Descriptive Title: A Multivariable Analysis of Childhood Psychosocial Behavior and Household Functionality

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Conflict of Interest
The authors declare that they have no conflict of interest.

Abstract

Background: Social determinants of health play a vital role in population health. Awareness of household social factors and their impact on health can help health professionals to provide effective strategies in health promotion, especially for children and adolescents showing signs of psychosocial dysfunction. The objective of this study was to explore the association between parents' perceptions of the psychosocial behavior of their children and the functionality of their household.

Methods: This cohort study analyzed data from the **C**oordinated **He**althcare for **C**omplex **K**ids (CHECK) program. The sample included 293 parents of children aged 4-17 years with chronic conditions, and from urban, low-income families. Psychosocial behavior of the child was measured using the Pediatric Symptom Checklist (PSC-17), which included subscales for internal, external, and attention symptoms. Household functionality was measured using the Confusion, Hubbub, and Order Scale (CHAOS). Responses to both assessments were scored in a standard manner.

Results: There was a significant association between parents' perceptions of the psychosocial behavior of their children and the functionality of the home environment. Mean CHAOS scores in the home environment improved from baseline to the first reassessment (the period between the two assessments ranged from 4 to 8 months). Additionally, positive PSC-17 screening results of the children decreased by 11% in the first reassessment. The odds of having a positive PSC-17 screening result also decreased in the first reassessment after receiving interventions.

Conclusion: The association between psychosocial dysfunction and household functionality indicates the importance of family-centered care and taking the home environment into consideration when administering health services to low-income children with chronic conditions. This study brings attention to the more hidden factors that influence child mental health, which must be addressed to improve care delivery and child health outcomes.

Introduction

Individuals and communities are influenced by both medical and social factors, also known as social determinants of health (Braveman & Gottlieb, 2014; Newacheck, Rising, & Kim, 2006). The functionality of the home environment, or the social conditions such as crowding, household composition, and frequency of conflicts, within a family unit is an important social determinant of health and plays a critical role in child development (Kamp Dush, Schmeer, & Taylor, 2013). However, much research has neglected this particular social context of children, focusing more on determinants of health such as socioeconomic status, race, and family structure (Carr & Springer, 2010). Crowding and unorganized home environments have been associated with poor child health outcomes (Kamp Dush et al., 2013; Solari & Mare, 2012; Suglia, Duarte, Sandel, & Wright, 2010). Such households can be described as chaotic, and can affect cognitive functioning across age and ethnic groups (Bradley et al., 1989; & Hart, Petrill, Deater-Deckard, & Thompson, 2007). Additionally, chaos can increase exposure to toxic pollutants and germs, increase parental and child stress, and reduce the quality of parental supervision and parents' ability to prevent and effectively treat illnesses (Kamp Dush et al., 2013).

Although household functionality has been found to be integral to the social microenvironment of the child, this variable has not been sufficiently examined especially in studies of children with special healthcare needs (Matheny, Wachs, Ludwig, & Phillips, 1995). It has also been neglected in psychological research on poverty, often ignoring the coexistence of adverse physical and psychosocial conditions in which low-income children and families live (Evans, 2004**)**. Compared to children from economically advantaged families, children from low-income families are exposed to a wide range of environmental adversities such as family turmoil,

violence, and chaotic households (Evans, 2004**).** High costs of obtaining measures on the social microenvironment, as well as limited access to equipment and expertise may be the reason for the neglect of this ecological variable in studies (Matheny et al., 1995). Our analysis contributes to existing knowledge and aims to fill in the gap by investigating the association between children's psychosocial behavior and their social microenvironment in a unique sample of urban, low-income families of children with chronic conditions.

A growing body of literature emphasizes development of integrated healthcare systems that address social determinants of health (Braveman & Gottlieb, 2014; Stanhope & Henwood, 2013). By being aware of social factors that influence health outcomes, clinical and public health professionals can work towards providing more effective strategies in health promotion (Braveman & Gottlieb, 2014). Chaos, or the lack of order and routine in the family, is an important risk factor for poor child health outcomes (Evans, 2004; Kamp Dush et al., 2013). Furthermore, parents' reports of chaos in the home environment have been found to be a valid and invaluable source of information about family processes that can be a predictor of childhood cognition and behavioral outcomes (Deater-Deckard et al., 2009; Hanscombe, Haworth, Davis, Jaffee, & Plomin, 2010). Awareness of household functionality and how it affects children's psychosocial behavior can be very informative for healthcare providers. Child health outcomes can be improved by educating and supporting families to reduce chaos in the home environment (Kamp Dush et al., 2013).

The data in our analysis was drawn from a large care coordination program called **C**oordinated **He**althcare for **C**omplex **K**ids (CHECK) (Centers for Medicare and Medicaid, 1C1CMS331342-01-00 Van Voorhees). CHECK offers comprehensive care coordination services, mental health interventions, education, and tools for disease management, while

focusing on social determinants of health. The program is unique as it has integrated mental health services into a large-scale care model of comprehensive health care delivery for children with chronic medical conditions (Glassgow et al., 2018). CHECK targets children and young adults (aged 0-25 years), who are enrolled in Medicaid with a chronic disease, such as asthma, diabetes, sickle cell disease, or prematurity (Glassgow et al., 2017). Establishing a system of family-centered care, the CHECK program offers a model to merge social and health services to obtain improved care for children with medical complexity.

The purpose of this analysis was to examine the association between parents' perceptions of the psychosocial behavior of their children and the functionality of their home environment. Given the importance of social determinants of health in relation to health outcomes, we hypothesized that children's psychosocial behavior would be associated with the functionality of their household environment. We also computed changes in children's psychosocial behavior and household functionality between baseline and reassessment data after enrolling in the program.

Methods

Conceptual Framework

Determinants of health can be classified into five domains: genetic endowment, social microenvironment, physical environment, behaviors, and medical care (Newacheck et al., 2006). These domains have been utilized to create single models to conceptualize risk factors for certain health outcomes. Complex interactions among social determinants of health and patterns of exposure play a critical role in health outcomes (Newacheck et al., 2006; Braveman & Gottlieb, 2014). Our analysis was guided by adapting a similar conceptual framework (Newacheck et al.,

2006). Within this framework, social determinants of a child's health were classified under concentric domains: child, family, community, and society. Based on the available data, this analysis focused on specific risk factors within the child- and family-level domains. Risk factors within the child-level domain included age, gender, race, chronic disease (asthma), and the CHECK risk category. Household functionality was a risk factor within the family-level domain. The CHECK model sought to comprehensively address these social determinants of health. It follows the chronic care model where enrolled patients are stratified by level of risk (based on emergency department visit and/or hospitalization). Further care coordination is planned by risk and implemented along with appropriate, customized follow up. Overall, the interventions focus on improving affect regulation in the child and parent as fundamental "building blocks" of resiliency and family function (Glassgow et al., 2017).

The University of Illinois at Chicago Institutional Review Board (IRB) determined that the study did not meet the definition of human subject research, as this was a secondary analysis using deidentified CHECK data. To maintain confidentiality, the data was analyzed using a laptop assigned by the CHECK team.

Study Sample and Design

This analysis involved the review of baseline data and the first reassessment data after patient enrollment into the CHECK program. As it was a continuous process, baseline data was collected from October 2015 to May 2017, and the first reassessment was conducted from May 2016 to August 2017. The period between the two assessments ranged from 4 to 8 months.

The analysis utilized data from two assessments: the Confusion, Hubbub, and Order Scale (CHAOS) and the Pediatric Symptom Checklist (PSC-17). Responses were collected from parents of the enrolled patients via telephone calls. Patients who had missing baseline or first

reassessment CHAOS or PSC-17 data were excluded from the study (22% of the total sample). The final sample included 293 parents of enrolled patients, between the ages of 4-17 years, with chronic conditions such as asthma, diabetes, and/or sickle cell disease.

Measures

Psychosocial dysfunction in child

The PSC-17 is a valid, shortened version of the PSC, which includes 17 items with the following responses: 0 = Never; 1 = Sometimes; and 2 = Often. This version includes subscales for internal (depression, anxiety), external (behavior problems), and attention symptoms. Individual item scores are summed to obtain subscale scores and total scores. Positive scores are determined as follows: 5 or greater for the internal subscale; 7 or greater for the external subscale; and 7 or greater for the attention subscale. A positive PSC-17 screening result is defined as at least one positive subscale score of PSC-17, or a total overall score of 15 or greater (Borowsky, Mozayeny, & Ireland, 2003). A positive PSC-17 screening result does not serve as a diagnosis, but rather an indication for further screening or diagnostic interventions. The parents of patients aged 4 to 17 years answered the PSC-17. Reliabilities were as follows for PSC-17: Cronbach's alpha = 0.89 at baseline and 0.90 at the follow-up first assessment.

Household functionality

The Confusion, Hubbub, and Order Scale (CHAOS) was originally a 15-item instrument that could be answered with only responses of true or false (Matheny et al., 1995; Haack, Gerdes, Schneider, & Hurtado, 2011). CHECK utilizes a valid and shortened 6-item questionnaire, with the following range of responses: 1 = Very much like your own home; 2 = Somewhat like your own home; 3 = A little bit like your own home; and 4 = Not at all like your own home. A total

score is obtained by summing the responses of the six items. *Lower* scores on the CHAOS indicate a *more* chaotic and disorganized home environment. Reliabilities were as follows for CHAOS: Cronbach's alpha = 0.58 at baseline and 0.73 at the follow-up first assessment.

Covariates

Demographic characteristics of the child included: age, gender, and race (White, Black, Hispanic, or Other). Additionally, the chronic condition of asthma was considered as a covariate, as it was the predominant diagnosis in the sample, and is known to affect quality of life (Juniper, 1997). The risk category assigned by the CHECK program to patients enrolled was also included. The three levels of risk were defined as low risk (no emergency department visits or hospitalizations in the past 12 months), medium risk (1-3 emergency department visits and/or 1 hospitalization in the past 12 months), and high risk (more than 3 emergency department visits and/or more than 1 hospitalization in the past 12 months).

Statistical Analysis

Descriptive statistics were computed for the total analytic sample and for subgroups based on the PSC-17 screening results of the child. Significant differences in characteristics by the PSC-17 screening results of the child were detected using chi-square tests for categorical variables, and the Wilcoxon Rank Sum Test for continuous variables. The proportion of children whose parents perceived chaos at home, their PSC-17 screening results, and the overall and subscale scores of PSC-17 were compared between baseline and the first reassessment data. Differences were determined by a chi-square test and Wilcoxon sign rank test for categorical and continuous variables respectively. Logistic regression was conducted to examine the association between CHAOS scores and a positive PSC-17 screen at baseline and the first reassessment.

Multivariable logistic regression was carried out to determine the joint and separate confounding effects of covariates (age, gender, race, chronic condition (asthma) and risk category). A sequential model building approach was employed to determine potential significant confounders. Covariates that had a significant p-value in the Analysis of Maximum Likelihood Estimates were considered as confounders. A p-value of <0.05 was considered significant. A final multivariable-adjusted model that includes only the significant covariates is presented.

In order to examine the effective changes in PSC-17 after receiving CHECK interventions, the following categories were created: improved, no change, and worsened. Those who had a positive PSC-17 screening result at baseline and a negative screening result at the first reassessment were categorized under the "improved" group. Those who had either a positive or a negative PSC-17 screening result at baseline and no change in PSC-17 at the first reassessment were categorized under the "no change" group. Finally, those who had a negative PSC-17 screening result at baseline and a positive PSC-17 at the first reassessment were categorized under the "worsened" group. A mean CHAOS score at baseline and at the first reassessment after receiving interventions was computed. Kruskal-Wallis test was used to assess the difference among these groups, while for baseline and first reassessment comparison, Wilcoxon sign rank test was used. Non-parametric tests were chosen as the continuous variables were not distributed normally. All analyses were conducted using SAS Version 9.4.

Results

Among parents of children ages 4-17 years who had been administered the assessments at baseline (N=293), 25.6% reported positive screening results on the PSC-17. For each subscale of the PSC-17, the proportion of parents reporting positive screening results was: 9.2% for internal,

10.2% for external, and 16.0% for attention symptoms. **Table 1** shows the CHECK patient demographics, household functionality, and the PSC-17 screening results of the child at baseline. [INSERT TABLE 1] In this sample of parents of children aged 4-17 years, the mean CHAOS score was 18.8 with a standard deviation of 3.4. The majority of the children were Black (59.7%), male (58.4%), and had a diagnosis of asthma (78.8%). Half of the patients were within the medium-risk category as defined within CHECK (55.6%). The CHAOS score and the age of the patient varied significantly by child PSC-17 screening result at baseline.

Table 2 displays the comparison of CHAOS and PSC-17 scores from baseline to the first reassessment after enrollment. [INSERT TABLE 2] Over time, both CHAOS and PSC-17 scores improved. An improvement of scores (decrease in the proportion of positive PSC-17 screening results) was also seen within the PSC-17 subscales (internal, external, and attention) and supported by the significant difference between baseline and first reassessment scores.

Table 3 shows the crude and adjusted relationship between CHAOS and PSC-17 at baseline and at the first reassessment post-enrollment into the CHECK program. [INSERT TABLE 3] There was a significant association between parents' perception of chaos in the home environment and positive PSC-17 screening results of the child. For every unit of change in CHAOS, the odds of having a positive PSC-17 screening result decreased over time between the baseline and first reassessment after interventions. A multivariable-adjusted model was conducted to determine the underlying joint and separate confounding effects of the covariates (age, gender, race, risk category, and asthma diagnosis). Age was found to be the only significant confounder at baseline in the relationship between CHAOS and PSC-17. However, no significant change was found in the CHAOS and PSC-17 relationship at the first reassessment.

Table 4 displays the mean CHAOS scores at baseline and at the first reassessment, among the different categories based on PSC-17 screening results. [INSERT TABLE 4] About 16.4% of enrolled children, who had a positive PSC-17 screening result at baseline, had a negative PSC-17 screening result at the first reassessment. For this category of "improved" children, baseline and first reassessment mean CHAOS scores were significantly different. 9.2% of enrolled children who had a positive PSC-17 screening result had "no change" at the first reassessment and their baseline and first reassessment mean CHAOS scores were not significantly different. 68.6% of enrolled children who had negative PSC-17 screening at baseline, had "no change" in the first reassessment. However, a significant mean difference was determined in the respective CHAOS score. About 5.8% of enrolled children were in the "worsened group," where their baseline negative PSC-17 changed to positive PSC-17 in the first reassessment. However, there was no significant difference in baseline and first reassessment mean CHAOS score for this group. Overall, the mean CHAOS score at baseline and at the first reassessment was significantly different among these categories (i.e. improved, no change, worsened).

Discussion

This study demonstrated a significant association between parents' perceptions of their children's psychosocial behavior and the functionality of their home environment, emphasizing the importance of studying household functionality to improve child health outcomes. Research on cognitive and behavioral development in children has often focused on the social microenvironment of the child, or the direct transactions that take place between caregivers and children (Matheny et al., 1995; Wohlwill & Heft, 1987). However, over the years, researchers

have been increasingly concerned about the levels of chaos in the home environment as it relates to the well-being of children and their families (Bronfenbrenner, 2001; Kamp Dush et al., 2013).

This study utilized parents' reports of chaos in the home environment. According to the first reassessment after enrolling into CHECK, there was a decrease in chaos in the household environment, as well as in the positive PSC-17 screening results of the child. This improvement in outcomes could be due to many factors, including the CHECK interventions through which community health workers provide ongoing behavioral support services to at-risk families, thereby helping to minimize parental stress and household chaos. This in turn could result in healthier home environments and improved psychosocial health of the child. However, at some level, the Hawthorne Effect, or improved performance due to awareness of being monitored (Fry, 2018), and other extraneous factors could have contributed to modifications in behavior of both children and parents.

Childhood psychosocial dysfunction has been widely recognized as a common chronic condition of both children and adolescents (Jellinek et al., 1999). Previous studies have found that among 4-16-year-olds, rates of psychosocial disorders have been as high as 27%, while rates in preschool children have been 13% (Borowsky et al., 2003; Horwitz, Leaf, Leventhal, Forsyth, Speechley, 1992; Lavigne et al., 1993). However, our analysis found that younger patients were more likely to have a positive psychosocial screen at baseline, compared to adolescents. This finding of lower psychosocial dysfunction in adolescents compared to younger children is in contrast to previous research (Blucker et al., 2014). This could be partially explained by the data reporting by caregivers instead of the adolescents themselves.

Our results also suggest that screening for mental health conditions should begin early so that supportive and remedial interventions can be provided as necessary. Mental health problems

are often not detected in pediatric practices and patients who could benefit from early care may not receive needed services (Borowsky et al., 2003). Evidence suggests that psychosocial screening, followed by referral to mental health services, can result in improved outcomes in children and adolescents identified with psychosocial dysfunction (Borowsky et al., 2003). In addition to referring children for professional services, supporting families to maintain consistent and calm household routines might also benefit children's psychosocial health. Community health workers and mental health staff within CHECK are able to work with distressed children and their families, which can mitigate parental stress to some extent. Future interventions should consider education and support services for "at risk" families so that family household routines can be created and maintained in a calmer setting, eliminating chaos in the home environment (Coldwell, Pike, & Dunn, 2006; Deater-Deckard et al., 2009).

This study had a few notable limitations. First, as the questionnaires were administered via telephone calls to parents, response bias is possible. Despite the fact that the CHAOS and PSC-17 are validated to be completed by a parent on behalf of a child, the results may not always be an accurate reflection of a child's well being. Future studies might benefit from use of clinician-observed assessments in combination with parent-reported measures to establish psychosocial dysfunction in children. A second limitation of this study was the sample size. As both baseline and first reassessment data were utilized, patients without data for both time periods were excluded. Some patients may have dropped out of the program after enrollment and were not included in the study. A third limitation was that interventions varied, and each patient received different doses and combinations of the interventions. Additionally, the observation time was not consistent. Due to the fact that there was a missing population, participation bias is a fourth limitation of this study as the missing population may have had different characteristics

of the sample included. However, this could not be determined as the CHECK data received was limited to selected variables for the study. Finally, there are many aspects of child well being, such as parental education, that were left out in this study. As a result, the findings cannot necessarily be generalized to the entire CHECK program, nor to other programs. However, this study does support previous studies in stressing the importance of measuring the home environment among families with children of all ages.

This study implies the measured association between household functionality and parents' perceptions of the psychosocial functioning of their children. The greater public health implication of this study is to demonstrate the importance of focusing on the social microenvironment when addressing children's psychosocial functioning. Further research is required to assess the effects of social determinants at all levels (child, family, community, and societal) that influence the mental health status of children with chronic diseases.

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Key Messages

- The association between children's psychosocial behavior and the functionality of their home environment emphasizes the importance of studying household functionality to improve health outcomes.
- Chaos in the household environment and positive PSC-17 screening results decreased after enrollment into the care coordination program, CHECK.
- In contrast to previous research, younger patients were more likely to have a positive psychosocial screen at baseline compared to adolescents.
- Social determinants of health, such as the home environment, can be improved by educating and supporting families.
- Awareness of household functionality and its effect on psychosocial behavior can help clinical and public health professionals provide better recommendations in health promotion.

Table 1 – Descriptive Characteristics by the Total Analytic Sample and by the PSC-17 Screening Result of the Child at Baseline (October 2015 – May 2017), CHECK Program					
Variables		**Total (n = 293)**	**Positive PSC-17 (n = 75)**	**Negative PSC-17 (n = 218)**	**p-value [#]**
		n (%)	**n (%)**	**n (%)**	
CHAOS score	Mean ± SD	18.8 ± 3.4	17.4 ± 4.0	19.3 ± 3.0	0.0002*
Age (years)	Mean ± SD	10.5 ± 3.8	9.5 ± 3.4	10.8 ± 3.8	0.01*
Gender	Female	122 (41.6)	26 (34.7)	96 (44.0)	0.16
	Male	171 (58.4)	49 (65.3)	122 (56.0)	
Race	White	6 (2.0)	2 (2.67)	4 (1.8)	0.49
	Black/African American	175 (59.7)	49 (65.3)	126 (57.8)	
	Hispanic/Latino	51 (17.4)	9 (12.0)	42 (19.3)	
	Other[a]	51 (17.4)	13 (17.3)	38 (17.4)	
Asthma	Yes	231 (78.8)	62 (82.7)	169 (77.5)	0.35
	No	62 (21.2)	13 (17.3)	49 (22.5)	
Diabetes	Yes	16 (5.5)	5 (6.7)	11 (5.0)	0.59
	No	277 (94.5)	70 (93.3)	207 (94.9)	
CHECK Risk Category	Low	105 (35.8)	27 (36.0)	78 (35.8)	0.73
	Medium	163 (55.6)	40 (53.3)	123 (56.4)	
	High	25 (8.5)	8 (10.7)	17 (7.8)	

[a]American Indian/Alaska Native, Asian, Native Hawaiian or other Pacific Islander, Two or more Race/Ethnicity
[#]p-values were obtained for categorical variables by chi-square tests, and the Wilcoxon Rank Sum Test for continuous variables
*Significant p-value

Table 2 - Comparison of Proportion of Children with CHAOS and PSC-17 Scores: Baseline (October 2015 – May 2017), and First Reassessment After Enrollment into the CHECK Program (4-8 months after baseline)				
Variable	**Categories**	**Baseline (n = 293)**	**1st Reassessment (n = 293)**	**p-value[#]**
		n (%)	**n (%)**	
CHAOS score	Mean + SD	18.8 + 3.4	19.7 + 2.9	<.0001*
PSC-17 Screening Result	Positive	75 (25.6)	44 (15.0)	<.0001*
	Negative	218 (74.4)	249 (85.0)	
PSC-17 Internal	Positive	27 (9.2)	18 (6.1)	0.0003*
	Negative	266 (90.8)	275 (93.9)	
PSC-17 External	Positive	30 (10.2)	14 (4.8)	0.0013*
	Negative	263 (89.8)	279 (95.2)	
PSC-17 Attention	Positive	47 (16.0)	26 (8.9)	<.0001*
	Negative	246 (84.0)	267 (91.1)	
PSC-17 Total	Positive	39 (13.3)	16 (5.5)	<.0001*
	Negative	254 (86.7)	277 (94.5)	

Baseline date ranges from October 2015 to May 2017, and first reassessment date ranges from May 2016 to August 2017

[#] p-values were computed by Wilcoxon sign rank test for continuous variables and by chi-square test for categorical variables

[*] Significant p-value

Table 3 – Crude and Adjusted Relationship between CHAOS and PSC-17, CHECK Program					
		Positive PSC-17 Screening: Baseline (n = 293)		**Positive PSC-17 Screening: 1st Reassessment (n = 293)**	
		Parameter Estimate*	**p-value**	**Parameter Estimate**	**p-value**
Crude	**CHAOS**	(-0.1639)	<0.0001	(-0.2024)	<0.0001
Adjusted	**CHAOS**	(-0.1570)	0.0001	(-0.1967)	0.0001
	Age	(-0.0798)	0.04	(-0.0453)	0.33

*Represents beta coefficient (i.e. the log odds of having a positive PSC-17 screening result for every unit change in the respective variable)

Table 4 – Mean CHAOS Score among Categories Based on PSC-17 Screening Results: Baseline and 1st Reassessment After Enrollment into the CHECK Program				
Groups		**CHAOS Score: Baseline**	**CHAOS Score: 1st Reassessment**	**p–value[#]**
	n (%)	**Mean ± SD**	**Mean ± SD**	
Improved				
Positive PSC-17 Baseline / Negative PSC-17 1st Reassessment	48 (16.4)	18.1 ± 3.5	19.6 ± 2.5	0.009*
No Change				
Positive PSC-17 Baseline / Positive PSC-17 1st Reassessment	27 (9.2)	16.1 ± 4.5	16.8 ± 4.3	0.33
Negative PSC-17 Baseline / Negative PSC-17 1st Reassessment	201 (68.6)	19.3 ± 3.0	20.1 ± 2.6	0.0007*
Worsened				
Negative PSC-17 Baseline / Positive PSC-17 1st Reassessment	17 (5.8)	18.5 ± 3.0	19.8 ± 3.0	0.08
	p-value[@]	0.0007*	0.0009*	

[#] p-values for significant difference at baseline and the first reassessment were computed by Wilcoxon sign rank test
[@] p-values for significant difference among the groups were computed by Kruskal Wallis test
* Significant p-value