RISK OF FOOD INSECURITY IN MOTHERS OF CHILDREN WITH SPECIAL HEALTH CARE NEEDS

By

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A THESIS

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List of Abbreviations

CDC	Centers for Disease Control and Prevention
CSHCN	Children with Special Health Care Needs
CI	Confidence Interval
DHS	Oregon Department of Human Services
FPL	Federal Poverty Level
HFSS	Household Food Security Survey
MCHB	Maternal and Child Health Bureau
OR	Odds Ratio
NH	Non-Hispanic
NS-CSHCN	National Survey of Children with Special Health Care Needs
PRAMS	Pregnancy Risk Assessment Monitoring System
TANF	Temporary Assistance for Needy Families
USDA	United States Department of Food and Agriculture
WIC	Special Supplementary Nutrition Program for Women, Infants, and Children

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ABSTRACT

Background

Food insecurity is a problem that affects millions of households in the United States every year, and is associated with poor health outcomes. Despite its high prevalence, food insecurity is a phenomenon that is not routinely screened for by most health care providers.

Children with special health care needs (CSHCN) are a population that is defined by the presence of, or risk for, a chronic condition, and an elevated need and use of health care services. The increased medical costs for families of CSHCN contribute to the risk for food insecurity; this population represents unique opportunities for screening and outreach. While the financial burden of having a CSHCN has been documented in the scientific literature, the association between food insecurity and having a CSHCN has not yet been studied.

This study seeks to: 1) estimate prevalence of food insecurity among mothers in Oregon, 2) estimate prevalence of children with special health care needs (CSHCN) among two-year-olds in Oregon and 3) test the hypothesis that mothers who have two-year-old children with special health care needs are at higher risk for food insecurity than mothers whose children do not have special health care needs. This hypothesis will be examined using both a cross-sectional and a longitudinal analysis approach.

Methods

Oregon Pregnancy Risk Assessment Monitoring System (PRAMS) surveys mothers who delivered live births in Oregon. At two to six months

postpartum, mothers are questioned about perinatal health events and birth outcomes. Oregon PRAMS-2 was developed as a two-year follow-up survey of mothers who responded to PRAMS, designed to assess early childhood health issues. Questionnaires are mailed to mothers identified by monthly stratified sampling, oversampling for race/ethnicity categories and low birth weight babies. PRAMS and PRAMS-2 data are weighted to provide a population-based sample and to allow for population-based estimates.

Data from the 2006 Oregon Pregnancy Risk Assessment Monitoring System: Two-Year Old Survey (PRAMS-2), a two-year follow-up study of women initially surveyed in 2004 Oregon PRAMS were used for this study. Responses to PRAMS and PRAMS-2 were considered to occur at Time 1 and Time 2, respectively. Individual responses were also linked to birth certificate data. Of the 1,968 women who responded to 2004 Oregon PRAMS, 865 responded to PRAMS-2. The weighted response rate to PRAMS-2 was 51.1%. The unweighted response rate was 44%.

Food insecurity at both time periods was assessed with a question on both surveys by asking "During the *12 months before* your new baby was born, did you ever eat less than you felt you should because there was not enough money to buy food?" (Time 1) and "In the *past 12 months*, did you ever eat less than you felt you should because there was not enough money to buy food?" (Time 2). Mothers who answered "yes" to these questions were classified as food insecure for the respective time periods.

Having a CSHCN at Time 2 was assessed with a 10-item question about ongoing needs lasting 6 months or more for specific health services: specialty health care, behavioral health or mental health services, physical therapy, occupational therapy, speech services, medication, home health services, special diet, use of assistive devices, or durable medical equipment. Mothers who responded "yes" to any 1 or more of the 10 items were classified as having a CSHCN; this variable was further categorized to represent the number of health services needed: one ongoing need, and two or more ongoing needs.

Two logistic regression analytic approaches were applied to study the hypotheses. The first was a cross-sectional analysis using data from the PRAMS-2 survey to examine whether having a CSHCN was associated with self-reported food insecurity. The second was a longitudinal examination of the cohort of women who were food secure at Time 1 to assess whether having a CSHCN was predictive of a shift to food insecurity at Time 2.

PRAMS and PRAMS-2 datasets contain weighted data accounting for complex sampling design. STATA 10 was used for analysis of weighted data in this study; all percentages reported are weighted.

Results

In this sample of mothers of two-year-olds in Oregon, 11.9% were food insecure at Time 1, while 12.8% were food insecure at Time 2. 62 (6.6%) women experienced a shift from food security to food insecurity in the 2-year follow-up period. 38 (5.5%) reported a shift from food insecurity to food security in the

follow-up period. Of the two-year-olds in this sample, 11.7% were classified as CSHCN.

In both the univariate and multivariate cross-sectional models, having a CSHCN was not significantly associated with food insecurity. In the longitudinal model, having a child with ongoing needs for two or more health services was significantly predictive of a shift to food insecurity in the two-year follow-up period (OR = 6.50, 95% CI: 1.71 – 24.74; p = 0.006) after adjusting for covariates.

Discussion

While the associations between food insecurity and having a CSHCN were not statistically significant in the cross-sectional analysis, a trend of increasing odds of food insecurity was observed as the number of ongoing health service needs increased. The longitudinal model in this study provides support that having a child with ongoing need for two or more health services at Time 2 is predictive of a shift to food insecurity from Time 1 to Time 2.

A major strength of this study was in the use of both a cross-sectional and a longitudinal analytic approach to study the association of maternal food insecurity and having a 2-year-old CSHCN. The PRAMS-2 survey question used to identify CSHCN in this study was a potential limitation.

This preliminary evidence identifies a unique and particularly vulnerable population for screening and intervention, and provides support for the importance of implementing routine food security screening by health care

providers. Future longitudinal research is needed to further identify risk factors that are predictive of a shift to food insecurity over time.

Introduction

Food Insecurity

Food insecurity is defined by the United States Department of Agriculture (USDA) as having "limited or uncertain availability of food, or limited or uncertain ability to acquire acceptable foods in socially acceptable ways." Nationally, 16.7% of all households with children under 6 years of age are estimated to be affected by food security concerns, corresponding to 2.94 million households or 12.79 million people[1], and potentially more than 10 million children[2].

Among families with income below the federal poverty line, 36.8% are estimated to be food insecure at some point during the year[3]. Food insecurity is more prevalent among African American and Hispanic families[4]. Other risk factors for food insecurity include caregiver's education, employment status, the presence of health, or mental health issues, being enrolled in The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), Food Stamps, or Temporary Assistance for Needy Families (TANF) programs[3,5,6,7,8,9,10]. Household structure also influences food insecurity: in 2001, 10.7% of households headed by a married couple were food insecure; of households headed by a single woman, 31.9% reported being food insecure; and of households headed by a single man, 15.9% reported food insecurity[1].

Data on food insecurity have been collected since 1995, but food security status is still not routinely inquired about at pediatric visits[11,12], and many caregivers are reluctant to bring it up themselves[13]. An emergency food bank recipient in Oregon echoed this sentiment, saying "I need to know I can discuss this issue without worrying they [doctors] will take my children away because I do not have the resources to feed them."[13]

Asking caregivers questions about sufficient resources, rather than about balanced diets will reveal more about specific needs of the family in culturally sensitive ways[3] and provide opportunity for referral to safety net services or local food assistance programs. Increasing awareness of government safety net programs by health care providers is necessary to provide valuable information to patients[14]. A study by Fleegler, et al found that while only 17% of families seen in 2 urban pediatric clinics were screened for food insecurity, of those who were screened and referred to agencies for food security assistance, 94% found their referral experience helpful[15].

Validated screening questions can easily be added to patient intake forms[13], and in a survey conducted by the Oregon Childhood Hunger Initiative, a majority of healthcare providers indicated that they were comfortable addressing food insecurity in clinic, and also demonstrated a willingness to screen for household food insecurity using standardized screening tools[13,14] .

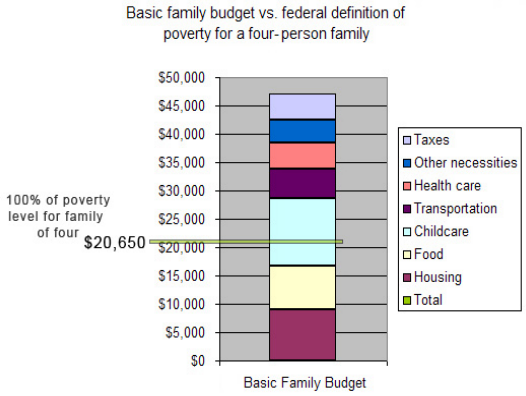
Food insecurity is associated with maternal depression and family stress[9,16,17]. However, while food insecurity adversely affects families, mothers have been known to buffer their children from hunger by reducing their own food intake before reducing food for their children[5]. According to the USDA, only 0.6% of households with children reported that food access was so uncertain that the children of the household experienced disrupted eating patterns, or went hungry[1].

Heads of food-insecure households have been more likely to report major depression, distress, and poor social support, in addition to higher odds of reporting multiple chronic conditions[12,17]. Associations between food insecurity and higher risk of obesity and overweight have been documented[3,17,68]. Parents of children under 3 who live

in food insecure households are more likely to report hospitalization and poor infant health[18,19], and higher frequency of medical diagnoses and chronic conditions have been observed in children from food-insecure households[12,16]. Other issues for children related to food insecurity include vitamin deficiency, higher incidence of infectious illnesses and other infections, behavioral and psychosocial dysfunction, and lower physical functioning[3,4,7,17,18,20].

Elevated costs of medical care contribute to family expenses, making food insecurity a concern among families with members who have special health care needs. Figure 1 represents an estimated basic family budget for a family of 4, as compared to 100% of the federal poverty level (FPL); from this figure, it is apparent how elevated health care costs can strain the family budget, even for families well above 100% FPL.

Figure 1. Source: Economics Policy Institute Basic Family Budget Calculator [21]



Identification of Food Insecurity

The Economic Research Service of the USDA generates national food security statistics from the Current Population Survey (CPS), administered by the Census Bureau. Since 1995, the CPS Food Security Supplement has been added annually to the survey, and about 50,000 households respond to the food security items[22, 23].

The USDA offers several food security screening modules. The *U.S. Household Food Security Survey Module* is an 18-item screener delivered in three stages to minimize respondent burden. Most households will only respond to the first three questions, or if there are children in the household, the first five questions[24].

Another popular screening tool for food insecurity is the *U.S. Household Food Security Survey Module: Six-Item Short Form* (HFSS) (See Appendix B). The six items in this survey represent increasing severity of food insecurity and were designed to address the essential experiences and indicators of food insecurity[25]. This shortened form was found to correctly identify food security levels for 97.7% families when compared to screening using the 18-item *U.S. HFSS Module*[25].

Food insecurity is complicated, and difficult to assess with a single indicator, however shorter tools are sometimes needed to facilitate screening for food insecurity in primary care settings[2], or on surveys. A single-question screening tool was developed by Kleinman et al and studied in routine screening at a neighborhood health clinic; this measure was found to have acceptable sensitivity, specificity, and reliability in identifying food insecure families[2].

The USDA definition is concerned with past-year food insecurity as a result of limited financial resources; as such each of the questions in the core module ask about certain conditions as a result of financial constraints ("…because there wasn't enough money"), and contain a temporal specification ("In the past 12 months…")[22].

Children with Special Health Care Needs

The Federal Maternal and Child Health Bureau (MCHB) defines children with special health care needs (CSHCN) as "those who have or are at risk for a chronic

physical, developmental, behavioral, or emotional condition and who also require health and related services of a type or amount beyond that required by children generally"[26]. This definition was adopted by MCHB in 1998 and is based on elevated need for services, as opposed to specific diagnosed conditions, or functioning[26,27]. Because chronic conditions can manifest differently by individual in terms of severity or degree of impairment, and because conditions can exist without formal diagnoses, MCHB sought to avoid a definition of CSHCN based only on diagnostic lists and categories. Further, a definition based only on functional status would not capture individuals who function normally, but still need occasional extra services to maintain function, as a child with asthma might. A definition based on elevated need for services captures a more diverse population that might have been otherwise neglected using a more narrow definition[26,27].

In June 1998, a collaborative effort was undertaken by the Child and Adolescent Health Measurement Initiative (CAHMI) and over 30 other stakeholders to create a screening tool to identify CSHCN which would make the MCHB definition operational[28]. A standardized screening tool based on an agreed-upon definition was necessary in order understand the prevalence and characteristics of CSHCN, the health care needs and experiences of CSHCN and their families, and where gaps in services might exist[28,29].

From this effort, the CSHCN Screener[30] was developed (See Appendix C). It is a parent survey containing five questions inquiring about specific health consequences, including "whether the child 1) is limited or prevented in any way in his or her ability to do things most children of the same age can do; 2) needs or used medications prescribed by a doctor (other than vitamins); 3) needs or uses specialized therapies such as physical, occupational, or speech therapy; 4) has above-routine need or use of medical, mental

health, or educational services; or 5) needs or receives treatment or counseling for an emotional, behavioral, or developmental problem"[28]. Each of the five main questions contain two follow-up questions regarding the nature of the health consequence (i.e., medical, behavioral, other health-related condition), and whether the consequence has lasted, or is expected to last for 12 months or more[28]. In order to be classified as a CSHCN, parents must answer "yes" to at least one question on the Screener, and both of its corresponding follow-up questions[28].

Using the CSHCN Screener, the 2005-2006 National Survey of Children with Special Health Care Needs (NS-CSHCN) estimated that 13.9% of children across the US require special health care services, accounting for approximately 10.2 million children[31]. Nationally, about 1 in 5 households have at least one CSHCN, corresponding to over 8.8 million households. Although only estimated to be 14% of the population, 40% of medical expenses for children overall are accounted for by CSHCN[27]. State-by-state prevalence of CSHCN varies as determined by the NS-CSHCN, ranging from 10% to 18.5%[27,29,31]. In Oregon, prevalence of CSHCN is estimated to be 13.7%; of that population 8.6% are aged 0-5 years[31].

Food Insecurity and Children with Special Health Care Needs

Food security is related to income, and excess out of pocket health care expenses in addition to other basic necessities can compete with resources otherwise budgeted for food[13]. A 2004 study demonstrated that among families of CSHSN, economy-wide increases in medical costs were associated with financial burdens of greater than 10% of family income[32]. Unlike other expenses which must be paid in full monthly, such as rent or utility payments, money budgeted for food can be somewhat flexible, and might be

reduced when resources are particularly strained. This study seeks to discern the association between having a child with special health care needs and elevated risk of maternal food insecurity.

To date, no studies have been published which specifically examine the association between having a CSHCN and maternal food insecurity, though several studies have considered the excess financial burden experienced by families of CSHCN. Mothers still assume many of the responsibilities and burdens of child and health care in families[33]. Nationally, 26.4% of families of CSHCN reported that care for their child resulted in financial concerns, while 30% of families reported employment problems[34].

A study in New Hampshire found that CSHCN, when compared to children who do not have special health care needs, were significantly more likely to be enrolled in public insurance programs (21.4% ±2.3 vs 11.5% ± 0.8), and less likely to live in families above 300% of the federal poverty level (48.2% ±2.5 vs 56.0% ±1.2)[35]. Further, among families of CSHCN, 31.1% (±2.3) indicated that their health insurance plan was inadequate, 20.6% (±2.1) reported financial problems, and 26.9% (±2.3) had to cut back on working, while 10.1% (±1.6) had to stop working altogether. 12.1% (±1.6) stated that they needed additional income to cover their child's medical expenses[35].

A study in Rhode Island found similar results among families of CSHCN. Financial difficulties were almost twice as likely among families of CSHCN aged 0-5 (31.6%) compared to families of teenagers with special health care needs (14.2%). Families with CSHCN whose incomes were below 200% of federal poverty were more likely to report financial problems (34.6%) than families with incomes at 200% or above federal poverty (12.3%)[34].

Below are some data regarding financial impact of having a CSHCN for families in Oregon from the 2005-2006 NS-CSHCN[31]:

1) 20% of families with a CSHCN pay $1,000 or more out of pocket in medical expenses per year for the child.

2) 18.1% of families with a CSHCN report that the child's condition causes financial problems for the family.

3) 8.7% of families of a CSHCN report spending 11 hours or more per week providing or coordinating the child's health care.

4) 29.2% of families of a CSHCN report that the child's condition caused family members to cut back or stop working.[27,31]

Elevated medical expenses related to care for a CSHCN, as well as potential impacts on employment status can certainly strain families' resources. These factors are related to general financial and familial well-being and can be used to identify a population in need of support and resources. Because families of CSHCN are already integrated in the health care system, this represents an opportunity to identify financial problems and assist such families in Oregon. Studies observing the association between having a CSHCN and maternal food insecurity have not yet been published.

Specific Aims

There are 4 specific aims for this study:

1.) This study will estimate prevalence of food insecurity among mothers of two-year-olds in Oregon by classifying maternal food insecurity status (present or absent) among this sample using the appropriate question on PRAMS-2. This estimate will provide important information about food insecurity among Oregon mothers, further

elucidating triggers for food insecurity, suggesting need for support and outreach opportunities.

2.) Using data from Oregon PRAMS-2, establish annual prevalence of CSHCN among Oregon 2-year olds in 2006 using an appropriate operational definition from PRAMS-2 survey questions.

3.) Building a cross-sectional multivariate logistic regression model controlling for covariates and adjusting for weighted sample, assess whether having a CSHCN is associated with elevated odds of maternal food insecurity as reported in PRAMS-2 (Time 2). This is the first study to examine this particular association, and if a significant association or trend is detected, an important and particularly vulnerable population will be identified for further research and allocation of resources for public health interventions. The main hypothesis of this study is that mothers of children of special health care needs will be at elevated risk of food insecurity when compared to mothers whose children do not have special health care needs.

4.) Finally, a longitudinal model will be built with a reduced sample comprised only of the women who were food secure as reported in PRAMS (Time 1). Of those women, outcome of interest is a shift to food insecurity in the two year follow-up period. The purpose of this analysis is to identify whether having a CSHCN is predictive of a shift from food security to food insecurity over time.

Methods

Oregon PRAMS Methodology

Since 2002, Oregon Pregnancy Risk Assessment Monitoring System (PRAMS) has been a part of the PRAMS surveillance system of the Centers for Disease Control (CDC) initiated in 1987 and created to evaluate relationships between prenatal events and birth outcomes across in the United States[36]. PRAMS surveys mothers at two to six months postpartum who delivered live births, and asks questions related to perinatal health events and birth outcomes. Following CDC data collection protocol, questionnaires contain core questions which appear on PRAMS in every participating state, in addition to other items tailored to meet the interests and needs of the Oregon Department of Human Services (DHS). PRAMS topics include prenatal care, contraception, social and medical support services, mental health, and physical abuse.

The PRAMS survey uses a monthly stratified random sampling method of birth certificates to identify new mothers and to allow for robust estimates of characteristics of certain variables of interest. Women are oversampled in six strata in Oregon, including 5 strata for race/ethnicity of the mother: Non-Hispanic (NH) American Indian/Alaska Native, NH Asian/Pacific Islander, Hispanic, NH African American and NH White. The sixth stratum is for low birth weight babies (< 2,500 grams) born to white mothers. Because of the population composition in Oregon, it is not feasible to oversample low birth weight babies among the other race/ethnicity strata[37].

Surveys are mailed to new mothers. A lengthy data collection process is followed to promote high response rates. A stratified sample of birth certificates is drawn in Oregon

each month of the year and mothers are initially contacted 2-4 months postpartum. For each monthly batch of new mothers, the following survey protocol is followed:

1. **Preletter** – Each mother receives a letter introducing PRAMS and informing her that a survey will arrive shortly.
2. **Initial Questionnaire Packet Mailed** – 3-7 days after the Preletter, this packet is mailed to sampled mothers.
3. **Tickler** – Serving as a thank-you and a reminder note, the tickler is sent 7-10 days after the initial questionnaire packet.
4. **Second Questionnaire Packet Mailed** – 7-14 days after the tickler is sent, the second packet is sent to mothers who have not yet responded.
5. **Third Questionnaire Packet Mailed** – 7-14 days after the second packet is sent, the third packet is sent to all remaining non-respondents.
6. **Telephone Follow-up** – 7-14 days after the third questionnaire is sent, telephone follow-up is attempted for all remaining non-respondents. Over a period of 2-3 weeks, up to 15 call attempts are made to reach a mother, with calls staggered over different times of day and days of the week.

This sequence of contacts lasts about 60-95 days for each batch of sampled mothers. PRAMTrac software, developed by the CDC, is used to assist in tracking mailings, telephone calls and responses.

Included in each Questionnaire Packet is a multi-purpose cover letter which serves as both an introductory letter and an informed consent information page. Also included in the mailing packages are: the questionnaire packet, a self-addressed stamped envelope for returning the questionnaire, a question and answer brochure to give mothers

additional information about PRAMS, a 3-year calendar to serve as a memory aid in answering questions and a participation incentive, which differs by state.

In 2005, PRAMS-2, a two-year follow-up survey of mothers who had previously responded to PRAMS, was developed. The Oregon Office of Family Health re-surveyed PRAMS respondents whose children had recently turned 2 years old, to elucidate issues regarding early childhood health using a longitudinal cohort design. The data collection protocol for PRAMS-2 is conducted identically to PRAMS in regard to the collection methodology described above. Questions on PRAMS-2 relate to insurance status, immunizations, well-child care, chronic diseases, oral care, family planning, breastfeeding, domestic violence, family stress, and developmental concerns and other topics.

The mothers included in 2006 PRAMS-2 (Time 2) and sampled in this study gave birth in 2004; they were included in the sampling frame for 2004 PRAMS (Time 1). All women who completed 2004 PRAMS surveys were sent a 2006 PRAMS-2 survey, with the exception of those who indicated "Do not contact me again" on the consent form, and those whose babies had died.

PRAMS Weighting Process

States participating in the CDC's PRAMS surveillance system draw a monthly stratified random sample of live births from birth certificate records. In order to make inferences on certain subpopulations of particular interest, many states oversample mothers exhibiting certain characteristics as a purely random sample would not have enough data on minority groups to make statistical inferences. In Oregon, stratification is done for those who gave birth to low birth weight babies, and is also done by mother's

race/ethnicity. Stratification is done on these categories because some populations do not represent a large enough proportion in the state's population to make statistical inferences [37]. Stratification variables in PRAMS datasets are derived from birth certificate files which provide demographic and health information collected by vital statistics systems.

There are three types of weighting in PRAMS datasets:

1) Sampling weights are created for each respondent based on the variables which are oversampled (race/ethnicity) and the rarity of certain health outcomes, such as very low birth weight[36].

2) Non-response weights are assigned on the assumption that mothers sharing certain characteristics might be less likely to respond to the survey than others, but that those who respond in certain strata are likely to have similar responses (i.e., women in low income categories might be less inclined to respond than those in higher income categories, but average responses among the low income women should represent the women who did not respond). Categories are collapsed until each cell has at least 25 responses. The overall response rate in each category determines the weighting scheme for non-response. Responses in categories with low response rates will have a higher weight than those with high response rates[36].

3) Finally, non-coverage weights are assigned based on the potential for the omission of eligible mothers from the sampling frame due to duplicate records or late processing[38]. Generally, non-coverage does not represent a critical issue in mail/phone surveillance systems[36].

Final weights for analysis are created by multiplying the sampling, non-response, and non-coverage weights for each respondent. "The weight can be interpreted as the number of women like herself in the population that each respondent represents."[36]

Analysis of PRAMS data requires use of advanced statistical software to take the complex sampling and weighting schemes into account. Oregon Department of Human Services (DHS) provides instructions on how to declare the predefined sample weights for analysis. For more information on PRAMS methodology and PRAMS weighting, see http://cdc.gov/prams/methodology.htm.

Data Management

Individual state health departments are responsible for data-cleaning and editing procedures for PRAMS databases, including monitoring telephone interviews, data entry confirmation and correction of errors. These procedures are completed by Oregon DHS. PRAMS and PRAMS-2 analysis files used for this study include a 2004 PRAMS dataset (N = 1,968), a 2006 PRAMS-2 only dataset (N = 865), and a merged dataset which includes responses for both surveys for each individual respondent, and the corresponding birth certificate data. (N = 865).

After submission and approval of an Oregon PRAMS Data Use Agreement, data dictionaries and data files were obtained in STATA format. All analyses were conducted for this study using STATA 10 (STATA Corporation).

Oregon PRAMS and PRAMS-2 have been approved by the Oregon DHS Institutional Review Board. This study was exempted from review by the Oregon Health and Science University Institutional Review Board because Oregon PRAMS and

PRAMS-2 datasets do not contain any personal identifying information, and cannot be linked to individual respondents.

Using 2004 Oregon PRAMS and 2006 Oregon PRAMS-2 data, this study will carry out both a cross-sectional analysis and a preliminary longitudinal analysis to examine whether having a CSHCN is associated with increased odds of maternal food insecurity among mothers whose babies were born in 2004.

Variable Coding

Outcome

Cross-Sectional Model

The outcome of interest for the cross-sectional logistic regression model in this study is self-reported food insecurity by mothers of two-year-old children. This outcome is measured using a one-item assessment of food insecurity from the PRAMS-2 survey, which asks: "In the *past 12 months,* did you ever eat less than you felt you should because there wasn't enough money to buy food?" This question closely resembles the fifth question in the *Six-Item HFSS* which asks "In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?"[39] The PRAMS-2 survey question captures both the perception of a lack of money to buy food, and the reduction of food intake common to more severe levels of food insecurity. These two components should allow for a fairly robust estimation of food insecurity for this study.

Possible responses to the PRAMS-2 food insecurity question include "Yes" and "No"; a respondent who answered "Yes" to this question was classified as being food insecure. For the purposes of the logistic regression analysis, the food insecurity variable was coded as 0 ("No," or food secure) and 1 ("Yes," or food insecure).

Of our initial sample of 865 women, food insecurity responses were available for 863 women. Those who did not respond to this question were excluded from the analysis.

Longitudinal Model

The PRAMS survey asks a similar question assessing food insecurity: "During the *12 months before* your new baby was born, did you ever eat less than you felt you should because there wasn't enough money to buy food?" Of particular concern for the longitudinal analysis were subjects who experienced a shift from food security at Time 1 to food insecurity at Time 2. Those who responded "No" to the food insecurity item on PRAMS, and responded "Yes" to the food insecurity item on PRAMS-2 were classified as having changed to food insecurity. Women who were classified as food insecure at the first survey period were excluded from the longitudinal analysis (n = 84).

A variable was created to represent change in food security status from food secure at Time 1 to food insecure at Time 2; this allowed for comparison of those who experienced a shift to food insecurity to the women who were food secure at both time periods. The sample for the longitudinal analysis had 730 women, of whom 62 (6.6%, weighted) reported a change from food secure to food insecure.

Predictor Variables

The main predictor variable for both models in this study is having a two-year-old CSHCN at Time 2. Initially this was coded as a dichotomous variable: mothers having answered "Yes" to any one or more of the options listed in questions 79 B or C (see Table 1; Also see Appendix D) on the PRAMS-2 survey were classified as having a

CSHCN, while those who answered "No" to all 10 options were classified as not having a CSHCN.

During the preliminary descriptive analysis process, the decision was made to expand the classification of CSHCN to capture how maternal food insecurity is affected by the *number* of health services needed for 6 months or more by the CSHCN in the sample. The final CSHCN variable for analysis had 3 levels: 0 needs, one ongoing need, and two or more ongoing needs, based on the number of the health services to which each mother responded "Yes." This three-level categorization was chosen to examine a potential trend in increasing risk of food insecurity with increasing numbers of health services needed. This categorization was also based on a need for sufficient sample sizes in each category of CSHCN, allowing for robust statistical analysis and interpretation of the association of interest.

Table 1. Identifying and classifying CSHCN:
Questions 79b and c from 2006 Oregon PRAMS-2

79. Please circle Y (Yes) or N (No) for each of the following.
Does your two-year-old have…

b. An ongoing need (lasting six months or more) for:

(1) Specialty health care	N	Y
(2) Behavioral health or mental health services	N	Y
(3) Physical therapy	N	Y
(4) Occupational therapy	N	Y
(5) Speech services	N	Y

c. An ongoing need (lasting six months or more) for:

(1) Medication	N	Y
(2) Home health services	N	Y
(3) Special diet	N	Y
(4) Use of assistive devices	N	Y
(5) Durable medical equipment	N	Y

Among the 863 mothers in the sample who responded to the food insecurity question, 29 did not respond to all 10 CHSCN items and were excluded. (Note: Of those 29 mothers who were excluded based on non-response to the CSHCN questions, 6 were classified as food insecure at Time 2.)

After excluding mothers who did not respond to the PRAMS-2 food insecurity item and/or all 10 of the CSHCN items, 835 mothers met the inclusion criteria. All 835 mothers were included in the cross-sectional model; the longitudinal model was comprised of 730 mothers.

Predictors Derived from PRAMS-2 Survey and Birth Certificate Files

All other predictor variables for this study were derived from the PRAMS-2 survey, or from the birth certificate files. Table 2 describes all of the variables for analysis, both as they were provided in the survey or the birth certificate files, and how they were coded for analysis in this study.

Annual household income was reported in question #40 in the PRAMS-2 survey. For the purposes of this study, the income variable was collapsed from eight categorical levels based on salary amounts (Less than $10,000; $10,000 to $14,999; $15,000 to $19,999; $20,000 to $24,999; $25,000 to $29,999; $30,000 to $34,999; $35,000 to $49,999; and $50,000 or more), to four levels to allow for an examination of the relationship between food insecurity and income, while providing sufficient cell size for statistical inference. The four categories for analysis include: Less than $15,000; $15,000 to $24,999; $25,000 to $34,999; and $35,000 or more.

Maternal age was provided in the dataset as a continuous variable based on the mother's age on the date she filled out the PRAMS-2 survey. For this study, age was

categorized into three standard levels: younger than 25 years, 25-29 years and 30 years and older.

Maternal race/ethnicity was derived from the birth certificate file and consisted of 5 categories: African American (non-Hispanic (NH)), American Indian/Alaska Native (NH), Asian/Pacific Islander (NH), Hispanic, and White (NH).

Maternal education was derived from question 2 in the PRAMS-2 survey and had three levels: less than 12th grade, 12th grade or GED, and more than 12th grade.

PRAMS-2 asks about marital status and provides five options: never married, married, widowed, divorced, and separated. Due to the relationship between food insecurity and family structure, all five marital status categories were included in this analysis.

Maternal employment status was determined from the PRAMS-2 survey and consisted of four responses to the question "Are you employed?" The responses are as follows: "Yes, full time," "Yes, part time," "No, but I am looking for work," and "No, I am not looking for work." This variable was left as is for this analysis.

There are 36 counties in Oregon. County of residence was derived from the birth certificate files and the counties were designated by DHS as "urban" or "rural" based on 2001 population density. Counties were classified as rural if the population density was less than 60 people per square mile; the following counties were classified as rural: Baker, Clatsop, Coos, Crook, Curry, Deschutes, Douglas, Gilliam, Grant, Harney, Hood River, Jefferson, Josephine, Klamath, Lake, Lincoln, Linn, Malheur, Morrow, Sherman, Tillamook, Umatilla, Union, Wallowa, Wasco, and Wheeler. The remaining counties

were classified as urban: Benton, Clackamas, Columbia, Jackson, Lane, Marion, Multnomah, Polk, Washington, and Yamhill.

Current child health insurance status at the time of the PRAMS-2 survey is inquired about in question #63 of the survey, and provides seven options: "None," "Oregon Health Plan (OHP), Medicaid or SCHIP," "Medicare," "Private Insurance," "Military/CHAMPUS," "Indian Health Service," or "Other, Please tell us." These categories were collapsed into three levels for this study: Privately insured, comprised of "Private" and "Military/CHAMPUS," Publicly insured, comprised of "Oregon Health Plan, Medicaid or SCHIP," "Medicare," and "Indian Health Service," and Uninsured, comprised of those who checked "None."

Finally, question #59 on the PRAMS-2 survey asks whether the child has ever been on WIC, providing three responses: "No," "Yes, on WIC now," and "Yes, but no longer on WIC." For this analysis, this variable was re-coded to contain two options "Never on WIC" (mothers who responded "No"), and "Ever on WIC" (mothers who checked either of the other two options).

Table 2. Variables derived from 2004 Oregon PRAMS‡, 2006 Oregon PRAMS-2†, or birth certificate file data*

Variable	Possible responses	Coding for analysis
Food Insecurity – Time 1‡	-No -Yes	0 = Food secure 1 = Food insecure
Food Insecurity – Time 2†	-No -Yes	0 = Food secure 1 = Food insecure
Shift to food insecurity‡†	-No on PRAMS Food insecurity question -No on PRAMS-2 Food insecurity question -Yes on PRAMS-2 Food insecurity question	0 = Food secure at both Time 1and Time 2 1 = Shift to food insecurity: Food secure at Time 1, food insecure at Time 2
CSHCN† – Ongoing need (lasting 6 months or more) for: -Specialty health care -Behavioral health or mental health services -Physical therapy -Occupational therapy -Speech services -Medication -Home health services -Special diet -Use of assistive devices	-No -Yes	Does not have CSHCN = 0; No to all health services Has CSHCN: 1 = Need for one health service 2 = Need for two or more health services
Annual household income†	-Less than $10,000 -$10,000 to $14,999 -$15,000 to $19,999 -$20,000 to $24,999 -$25,000 to $29,999 -$30,000 to $34,999 -$35,000 to $49,999 -$50,000 or more	1 = Less than $15,000 2 = $15,000 to $24,999 3 = $25,000 to $34,999 4 = $35,000 or more
Maternal age†	-Mother's age on date of PRAMS-2 survey (continuous)	1 = younger than 25 years 2 = 25 – 29 years 3 = 30 years or older
Maternal race/ethnicity*	-African American€ -American Indian/ Alaska Native€ -Asian/Pacific Islander€ -Hispanic -White€	1 = African American€ 2 = American Indian/Alaska Native€ 3 = Asian/Pacific Islander€ 4 = Hispanic 5 = White€

Table 2 (Continued). Predictor variables derived from 2006 Oregon PRAMS-2 or birth certificate file data*

Maternal education†	-Less than 12th grade -12th grade or GED -More than 12th grade	1 = < 12 years 2 = 12 years/GED 3 = < 12 years
Marital status†	-Never married -Married -Widowed -Divorced -Separated	1 = Never married 2 = Married 3 = Widowed 4 = Divorced 5 = Separated
Maternal employment status†	-Yes, full time -Yes, part time -No, but I am looking for work -No, I am not looking for work	1 = Full time 2 = Part time 3 = Unemployed, looking for work 4 = Unemployed, not looking for work
County type*	All Oregon counties	1 = Rural 2 = Urban
Current child insurance status†	-None -Oregon Health Plan, Medicaid or SCHIP -Medicare -Private Insurance -Military/CHAMPUS -Indian Health Service -Other → Please tell us	1 = Private/Military 2 = Public 3 = Uninsured
Child ever on WIC†	-No -Yes, on WIC now -Yes, but no longer on WIC	1 = Never on WIC 2 = Ever on WIC (now or previously)

‡ Variable derived from 2004 PRAMS survey
† Variables derived from 2006 PRAMS-2 survey
*Variables derived from birth certificate data
€ Non-Hispanic

Statistical Analysis

Descriptive Statistics

Simple frequency statistics were run to determine prevalence of food insecurity at Time 1 and Time 2, and the prevalence of each covariate of interest. Two methods were used: (1) simple one-way tables to determine unweighted numbers of subjects in each category, and (2) one-way tables using the Survey Data Analysis function in STATA to obtain weighted proportions using predefined sample weights.

Additionally, to determine the distribution of reported food insecurity for each level of the predictor variables, two-way tables were generated for each individual variable and food insecurity using both of the methods listed above in order to examine cell counts, weighted proportions, and chi-square test statistics.

Weighted data were used for all other statistical procedures in this study.

Univariate Analyses

Cross-Sectional Model

A simple logistic regression model was built to examine the univariate relationship between having a CSHCN and maternal food insecurity at Time 2. Odds ratios (OR) were evaluated for the two levels of health service needs (1 need, and two or more needs), as compared to not having a CSHCN (0 needs).

Additionally, univariate models were built examining the associations between maternal food insecurity at Time 2 and the other predictor variables. Though the predictor variables tested were identified for their clinical significance, odds ratios, confidence intervals (CI) and p-values from Wald test statistics were examined to identify

statistical significance of each variable's relationship with food insecurity before adjusting for other covariates.

Longitudinal Model

A simple logistic regression model was built examining the relationship between having a 2-year-old CSHCN and experiencing a shift to food insecurity in the follow-up period. Univariate logistic regression models were also built examining the associations of each of the individual covariates and the shift to food insecurity in the follow-up period.

Assessment for Confounding

For both of the outcomes of interest (food insecurity at Time 2 in the cross-sectional model, and having changed to food insecurity in the longitudinal model), nine separate univariate logistic regression models were built to examine how associations between outcomes and having a 2-year-old CSHCN changed based on inclusion of each individual predictor variable described in Table 2. Predictors which changed the univariate ORs between food insecurity, or a shift to food insecurity, and any of the two levels of CSHCN by greater than 10% were considered potential confounders.

Multivariate Analyses

Cross-Sectional Model

All of the covariates were determined a priori to be important in both the cross-sectional and longitudinal models, given their relationship to food insecurity in the scientific literature. Hence, due to their clinical importance and their significance in univariate models, all predictors remained in the full multivariate model. The decision to leave all variables in the model was made based on non-statistical inference.

All multivariate analyses were conducted using the Survey Data Analysis menu in STATA 10, which allows for analysis of weighted data. Predefined sample weights were created by CDC, and included in the PRAMS-2 dataset as variables, which were used to declare the survey design for the whole dataset. Instructions on how to declare the sample weights and survey design were provided to me by Oregon DHS.

Longitudinal Analysis

The longitudinal analysis was carried out to evaluate if having a CSHCN is predictive of a shift to food insecurity. Comparing the women whose food security status changed (from food secure at Time 1 to food insecure at Time 2) to the women who were food secure at both survey periods, a multivariate logistic regression analysis was carried out adjusting for the same clinically-significant covariates as in the cross-sectional model. Additionally, a reduced multivariate model was built to examine the combination of variables which were most predictive of experiencing a shift to food insecurity.

Results

Summary

The 2004 Oregon PRAMS originally sent surveys to 2,814 women, and had a total sample of 1,968 respondents. PRAMS-2 surveys were sent to all women who responded to PRAMS, except for those whose babies were deceased, and those who indicated "Do not contact me again;" 1,935 mothers were sent PRAMS-2 surveys in 2006. 865 responded to PRAMS-2. The weighted response rate of 51.1% corresponds to the number of mothers who responded to both the PRAMS and PRAMS-2 surveys, out of the total (n = 1,935) who were sent PRAMS-2 surveys. All proportions reported henceforth are weighted.

Among this sample of mothers of two-year-old children surveyed in 2006, most had 12 or more years of education (84.9%), were married (79.1%), and lived in an urban county (77.5%). 72.9% had an average household income greater than 100% Federal Poverty Level. More than half of this sample were 30 years or older (54.6%). (See Table 4)

One third (33.2%) of mothers reported that their child was currently enrolled in WIC, while 16.0% had been enrolled in WIC, but were no longer participating in the program; 50.8% had never been enrolled in WIC. In this sample, 62% of mothers had a private health insurance plan, while 18.7% were publicly insured, and 19.4% were uninsured. Among the children, 56.5% were privately insured, 34.7% were publicly insured, and 8.8% were uninsured. Nearly one in five (19.5%) of mothers reported that their children were uninsured at some point in the two years since birth.

Food Insecurity

Table 3 demonstrates that 6.4% were food insecure at both time periods, while 81.5% were food secure at both time periods. 5.5% shifted from food insecure to food secure, while 6.6% shifted from food secure to food insecure.

Table 3. Distribution of food insecurity by survey time period, Time 1 (3 months), Time 2 (24 months), 2004 Oregon PRAMS and 2006 Oregon PRAMS-2 (N = 814)

Food Insecure	Time 1	Time 2	n (weighted %)
	Yes	Yes	46 (6.4)
	Yes	No	38 (5.5)
	No	Yes	62 (6.6)
	No	No	668 (81.5)

At Time 1, 84 (11.7%) were food insecure, while at Time 2, 109 (12.8%) reported being food insecure at some point in the previous 12-month period. Table 4 describes the distribution of maternal characteristics by food insecurity at Time 2.

Table 4. Distribution of maternal characteristics by food insecurity status at Time 2 (24 months), 2006 Oregon PRAMS-2 (N = 835)

Characteristic	Total n (weighted %)*	Food Insecure n (weighted %)*
Total	865 (100)	109 (12.8)
Has CSHCN (n = 835)		
No (0 services)	710 (88.3)	84 (11.7)
Yes – 1 need for service	69 (6.0)	12 (17.6)
Yes – 2 or more needs	56 (5.7)	13 (23.1)
Maternal age (n = 811)		
<25	143 (21.3)	34 (22.5)
25-29	200 (24.1)	27 (15.7)
30 and older	468 (54.6)	46 (7.5)
Maternal race/ethnicity (n = 833)		
AI/AN †‡	87 (1.4)	27 (19.3)
Black†	89 (1.8)	15 (32.6)
Asian/PI†+	141 (4.9)	9 (6.7)
Hispanic	136 (20.1)	17 (12.3)
White†	380 (71.9)	41 (12.9)
Maternal education (n=825)		
< 12 years	112 (15.1)	23 (14.8)
12 years	226 (31.0)	46 (23.5)
>12 years	487 (53.9)	38 (6.3)
Income¶ (n = 804)		
Less than $15,000	178 (22.0)	55 (28.5)
$15,000 to $24,999	97 (13.0)	23 (23.5)
$25,000 to $34,999	111 (11.6)	19 (21.8)
$35,000 or more	418 (53.4)	12 (2.5)
Maternal Employment Status (n = 831)		
Employed full time	276 (30.7)	29 (11.2)
Employed part time	212 (27.3)	28 (13.1)
Unemployed, looking	78 (9.4)	23 (29.1)
Unemployed, not looking	265 (32.7)	28 (9.3)
Marital status (n = 834)		
Married	628 (76.8)	55 (8.9)
Never married	153 (16.8)	38 (27.3)
Divorced	34 (4.2)	10 (26.3)
Separated	19 (2.3)	6 (11.5)
Child ever on WIC (n = 832)		
No	413 (50.8)	21 (5.7)
Yes	419 (49.2)	88 (20.0)
County type (n = 835)		
Rural	161 (22.5)	34 (19.4)
Urban	674 (77.5)	75 (10.8)

Table 4 (Continued). Distribution of maternal characteristics by food insecurity status at Time 2 (24 months), 2006 Oregon PRAMS-2 (N = 835)

Maternal insurance status (n = 815)		
Private/Military	496 (62.0)	43 (8.6)
Public±	174 (18.7)	37 (21.7)
Uninsured	145 (19.4)	26 (18.0)
Child current insurance status (n = 790)		
Private/Military	453 (56.5)	39 (8.4)
Public±	275 (34.7)	55 (21.4)
Uninsured	62 (8.8)	14 (18.1)
Child ever uninsured (n = 833)		
No	685 (80.5)	67 (11.0)
Yes	148 (19.5)	41 (18.0)

* Unweighted number of respondents (excluding those who did not respond, or responded they did not know) and percent of total with data weighted as described in the methods section
† Non-Hispanic
‡ American Indian/Alaskan Native
+ Asian/Pacific Islander
¶ Current annual household income before taxes, as reported on PRAMS-2 survey
± Public Insurance includes Oregon Health Plan, Medicare, or Indian Health Service

Children with special health care needs

125 (11.7%) mothers met the dichotomous criteria for having a CSHCN. Of the total sample, 69 (6.0%) reported that their child had an ongoing need (lasting 6 months or more) for 1 health service. 56 (5.7%) mothers reported that their two-year-old had an ongoing need two or more health services (See Table 5).

Table 5. Proportion of mothers reporting ongoing* need for health services for their two-year-old child, 2006 Oregon PRAMS-2

Number of services needed	**n (weighted %)**
0	710 (88.3)
1	69 (6.0)
2 or more	56 (5.7)

*Lasting 6 months or more

Table 6 describes the distribution of ongoing needs for specific services by two-year-olds in this sample. Ongoing need for medication (5.8%) and specialty health care

(4.3%) were the most prevalent of the health services needed in our sample, followed by speech services (3.7%), physical therapy (2.0%), special diet (2.0%), and behavioral/mental health services (1.5%), and occupational therapy (1.3%). Less frequently reported were needs for home health services (0.8%), durable medical equipment (0.8%), and use of assistive devices (0.2%).

Table 6. Prevalence of CSHCN and need for specific health services lasting 6 months or more among 2-year-olds, 2006 Oregon PRAMS-2

Characteristic	n (weighted %)
Total CSHCN± (n=835)	125 (11.7)
Specialty health care	42 (4.3)
Behavioral/mental health services	7 (1.5)
Physical therapy	17 (2.0)
Occupational therapy	16 (1.3)
Speech services	32 (3.7)
Medication	67 (5.8)
Home health services	15 (0.8)
Special diet	28 (2.0)
Use of assistive devices	8 (0.2)
Durable medical equipment	14 (0.8)

± CSHCN defined as an affirmative response to an ongoing need for any one or more of the 10 health services listed

Cross-Sectional Model

Univariate Analysis

In the univariate logistic regression analysis, the odds of food insecurity and increased based on the number of services needed by CSHCN, though none of the associations were statistically significant (OR for 1 need = 1.6 (95% CI: 0.52 – 4.9); p = 0.41) (OR for two or more needs: 2.26 (95% CI: 0.68 – 7.52); p = 0.19). While both ORs were greater than 1, indicating an elevated risk for food insecurity, the risk of food insecurity was not significantly higher than that for mothers whose children have 0

ongoing health service needs. The F-test for this model was not significant ($F_{3, 828} = 1.27$; $p = 0.32$)

Results of univariate logistic regression demonstrated that maternal age, race/ethnicity, education level, annual household income, child insurance status, maternal employment status, marital status, county type, and child ever being enrolled in WIC were all significantly associated with food insecurity at the 0.05 level, or less. The results from the cross-sectional univariate regression analyses are shown in Table 7.

Table 7. Associations between food insecurity and maternal characteristics at Time 2: Univariate logistic regression models, 2006 Oregon PRAMS-2 (N = 835)

Characteristic	OR (95% CI)	Food Insecure n (weighted %)	p-value (Wald)	p-value (F-test)
CSHCN				
0 needs	Referent	84 (11.7)		0.32
1 ongoing need	1.60 (0.52 – 4.9)	12 (17.6)	0.41	
2 or more needs	2.26 (0.68 – 7.52)	13 (23.1)	0.19	
Maternal age				
Younger than 25	3.59 (1.64 – 7.85)	34 (22.5)	0.01	0.005
25-29	2.29 (1.03 – 5.10)	27 (15.7)	0.04	
30 or older	Referent	46 (7.5)		
Maternal race/ethnicity				
Black†	1.61 (0.79 – 3.30)	15 (19.3)	0.19	<0.001
AI/AN†	3.26 (1.74 – 6.12)	27 (32.6)	< 0.001	
Asian/PI†	0.49 (0.22 – 1.09)	9 (6.7)	0.08	
Hispanic	0.94 (0.48 – 1.85)	17 (12.3)	0.87	
White†	Referent	41 (12.9)		
Maternal education				
Less than 12 years	2.58 (0.99 – 6.73)	23 (14.8)	0.053	<0.001
12 years or GED	4.56 (2.25 – 9.26)	46 (23.5)	< 0.001	
More than 12 years	Referent	38 (6.3)		
Annual household income				
Less than $15,000	15.44 (5.72 – 41.68)	55 (28.5)	<0.001	<0.001
$15,000 to $24,999	11.88 (3.82 – 39.94)	23 (23.5)	<0.001	
$25,000 to $34,999	10.79 (3.34 – 34.87)	19 (21.8)	<0.001	
$35,000 or more	Referent	12 (2.5)		
Child insurance status				
Private	Referent	39 (8.4)		
Public	2.97 (1.46 – 6.03)	55 (21.4)	0.003	0.0097
Uninsured	2.41 (0.81 – 7.14)	14 (18.1)	0.112	
Maternal employment status				
Full time	Referent	29 (11.2)		
Part time	1.19 (0.49 – 2.89)	28 (13.1)	0.70	0.042
Unemployed, looking for work	3.26 (1.22 – 8.70)	23 (29.1)	0.018	
Unemployed, not looking for work	0.82 (0.35 – 1.90)	28 (9.3)	0.642	
Marital status				
Married	Referent	55 (8.9)		0.002
Never married	3.85 (1.84 – 8.04)	38 (27.3)	<0.001	
Divorced	3.66 (1.03 – 12.96)	10 (26.3)	0.04	
Separated	1.33 (0.28 – 6.31)	6 (11.5)	0.72	

Table 7 (Continued). Associations between food insecurity and maternal characteristics at Time 2: Univariate logistic regression models

Child ever on WIC				
No	Referent	21 (5.7)		
Yes	4.14 (1.86 – 9.20)	88 (20.0)	0.001	0.001
County type				
Rural	Referent	34 (19.4)		
Urban	0.50 (0.25 – 0.998)	75 (10.8)	0.05	0.05

† Non-Hispanic

Assessment for Confounding

In the nine separate logistic regression models which included food security as the outcome of interest, CSHCN as the primary predictor variable, and each additional covariate, a change greater than 10% was observed for at least one of the ORs for the two levels of CSHCN, as compared to the univariate relationships between food security and CSHCN. Table 8 describes the ORs for the two levels of CSHCN, and the percent change from the univariate OR when controlling for one other covariate.

The associations for both levels of CSHCN with food insecurity increased in the models which included race, education, employment status, and marital status. In the models containing income, and insurance status, the associations of interest both decreased. Maternal age, county type and ever being enrolled in WIC caused varied changes in the direction of the relationships between CSHCN and food insecurity (i.e., one odds ratio increased while the other decreased).

These observed changes in the association of interest, coupled with the predetermined clinical significance of the relationships between each covariate and food security, led to the conclusion to keep all of the covariates in the final multivariate model.

Table 8. Assessment for confounding: Associations between food insecurity and having a 2-year-old CSHCN controlling for one other covariate, 2006 Oregon PRAMS-2

	OR (95% CI)	p-value	% Change
Univariate model: CSHCN status			
1 ongoing need	1.60 (0.52 – 4.90)	0.41	Referent
2 or more ongoing needs	2.26 (0.68 – 7.52)	0.19	Referent
Model 1: CSHCN status + Maternal age			
1 ongoing need	1.37 (0.41 – 4.56)	0.60	23% decrease
2 or more ongoing needs	2.65 (0.68 – 10.34)	0.16	39% increase
Model 2: CSHCN status + Maternal race/ethnicity			
1 ongoing need	1.61 (0.52 – 4.99)	0.41	1% increase
2 or more ongoing needs	2.60 (0.77 – 8.81)	0.13	34% increase
Model 3: CSHCN status + Maternal education			
1 ongoing need	2.03 (0.64 – 6.45)	0.23	43% increase
2 or more ongoing needs	2.56 (0.71 – 9.27)	0.15	30% increase
Model 4: CSHCN status + Annual household income			
1 ongoing need	1.32 (0.34 – 5.02)	0.69	28% decrease
2 or more ongoing needs	1.70 (0.45 – 6.32)	0.43	56% decrease
Model 5: CSHCN status + Child insurance status			
1 ongoing need	1.42 (0.48 – 4.20)	0.52	18% decrease
2 or more ongoing needs	2.03 (0.52 – 7.97)	0.31	23% decrease
Model 6: CSHCN status + Maternal employment status			
1 ongoing need	1.64 (0.52 – 5.12)	0.40	4% increase
2 or more ongoing needs	2.49 (0.72 – 8.57)	0.15	23% increase
Model 7: CSHCN status + Marital status			
1 ongoing need	1.92 (0.56 – 6.57)	0.30	32% increase
2 or more ongoing needs	2.38 (0.64 – 8.88)	0.20	12% increase
Model 8: CSHCN status + Child ever on WIC			
1 ongoing need	1.66 (0.51 – 5.44)	0.40	6% increase
2 or more ongoing needs	2.13 (0.53 – 8.51)	0.29	13% decrease
Model 9: CSHCN status + County type			
1 ongoing need	1.63 (0.54 – 4.96)	0.39	3% increase
2 or more ongoing needs	2.13 (0.61 – 7.49)	0.24	13% decrease

Multivariate Analysis

After adjusting for maternal age, race/ethnicity, education level, annual household income, child insurance status, maternal employment status, marital status, county type and child ever being enrolled in WIC, the OR for having a child with one ongoing health need decreased from the association observed in the univariate model (OR for 1 need: 1.23 (95% CI: 0.31 – 4.82), p = 0.77). The OR for having two or more ongoing needs decreased to 1.86 (95% CI: 0.49 – 7.06), p = 0.36). Neither of these associations were significantly different from 1.0, nor was the F-test for the group of CSHCN variables significant (p = 0.63).

In the multivariate model, maternal race/ethnicity and annual household income remained significant at the 0.05 level. The following variables were not statistically significant in the multivariate model at the 0.05 level, though they were significant in the univariate analyses: maternal age, education, child insurance status, maternal employment status, marital status, ever being enrolled in WIC, and county type. These variables are all risk factors for food insecurity, and are potentially co-linear in their associations with food insecurity.

Table 9 presents the final multivariate model for the cross-sectional analysis.

Table 9. Association between food insecurity at Time 2 and having a 2-year-old CSHCN: Multivariate logistic regression model, 2006 Oregon PRAMS-2 (N = 835)

Characteristic	OR (95% CI)	Food Insecure n(weighted %)	p-value (Wald)	p-value (F-test)
CSHCN				
0 needs	Referent	84 (11.7)		0.63
1 ongoing need	1.23 (0.31 – 4.82)	12 (17.6)	0.77	
2 or more needs	1.86 (0.49 – 7.06)	13 (23.1)	0.36	
Maternal age				
Younger than 25	0.89 (0.31 – 2.57)	34 (22.5)	0.83	0.74
25-29 years	1.31 (0.50 – 3.45)	27 (15.7)	0.59	
30 or older years	Referent	46 (7.5)		
Maternal race/ethnicity				
African American†	0.55 (0.20 – 1.55)	15 (19.3)	0.26	0.04
AI/AN†	2.32 (0.99 – 5.47)	27 (32.6)	0.05	
Asian/PI†	0.49 (0.17 – 1.40)	9 (6.7)	0.18	
Hispanic	0.50 (0.17 – 1.46)	17 (12.3)	0.21	
White†	Referent	41 (12.9)		
Maternal education				
Less than 12 years	1.27 (0.34 – 4.81)	23 (14.8)	0.72	0.10
12 years or GED	2.45 (1.04 – 5.79)	46 (23.5)	0.04	
More than 12 years	Referent	38 (6.3)		
Annual household income				
Less than $15,000	28.98 (4.07 – 206.54)	55 (28.5)	0.001	0.002
$15,000 to $24,999	19.70 (3.29 – 118.03)	23 (23.5)	0.001	
$25,000 to $34,999	13.73 (3.47 – 54.32)	19 (21.8)	<0.001	
$35,000 or more	Referent	12 (2.5)		
Child insurance status				
Private	Referent	39 (8.4)		0.76
Public	0.66 (0.16 – 2.68)	55 (21.4)	0.56	
Uninsured	0.58 (0.13 – 2.54)	14 (18.1)	0.47	
Maternal employment status				
Full time	Referent	29 (11.2)		0.41
Part time	1.07 (0.40 – 2.84)	28 (13.1)	0.90	
Unemployed, looking for work	2.01 (0.61 – 6.61)	23 (29.1)	0.25	
Unemployed, not looking for work	0.76 (0.27 – 2.09)	28 (9.3)	0.59	
Marital status				
Married	Referent	55 (8.9)		0.22
Never married	1.24 (0.46 – 3.38)	38 (27.3)	0.67	
Divorced	1.08 (0.22 – 5.23)	10 (26.3)	0.93	
Separated	0.19 (0.03 – 1.33)	6 (11.5)	0.10	

Table 9 (Continued). Association between food insecurity at Time 2 and having a 2-year-old CSHCN: Multivariate logistic regression model

Child ever on WIC				
No	Referent	21 (5.7)		
Yes	0.35 (0.10 – 1.24)	88 (20.0)	0.10	0.10
County type				
Rural	Referent	34 (19.4)		
Urban	0.66 (0.26 – 1.68)	75 (10.8)	0.38	0.38

† Non-Hispanic

Longitudinal Model

Univariate Analysis

In this sample of 730 women, 62 experienced a shift from food security at Time 1, to food insecurity at Time 2; Table 9 demonstrates the distribution and the univariate odds ratios for change to food insecurity by the 3 levels of CSHCN classification, and all of the covariates.

Results from the univariate longitudinal model suggest that having a child who has ongoing need for two or more health services is marginally predictive of a shift from food security to food insecurity (OR = 3.61, 95% CI: (0.84 – 15.46); p = 0.08). Mothers whose children have ongoing needs for 1 health service were not significantly more likely to experience a shift from food secure to food insecure in the 2 year follow-up period when compared to mothers whose children do not have special health care needs (OR = 0.51, 95% CI: (0.20 – 1.33); p = 0.17) (see Table 10).

Table 10. Associations between change to food insecurity in follow-up period and maternal characteristics at Time 2: Univariate logistic regression models, 2004 Oregon PRAMS and 2006 PRAMS-2 (N = 730)

Characteristic	OR (95% CI)	Change to food insecurity n (weighted %)	p-value (Wald)	p-value (F-test)
CSHCN				
0 needs	Referent	46 (6.9)		0.0047
1 ongoing need	0.51 (0.20 – 1.33)	8 (3.7)	0.17	
2 or more needs	3.61 (0.84 – 15.46)	8 (21.1)	0.08	
Maternal age				
Younger than 25	4.05 (1.39 – 11.79)	19 (15.4)	0.01	0.04
25-29	2.31 (0.75 – 7.09)	14 (9.4)	0.14	
30 and older	Referent	29 (4.3)		
Maternal race				
African American†	2.87 (1.16 – 7.08)	11 (18)	0.02	0.002
AI/AN†	3.71 (1.57 – 8.76)	14 (22.1)	0.003	
Asian/PI†	0.65 (0.23 – 1.82)	6 (4.7)	0.41	
Hispanic	1.21 (0.48 – 3.08)	9 (8.5)	0.68	
White†	Referent	22 (7.1)		
Maternal education				
Less than 12 years	3.70 (0.98 – 13.98)	12 (10.0)	0.05	0.002
12 years or GED	6.36 (2.31 – 17.48)	28 (16.0)	<0.001	
More than 12 years	Referent	20 (2.9)		
Annual household income				
Less than $15,000	50.36 (12.44 – 203.94)	30 (22.3)	<0.001	<0.001
$15,000 to $24,999	22.16 (4.01 – 122.47)	12 (11.2)	<0.001	
$25,000 to $34,999	39.16 (7.91 – 193.93)	13 (18.3)	<0.001	
$35,000 or more	Referent	7 (0.57)		
Child insurance status				
Private	Referent	23 (4.3)		0.02
Public	4.01 (1.49 – 10.77)	32 (15.2)	0.006	
Uninsured	2.37 (0.52 – 10.80)	7 (9.6)	0.26	
Maternal employment status				
Full time	Referent	15 (4.4)		0.001
Part time	2.27 (0.70 – 7.39)	18 (9.5)	0.17	
Unemployed, looking for work	7.80 (2.34 – 25.92)	15 (26.4)	0.001	
Unemployed, not looking for work	0.77 (0.23 – 2.62)	13 (3.4)	0.68	
Marital status				
Married	Referent	30 (3.7)		<0.001
Never married	9.09 (3.37 – 24.50)	22 (25.7)	<0.001	
Divorced	7.79 (1.73 – 35.11)	8 (22.9)	0.008	
Separated	0.85 (0.14 – 5.0)	2 (3.1)	0.86	

Table 10 (Continued). Associations between change to food insecurity in follow-up period and maternal characteristics at Time 2, Univariate logistic regression models

Child ever on WIC				
No	Referent	16 (4.1)		0.03
Yes	3.16 (1.13 – 8.85)	46 (11.9)	0.03	
County type				
Rural	Referent	17 (11.8)		0.16
Urban	0.51 (0.20 – 1.30)	45 (6.4)	0.16	

† Non-Hispanic

Assessment for Confounding

Table 11 describes how the association between change to food insecurity status and having a CSHCN changed based on the inclusion of one other covariate. Again, when compared to the univariate associations, changes of greater than 10% in the odds ratios for both levels of CSHCN status were observed controlling for each of the covariates. This observation contributed to the decision to leave all covariates in the final model.

Table 11. Assessment for confounding: Associations between change to food insecurity and having a 2-year-old CSHCN controlling for one other covariate, 2004 Oregon PRAMS and 2006 Oregon PRAMS-2

	OR (95% CI)	p-value	% Change
Univariate model: CSHCN status			
1 ongoing need	0.51 (0.20 – 1.33)	0.17	Referent
2 or more ongoing needs	3.61 (0.84 – 15.46)	0.08	Referent
Model 1: CSHCN status + Maternal age			
1 ongoing need	0.57 (0.21 – 1.53)	0.26	6% increase
2 or more ongoing needs	4.52 (0.89 – 22.87)	0.07	91% increase
Model 2: CSHCN status + Maternal race/ethnicity			
1 ongoing need	0.48 (0.20 – 1.17)	0.10	3% decrease
2 or more ongoing needs	4.54 (1.02 – 20.30)	0.05	93% increase
Model 3: CSHCN status + Maternal education			
1 ongoing need	0.57 (0.21 – 1.57)	0.28	6% increase
2 or more ongoing needs	4.33 (0.92 – 20.38)	0.06	72% increase
Model 4: CSHCN status + Annual household income			
1 ongoing need	0.36 (0.12 – 1.09)	0.07	15% decrease
2 or more ongoing needs	2.86 (0.58 – 14.10)	0.20	75% decrease
Model 5: CSHCN status + Child insurance status			
1 ongoing need	0.48 (0.17 – 1.34)	0.16	3% decrease
2 or more ongoing needs	3.35 (0.60 – 18.69)	0.17	26% decrease
Model 6: CSHCN status + Maternal employment status			
1 ongoing need	0.47 (0.16 – 1.38)	0.17	4% decrease
2 or more ongoing needs	5.11 (1.11 – 23.49)	0.04	150% increase
Model 7: CSHCN status + Marital status			
1 ongoing need	0.95 (0.37 – 2.46)	0.91	44% increase
2 or more ongoing needs	6.43 (1.29 – 2.46)	0.02	282% increase
Model 8: CSHCN status + Child ever on WIC			
1 ongoing need	0.54 (0.20 – 1.42)	0.21	3% increase
2 or more ongoing needs	3.55 (0.71 – 17.76)	0.12	6% decrease
Model 9: CSHCN status + County type			
1 ongoing need	0.53 (0.20 – 1.41)	0.20	2% increase
2 or more ongoing needs	3.48 (0.78 – 15.48)	0.10	13% decrease

Multivariate Analysis

In the longitudinal model, after adjusting for maternal age, race, education level, annual household income, child insurance status, maternal employment status, marital status, county type and child ever being enrolled in WIC, the OR for change to food insecurity and having a child with ongoing need for two or more services increased substantially and became statistically significant (OR = 6.50, 95% CI: (1.71 – 24.74); p = 0.006). The OR for a shift to food insecurity for mothers whose children have ongoing needs for 1 service remained non-significant when compared to mothers whose children do not have ongoing needs for health services (OR for 1 need: 0.47 (0.13 – 1.73), p-value = 0.25). The final longitudinal model is presented in Table 12.

Table 12. Association between change to food insecurity in follow-up period and having a 2-year-old CSHCN: Multivariate logistic regression model, 2004 Oregon PRAMS and 2006 PRAMS-2 (N = 730)

Characteristic	OR (95% CI)	Change to food insecurity n (weighted %)	p-value (Wald)	p-value (F-test)
CSHCN				
0 needs	Referent	46 (6.9)		0.006
1 ongoing need	0.47 (0.13 – 1.73)	8 (3.7)	0.25	
2 or more needs	6.50 (1.71 – 24.74)	8 (21.1)	0.006	
Maternal age				
Younger than 25	0.99 (0.31 – 3.13)	19 (15.4)	0.99	0.61
25-29	1.76 (0.54 – 5.77)	14 (9.4)	0.35	
30 and older	Referent	29 (4.3)		
Maternal race				
Black†	0.78 (0.19 – 3.26)	11 (18)	0.74	0.31
AI/AN†	3.81 (1.07 – 13.52)	14 (22.1)	0.04	
Asian/PI†	0.88 (0.17 – 4.59)	6 (4.7)	0.88	
Hispanic	1.32 (0.32 – 5.49)	9 (8.5)	0.71	
White†	Referent	22 (7.1)		
Maternal education				
Less than 12 years	0.79 (0.14 – 4.51)	12 (10.0)	0.79	0.52
12 years or GED	1.63 (0.47 – 5.62)	28 (16.0)	0.44	
More than 12 years	Referent	20 (2.9)		
Annual household income				
Less than $15,000	137.26 (6.61 – 2849.47)	30 (22.3)	0.002	0.005
$15,000 to $24,999	47.63 (3.57 – 635.02)	12 (11.2)	0.004	
$25,000 to $34,999	99.04 (8.11 – 1209.82)	13 (18.3)	<0.001	
$35,000 or more	Referent	7 (0.57)		
Child insurance status				
Private	Referent	23 (4.3)		0.66
Public	0.66 (0.16 – 2.66)	32 (15.2)	0.56	
Uninsured	0.38 (0.05 – 3.14)	7 (9.6)	0.37	
Maternal employment status				
Full time	Referent	15 (4.4)		0.01
Part time	2.02 (0.58 – 6.97)	18 (9.5)	0.27	
Unemployed, looking for work	6.32 (1.43 – 27.89)	15 (26.4)	0.02	
Unemployed, not looking for work	0.52 (0.12 – 2.23)	13 (3.4)	0.38	
Marital status				
Married	Referent	30 (3.7)		0.03
Never married	3.80 (1.20 – 12.02)	22 (25.7)	0.02	
Divorced	4.55 (0.79 – 26.19)	8 (22.9)	0.09	
Separated	0.37 (0.03 – 4.01)	2 (3.1)	0.41	

Table 12 (Continued). Association between change to food insecurity in follow-up period and having a 2-year-old CSHCN: Multivariate model

Child ever on WIC				
No	Referent	16 (4.1)		0.002
Yes	0.07 (0.01 – 0.36)	46 (11.9)	0.002	
County type				
Rural	Referent	17 (11.8)		0.28
Urban	0.50 (0.14 – 1.75)	45 (6.4)	0.28	

† Non-Hispanic

In a reduced multivariate longitudinal model controlling only for household income, marital status, maternal employment status, maternal race/ethnicity, maternal education and child insurance status, the OR for experiencing a shift to food insecurity in the follow-up period for mothers whose children have ongoing needs for two health services increased to 7.60 (95% CI: 1.91 – 30.29). This combination of variables is the most predictive of a shift to food insecurity in the follow-up period.

Discussion

This study found positive associations between food insecurity and both levels of CSHCN (one ongoing need, and two or more ongoing needs), in both the cross-sectional and longitudinal models. The associations in the cross-sectional model were positive, but were not statistically significant in either the univariate, or multivariate models. In the longitudinal model, the association between experiencing a shift to food insecurity in the two-year follow-up period and having a CSHCN with two or more ongoing health service needs was statistically significant, both in the univariate and multivariate models.

Comparison with Previous Findings

Prevalence of Food Insecurity

In this sample, 11.7% were food insecure at Time 1, and 12.8% were food insecure at Time 2. Both of these figures are comparable to the estimated prevalence food insecurity in Oregon in 2004-2006: 11.9% (90% CI: (10.6% – 13.2%))[1] found by the Economic Research Service (ERS) of the USDA. The USDA figure was estimated after surveying 1,997 Oregon households using the Food Security Supplement to the Current Population Surveys administered in December 2004, 2005 and 2006.

Food insecurity estimates found in this study are substantially less than the national prevalence of food insecurity in households with children under 6. The ERS estimated that in 2006, 16.7% of households with children under 6 were food insecure[1].

The single-item assessments of food insecurity used in this study contained both a temporal component, and a perception of a lack of enough resources to obtain enough food. Including these two components in the food insecurity questions allowed for identification of food insecurity that reflects a compromise in diet quality. It is possible

that the use of this tool resulted in an underestimate of food insecurity. Further study is needed to assess the sensitivity of this tool to identify food insecurity in this population.

Prevalence of Children with Special Health Care Needs

At 11.7%, the prevalence of CSHCN estimated in this study was higher than the estimate from the NS-CSHCN for Oregon. Further, it was expected that the estimated prevalence of CSHCN in this sample would actually be lower than that determined using other identification tools because the sample population was made up of two-year-olds only, while other estimates tend assess prevalence among young children aged 0-5 years. Almost twelve percent (11.7%) of this sample of mothers of two-year-olds met the binary criteria for having a CSHCN. According to the 2005-2006 National Survey of Children with Special Health Care Needs (NS-CSHCN), 8.6% of children aged 0-5 in Oregon were estimated to be CSHCN[31].

This disparity in the estimated prevalence of CSHCN represents potential misclassification bias, and a limitation of the survey question used for identification of CSHCN in this study (See Strengths & Limitations).

In this sample, the most commonly reported ongoing need was for medications. The likelihood for identifying CSHCN based on need or use of prescription medication has been replicated in large studies using the CSHCN Screener[29]. Results from the 2005-2006 NS-CSHCN indicated that 78.4% of CSHCN were identified based on ongoing need for or use of prescription medication[31].

Neither this study nor the NS-CSHCN identified specific medications used by CSHCN, but information on the most commonly identified conditions is available. Of the sample of CSHCN identified by the 2005-2006 NS-CSHCN, 91% had at least one of

the following 16 conditions, while 25% had three or more: allergies (53%), asthma (30%), ADD/ADHD (30%), depression, anxiety or emotional problems (21%), migraines/frequent headaches (15%), mental retardation (11%), autism or autism spectrum disorder (5%), joint problems (4%), seizure disorder (4%), heart problems (4%), blood problems (2%), diabetes (2%), cerebral palsy (2%), down syndrome (1%), muscular dystrophy (0.3%), or cystic fibrosis (0.3%)[27]. The specific conditions inquired about in the PRAMS-2 survey include: asthma, autism, cleft palate, down syndrome and cerebral palsy.

Association between Food Insecurity and CSHCN

Cross-sectional Analysis

In the cross-sectional analysis, having a CSHCN was associated with increased odds of food insecurity, though the odds ratios in both the univariate and multivariate models were not statistically significant. While the estimates were not significant, the direction and magnitude of the associations were as hypothesized: odds of food insecurity increased as the need for health services increased.

The lack of significance of the findings could be related to inadequate power to detect differences in this sample. A priori power and sample size analyses suggested that the minimum detectable odds ratio for this study was 2.3, with 80% power and an alpha level of 0.05. It is possible that this association would be statistically significant with a slightly larger sample.

When compared to mothers whose children do not have special health care needs, the odds of food insecurity for mothers whose children needed one or more services was 23% greater. The odds of food insecurity for mothers whose children have ongoing needs

for two or more health care services was 133% higher than that for women who do not have a CSHCN, after controlling for maternal age, race, education level, annual household income, child insurance status, maternal employment status, marital status, county type and child ever being enrolled in WIC.

Studies examining the specific association between food insecurity and having a CSHCN have not yet been published in the scientific literature, so it is difficult to make comparisons to previous findings. Despite this, it is important to study and understand the financial burdens of having a CSHCN, as these families may be particularly vulnerable to economic hardship, and may benefit from financial assistance, outreach services, and health care policy changes[32].

While the estimates from this analysis were not statistically significant, a trend was observed demonstrating increasing odds of food insecurity as the number of health services needed increased. The rationale for this study was that medical expenditures related to providing care for a CSHCN could contribute to financial burdens leading to food insecurity, the trend observed from these data support that. Further analysis of this relationship using several years of PRAMS-2 data will allow for more robust estimates with larger samples. Only one year of PRAMS-2 data were available from Oregon DHS at the time of this study.

Longitudinal Analysis

The longitudinal analysis was conducted with only the mothers who were food secure at the time of the first survey; the food insecurity variable represented a change from food secure to food insecure in the 2-year follow-up period. 62 women in this sample reported experiencing this type of shift. After adjusting for covariates, having a

child with one ongoing health service need was not associated with a shift to food insecurity in this sample, and the OR for the association was negative. An association in this direction was not expected. The odds ratio for becoming food insecure for mothers whose children have ongoing needs for two or more health services was 9.03 (95% CI: 2.47 – 33.04). This estimate provides strong support that having a CSHCN is a risk factor for becoming food insecure.

This analysis benefits from its longitudinal design, allowing for an examination of the factors which are predictive of a shift to food insecurity. Much of the food insecurity literature is cross-sectional in nature, so the findings from this study are important, not only because of strengths of the study design, but because of the information gleaned about burdens experienced by families of CSHCN.

While there was no increased risk of food insecurity for mothers whose children have ongoing need for one health service, the increased odds of food insecurity in the population of mothers with children with two or more needs suggests a potential threshold that may be related to adequate insurance coverage, or time constraints leading to financial burdens, which in turn predict food insecurity. Further study of these potential effects is necessary. The information from this preliminary analysis is important to share with clinicians and educators who work with CSHCN, in order to provide more information and support for food insecurity screening, outreach, and referral services for parents of CSHCN.

Strengths and Limitations

There are several strengths to this study. The first major strength is in the complex sampling design and weighting scheme of the PRAMS and PRAMS-2 datasets

which are intended to allow inferences from PRAMS studies to be generalized to the population of Oregon mothers.

This is one of the first studies to analyze data from Oregon PRAMS-2, and 2006 was the first year the surveys were sent to mothers. The PRAMS-2 survey is administered as a follow-up to the PRAMS survey, so to take advantage of the longitudinal nature of the dataset, this study conducted both cross-sectional and longitudinal analyses, essentially addressing two different questions, made up of two different populations.

The cross-sectional analysis made use of all of the mothers in the sample who responded in full to the food insecurity and CSHCN survey questions, and because of the larger sample, the estimates were more precise, although they were not significant. Despite this, a trend of increasing odds of food insecurity was observed for both levels of CSHCN status, when compared to mothers who do not have a CSHCN. Conducting this analysis with more than one year of PRAMS-2 data will provide more power to detect significant associations, and can contribute to the understanding of this trend, which has not yet been studied. As with all cross-sectional studies, this analysis is limited in its ability to assess causality.

In the longitudinal analysis, reducing the sample to mothers who were food secure at Time 1 allowed for a more sophisticated analysis of the potential for CSHCN status to predict food insecurity over time. While the association between having a CSHCN and being food insecure was not significant in the cross-sectional analysis, the longitudinal analysis demonstrated significantly increased odds of a shift to food insecurity in the follow-up period for mothers whose children have ongoing needs for two or more health

services. This preliminary finding will contribute to the literature regarding financial concerns and socioeconomic impacts of having a CSHCN, and will provide support for future studies of this association.

Another strength of this study is the longitudinal capability provided by PRAMS-2 as a follow-up survey. Previous food insecurity literature has been criticized for its cross-sectional nature. The longitudinal analysis in this study provides information about food insecurity at two time points, and allows for assessments of factors which predict a shift to food insecurity for mothers of young children.

The most important limitation to this study is how CSHCN were defined using questions on the PRAMS-2 survey. There are two questions in PRAMS-2 which could be used to identify CSHCN (#79 and #80) (See Appendix D). Of the two survey items, question #80, which asks: "Does your two-year-old… (a) Need more time at doctor's visits than usual for children his/her age? (b) Need more frequent office visits than usual for children his/her age? (c) Need or use more medical or mental health services than usual for children her/age? (d) Currently need or use medicine (other than vitamins) prescribed by a doctor? (e) Seem limited or prevented in any way in his or her ability to do the things most two-year-olds can do? (f) Experience any kind of emotional, developmental or behavioral problem for which he/she needs treatment or counseling?" is worded most similarly to the 5-item assessment in the CSHCN Screener (See Appendix C), however this question on PRAMS-2 completely lacks a time component. The CSHCN Screener requires that in order to classify as CSHCN, the condition(s) must have lasted, or be expected to last for 12 months or more[30].

This survey question was deemed an inappropriate measure for identifying CSHCN for this study because it was not specific enough to correctly identify children who would not meet the criteria for CSHCN, as defined by the CSHCN Screener. For example, a mother might answer "yes" to the medication question because her child was taking prescribed medicine for an acute condition, such as an ear infection, at the time of the survey; this question does not allow for an understanding of ongoing health consequences. If this survey question on PRAMS-2 is intended to identify CSHCN among two-year-olds in Oregon, it would be necessary to add a time component in the wording of the question to increase specificity. This information will be useful to the committee at Oregon DHS which writes and implements the PRAMS surveys.

Question #79 on PRAMS-2 has three parts: A, B, and C. Part A inquires about specific chronic conditions: asthma, autism, cleft palate, down syndrome, and cerebral palsy, and includes an option to write in 'other' chronic conditions. I elected to exclude this particular section from our definition of CSHCN because the MCHB definition of CSHCN does not use specific diagnoses to identify CSHCN[26]. In addition, many chronic conditions have not yet presented, or been diagnosed in two-year-old children, so this assessment seemed inappropriate for the population being surveyed by PRAMS-2.

Due to the limitations of question #80 and #79A, it was decided that #79B and C would be used to identify CSHCN in this study. The 10 health services inquired about represent a wide variety of services, from medications which might be more commonly needed, to services which might be less common for two-year-olds, including assistive devices or durable medical equipment. The biggest strength to this survey question was

time component, allowing for inferences related to the ongoing (six months or more) need for health services.

Question #79B and C seem to best of the choices on PRAMS-2 for identifying CSHCN, though the potential for misclassification bias exists using this survey question. The estimate of the prevalence of CSHCN in this sample was higher than the estimate for Oregon children aged 0-5, suggesting that a proportion of children classified as CSHCN in this study would not meet the criteria using the CSHCN Screener.

While the children identified using this measure might not meet the MCHB definition of CSHCN, the population identified by this survey question is defined by ongoing need for health services. Additionally, this definition could be biased by health insurance status, or access to health care. Parents of children who lack health insurance or well-child care might not have been identified using this survey question, as it is based on use of health care services. Those who do not have access to such services might not have been captured by this identification tool. The CSHCN Screener inquires about health consequences, in addition to health services.

Despite these limitations, the findings from this study can be interpreted as demonstrating the increasing risk of maternal food insecurity as ongoing needs for health services are present, whether or not these children meet the formal MCHB definition of CSHCN. These findings are still useful for clinicians to identify families who are at risk of food insecurity based on higher utilization of health care services.

Another potential limitation of this study arises from differential loss-to-follow-up. Because this is a follow-up survey, the women who responded in 2004 were sent PRAMS-2 surveys in 2006. Of the 1,935 women who responded to PRAMS, and were

sent PRAMS-2 surveys, 865 responded, corresponding to a weighted response rate of 51.1%. There are some conceptual difficulties in understanding the response rates of PRAMS-2 data, as the survey population of interest changes depending on the sampling frame. These data were then re-weighted to allow for a population-based sample.

Prior to any analysis, comparisons were made between the distribution of key characteristics of mothers who responded to both PRAMS and PRAMS-2 surveys to those who only responded to PRAMS in order to assess for potential bias due to differential loss to follow-up[40]. Table 13 in Appendix A demonstrates the composition of the two samples and corresponding p-values from chi-square tests.

Past-year food insecurity was reported for 14.5% of women who responded only to PRAMS, and 12.8% of women who responded to both surveys. These estimates were not significantly different ($p = 0.53$).

Statistically significant differences between the two samples were found for nearly every other key variable. Mothers who responded to both surveys were more likely to have 12 or more years of education at the time of the first survey (89.1%) than those who did not respond to PRAMS-2 (70.5%); they were also more likely to be married (75.6% compared to 43.0%; $p < 0.001$), and to be privately insured (66.6% vs. 44.9%; $p < 0.001$) at the time they gave birth. Similarly, mothers who responded to both surveys were less likely to be publicly insured (30.7%) than those who only responded to PRAMS (52.5%) ($p < 0.001$), and were less likely to have been on WIC during pregnancy (31.5% vs. 52.6%; $p < 0.001$). Further, mothers who responded to both surveys were more likely to be 25 or older (74.7% vs. 47.8%; $p < 0.001$) and to live in

households with annual income at or above 185% of the Federal Poverty level (61.8% compared to 42.6%; $p < 0.001$).

The racial composition of the two samples was also significantly different. The women who responded to both surveys were predominantly white (79.1%). The sample of women who responded only to PRAMS was comprised of higher proportions of Hispanic (26.4%), Non-Hispanic Black (3.0%), Asian/Pacific Islander (Non-Hispanic) (6.3%), and American Indian/Alaska Native (Non-Hispanic) (2.1%) women than the sample of women who responded to both surveys (12.8%, 1.5%, 4.7%, and 1.1%, respectively).

All of these variables have been associated with food insecurity in the literature; it is not possible to assess whether women who were lost to follow up were at higher risk for food insecurity in the follow-up period, or if their children would have met the definition for CSHCN. It is possible that our sample represents women who are at lower risk of food insecurity and the associations in this study might be biased toward the null.

Another potential limitation of this study is related to reporting bias. The PRAMS and PRAMS-2 surveys ask a wide variety of questions related to maternal and child health, many of which could be considered sensitive, and mothers might be reluctant to honestly report their concerns and behaviors. However, this study is administered as a mail-in study with no personally identifying information, and the consent form clearly describes that all answers are confidential, so responses to this survey are likely to be more accurate than from those obtained from telephone interviews.

Public Health Implications

This study provides support for the importance of implementing food security screening in pediatric visits. Families of CSHCN experience financial burdens associated with the costs of care for their children, and because many of these families are already active in the health care system, oftentimes at rates more than usual for children of similar age, unique potential for outreach exists for healthcare providers. Food insecurity is a sensitive issue, but if rapport exists between the patient and the health care provider, routine conversations with patients about financial problems can lead to opportunities to share information about services for which they might be eligible, such as The Food Stamp Program, WIC, or community assistance programs such as emergency food pantries, or kitchens, or community gardening opportunities.

Conversations about food security in health care settings can act not only as a means of providing this valuable information but can also reduce some of the stigma that needy families might feel. According to the USDA, 79% of households which reported food insecurity in the past 12 months did not use a food pantry: 67% of those households knew that a food pantry existed in their community but did not make use of it. Of those who did not use a food pantry, 25% reported that their community did not have a food pantry; 19% indicated that they were not aware of such a resource[1]. Because families of CSHCN are already integrated in the medical system to address the child's needs, health care providers can play an important role in increasing awareness of such resources. Further research on the triggers to food insecurity will be useful in the attempt to develop a system wherein food insecurity is prevented in this population.

Future Studies

Future studies can be conducted using Oregon PRAMS and PRAMS-2 data. As future years of data become available, the effect of having a CSHCN on risk for food insecurity, as well as the other risk factors for food insecurity can be studied with greater power to detect statistically significant differences. The PRAMS and PRAMS-2 surveys assess a wide variety of topics, many of which are related to both CSHCN and food insecurity, but were not included in the models for this particular study. For example, it would be beneficial to examine how food insecurity is related in this sample to child-health assessments and well-child care. Future studies are also needed to understand the long-term health effects of chronic food insecurity for both children and families.

This study was limited by the operational definition of CSHCN derived from the PRAMS-2 survey questions; this information will be useful for future revisions of the PRAMS-2 survey in the interest of creating a survey question that captures a CSHCN population more comparable to the population identified with the accepted MCHB definition.

The use of validated screening tools, such as the CSHCN Screener will provide information on CSHCN who meet the accepted MCHB definition of CSHCN. The CSHCN Screener has become the accepted screening tool for classifying CSHCN, and as more studies use this tool, a more complete understanding of the characteristics, concerns and burdens of families with CSHCN will emerge. This type of analysis will also be useful in understanding the adequacy of health insurance coverage for families of CSHCN.

More longitudinal studies of food insecurity, and its risk factors, are needed to more fully understand food insecurity. Many studies of food insecurity analyze cross-sectional data, limiting the ability to truly assess the risk factors for becoming food insecure. Such studies are limited in that researchers cannot ascertain whether food insecurity was caused by certain risk factors, or if being food insecure makes one more susceptible to certain problems. Longitudinal studies to examine shifts from food security to food insecurity over time could be used to identify triggers that change food security status and clarify if costs of medical care for children or other family members contribute to the shift. Having data on participants over several time points can help elucidate whether food insecurity is a persistent problem for families, or a concern that fluctuates with time, by season, or in some other fashion.

Summary and Conclusions

This study reveals important information about the relationship between maternal food insecurity and having a CSHCN. While the association between food insecurity and CSHCN was not significant in the cross-sectional analysis, a trend of increasing odds of food insecurity was observed as the number of ongoing health service needs increased. In the longitudinal model, having a two-year-old CSHCN with two or more ongoing health service needs was found to be significantly predictive of a shift to food insecurity. This association was not observed for mothers whose children have only one ongoing health service need. As more years of PRAMS-2 data are available, it will be useful to conduct studies similar to this one to examine these associations with a larger sample.

Findings from this study provide support for regular food insecurity screening by health care providers. This is the first study to examine the association between food

insecurity and having a child with special health care needs, and will contribute to the literature about this vulnerable population.

Appendix A

Table 13. Distribution of maternal characteristics 2-6 months post-partum by response to PRAMS-2 survey, 2004 Oregon PRAMS (N = 1,968)

Characteristic	PRAMS only Respondents (n, weighted %)*	PRAMS and PRAMS-2 Respondents (n, weighted %)*	p-value
Total	1,103 (48.9)	865 (51.1)	
Food Insecure			
No	901 (85.5)	750 (87.2)	0.53
Yes	149 (14.5)	93 (12.8)	
Maternal age			
<25	517 (52.2)	220 (25.4)	<0.001
25-29	260 (22.6)	240 (27.5)	
30 or older	326 (25.2)	405 (47.2)	
Maternal education			
< 12 years	329 (29.5)	123 (10.9)	<0.001
≥ 12 years	764 (70.5)	732 (89.1)	
Marital status§			
Married	620 (43.0)	633 (75.6)	<0.001
Unmarried	483 (57.0)	232 (24.4)	
Maternal race/ethnicity			
AI/AN †‡	159 (2.1)	92 (1.1)	<0.001
Black†	167 (3.0)	89 (1.5)	
Asian/PI†+	184 (6.3)	147 (4.7)	
Hispanic	281 (26.4)	146 (12.8)	
White†	311 (62.2)	389 (79.1)	
Income¶			
0-99% FPL	423 (39.1)	238 (23.7)	<0.001
100-184% FPL	188 (18.3)	121 (14.5)	
≥185% FPL	356 (42.6)	460 (61.8)	
Insurance type at birthə			
Private	469 (44.9)	548 (66.6)	<0.001
Public	503 (52.6)	568 (30.7)	<0.001
Other	5 (0.14)	3 (0.1)	0.74
Uninsured	29 (2.4)	17 (2.5)	0.93
County type			
Rural	234 (28.5)	164 (21.4)	0.03
Urban	869 (71.5)	701 (78.6)	
On WIC during pregnancy			
No	529 (47.4)	554 (68.5)	<0.001
Yes	574 (52.6)	311 (31.5)	

* Unweighted number of respondents (excluding those who did not respond, or responded did not know) and percent of total with data weighted as described in the methods section

† Non-Hispanic

‡ American Indian/Alaskan Native

+ Asian/Pacific Islander
§ Married = married/separated; Unmarried = divorced/annulled/unmarried/no response/ co-habitating
¶ Household income before taxes, 12 months before baby was born
ɜ From birth certificate data – how birth was paid for

Appendix B

U.S. Household Food Security Survey Module: Six-Item Short Form[39]

HH3. "The food that (I/we) bought just didn't last, and (I/we) didn't have money to get more." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

[ ] Often true
[ ] Sometimes true
[ ] Never true
[ ] DK or Refused

HH4. "(I/we) couldn't afford to eat balanced meals." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

[ ] Often true
[ ] Sometimes true
[ ] Never true
[ ] DK or Refused

AD1. In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?

[ ] Yes
[ ] No (Skip AD1a)
[ ] DK (Skip AD1a)

AD1a. [IF YES ABOVE, ASK] How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

[ ] Almost every month
[ ] Some months but not every month
[ ] Only 1 or 2 months
[ ] DK

AD2. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?

[ ] Yes
[ ] No
[ ] DK

AD3. In the last 12 months, were you every hungry but didn't eat because there wasn't enough money for food?

[ ] Yes
[ ] No
[ ] DK

[End of Six-Item Food Security Module]

Appendix C

Children with Special Health Care Needs (CSHCN) Screener©[30] (mail or telephone)

1. Does your child currently need or use **medicine prescribed by a doctor** (other than vitamins?

□ Yes → Go to Question 1a
□ No → Go to Question 2

1a. Is this because of ANY medical, behavioral or other health condition?

□ Yes → Go to Question 1b
□ No → Go to Question 2

1b. Is this a condition that has lasted or is expected to last for *at least* 12 months?

□ Yes
□ No

2. Does your child need or use more **medical care, mental health or educational services** than is usual for most children of the same age?

□ Yes → Go to Question 2a
□ No → Go to Question 3

2a. Is this because of ANY medical, behavioral or other health condition?

□ Yes → Go to Question 2b
□ No → Go to Question 3

2b. Is this a condition that has lasted or is expected to last for *at least* 12 months?

□ Yes
□ No

3. Is your child **limited or prevented** in any way in his or her ability to do the things most children of the same age can do?

□ Yes → Go to Question 3a
□ No → Go to Question 4

3a. Is this because of ANY medical, behavioral or other health condition?

□ Yes → Go to Question 3b
□ No → Go to Question 4

3b. Is this a condition that has lasted or is expected to last for *at least* 12 months?

□ Yes
□ No

4. Does your child need or get **special therapy**, such as physical, occupational or speech therapy?

□ Yes → Go to Question 4a
□ No → Go to Question 5

4a. Is this because of ANY medical, behavioral or other health condition?

□ Yes → Go to Question 4b
□ No → Go to Question 5

4b. Is this a condition that has lasted or is expected to last for *at least* 12 months?

□ Yes
□ No

5. Does your child have any kind of emotional, developmental or behavioral problem for which he or she needs or gets **treatment or counseling**?

□ Yes → Go to Question 5a
□ No

5a. Has this problem lasted or is it expected to last for *at least* 12 months?

□ Yes
□ No

Appendix D

2006 Oregon Pregnancy Risk Assessment and Monitoring System: Two-Year Old Survey (PRAMS-2) Questionnaire

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