- Data came from 3288 mothers in the Fragile Families and Child Wellbeing Study.
- Mothers reported young children experiencing higher levels of household and maternal work chaos had worse health
- Using structural equation models to test reciprocal effects, we find that children's health does not predict later chaos
- Results suggest that chaos in children's immediate and distal environments have implications for child health

Figure 1.
Theoretical model of chaos and child health.

Figure 2.

Autoregressive crosslagged model of chaos and child health ($N=3288$). Unstandardized regression coefficients reported. See Table 2 and Table 3 for full model results including standardized coefficients. Model included all control variables; control variables directly predicted child health and chaos at age 3. Model fit statistics: $\chi^2 = 1442.99$, $df = 652$; CFI = .90; RMSEA = .02. *** $p < .001$, ** $p < .01$, * $p < .05$.

Table 1

Descriptive Statistics (N = 3288)

Indicators	Birth			Age 3			Age 5		
	M	SD	%	N	M	SD	%	N	%
Maternal-rated child health					1.54	0.78		3288	1.53
<i>Household chaos</i>									0.76
Crowding									
Television background noise									
Lack of regular bedtime									
Interviewer-rated noise									
Interviewer-rated unclean									
Interviewer-rated cluttered									
<i>Maternal work chaos</i>									
Work stress									
Childcare problems at work									
Inflexible work schedule									
Irregular work schedule									
<i>Childcare/overwork chaos</i>									
Multiple jobs									
Change in childcare									
Childcare fell through									
<i>Control variables</i>									
Maternal race Black/Hispanic									
Maternal less than high school education									
Maternal age									
Paternal age									
Male child gender									
Child low-birth weight									
Maternal higher-order birth									
Mother in union with biological father at birth									

Indicators	Birth			N	Age 3			N	Age 5		
	M	SD	%		M	SD	%		M	SD	%
Maternal union change	0.29	0.51		3257							
Maternal self-rated health					2.26	1.04		3288			
Maternal employment							55.58	3147			
Paternal employment							75.10	3068			
Income-to-poverty ratio					1.88	2.56		3288			
Uninsured							25.72	3153			

Note. N represents the number of respondents with a valid (i.e. non-missing) response for that indicator.

Table 2

Autoregressive Crosslagged Model of Chaos and Child Health: Results Across Ages 3 and 5 (N= 3288)

	<i>b</i>	SE	β
Household chaos 3 -> Child health 5	0.68	.15	0.13***
Maternal work chaos 3 -> Child health 5	0.39	.15	0.08*
Childcare/overwork chaos 3 -> Child health 5	0.29	.22	0.03
Child health 3 -> Household chaos 5	0.00	.01	0.02
Child health 3 -> Maternal work chaos 5	-0.00	.01	-0.01
Child health 3 -> Childcare/overwork chaos 5	0.00	.00	-0.01
Household chaos 3 -> Household chaos 5	1.00	.08	0.94***
Maternal work chaos 3 -> Maternal work chaos 5	0.45	.07	0.41***
Childcare/overwork chaos 3 -> Childcare/overwork chaos 5	0.04	.02	0.13*
Child health 3 -> Child health 5	0.40	.02	0.41***

Note. Fit statistics reported in Figure 2. This model included all control variables; control variable estimates are reported in Table 3. *b* = unstandardized coefficient. β = standardized coefficient. 3 = age 3. 5 = age 5.

 $p < .001$

**
 $p < .01$

*
 $p < .05$.

Table 3

Autoregressive Crosslagged Model of Chaos and Child Health: Results Predicting Age 3 Chaos and Child Health from Covariates (N= 3288)

	House hold chaos 3			Ma ternal work chaos 3			Child care/o verwork chaos 3			Chi ld health 3		
	b	SE	β	b	SE	β	b	SE	β	b	SE	β
Maternal race Black/Hispanic B	0.06	.01	0.17***	-0.01	.01	-0.02	-0.01	.01	-0.03	0.08	.03	0.05*
Maternal less than high school education B	0.06	.01	0.21***	0.02	.01	0.05	-0.03	.01	-0.16***	0.13	.03	0.08***
Maternal age B	-0.00	.00	-0.12**	-0.00	.00	-0.08	-0.00	.00	-0.04	0.00	.00	0.03
Paternal age B	0.00	.00	0.00	0.00	.00	0.12**	0.00	.00	-0.03	0.00	.00	0.02
Male child gender B	0.01	.01	0.02	-0.00	.01	-0.01	0.01	.01	0.03	0.11	.03	0.07***
Child low-birth weight B	0.01	.01	0.03	0.01	.01	0.02	0.01	.01	0.03	0.13	.05	0.05**
Maternal higher-order birth B	0.07	.01	0.24***	0.00	.01	0.00	-0.01	.01	-0.05	0.03	.03	0.02
Mother in union with biological father B	-0.02	.01	-0.06*	-0.01	.01	-0.03	-0.01	.01	-0.08*	-0.01	.03	-0.01
Maternal union change 3	0.01	.01	0.03	0.01	.01	0.03	0.01	.01	0.05	0.00	.03	0.00
Maternal self-rated health 3	0.01	.00	0.11***	0.04	.01	0.26***	0.01	.00	0.11**	0.19	.01	0.25***
Maternal employment 3	-0.05	.01	-0.18***	-0.08	.01	-0.28***	0.07	.01	0.41***	-0.00	.03	0.00
Paternal employment 3	-0.04	.01	-0.11***	0.00	.01	0.01	-0.01	.01	-0.03	0.02	.03	0.01
Income-to-poverty ratio 3	-0.01	.00	-0.26***	-0.00	.00	-0.06	0.00	.00	0.02	-0.01	.01	-0.03
Uninsured 3	-0.00	.01	-0.01	0.01	.01	0.02	-0.01	.01	-0.03	0.06	.03	0.03

Note. Fit statistics reported in Figure 2; main effects reported in Table 2. B = birth. 3 = age 3.

 $p < .001$ **
 $p < .01$ *
 $p < .05$.