

# Multiple Childcare Arrangements and Health Outcomes in Early Childhood

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**Abstract** This study examined the associations between multiple childcare arrangements and young children's health problems. This study used three waves of the Early Childhood Longitudinal Study—Birth Cohort, collected from a nationally representative sample of children when they were 9 months old, 2 years old, and 4 years old ( $N = 7,150$ ). 'Multiple childcare arrangements' was defined and measured by the number of non-parental childcare arrangements that occurred on a regular basis. During each wave of the data collection, the mother reported the number of regular childcare arrangements by three types: relative care, non-relative care, and center-based care. These numbers were summed to calculate the total number of arrangements. The mother also reported the incidence of ear infections, gastrointestinal illnesses, asthma diagnosis, and unintentional injuries of the child. Random effects and fixed effects regression models were used to estimate the association between the number of childcare arrangements and measures of early childhood health problems. Increases in the total number of childcare arrangements were associated with an elevated risk of ear infections, gastrointestinal illnesses, and diagnosed asthma in children. Further analysis indicates that increases in both the number of center-based care and non-relative care (but not relative care) arrangements can lead to a greater chance of health problems in young children. Multiple childcare arrangements are associated with communicable illness and diagnosed asthma in early childhood and appear to be a risk factor for health problems in early childhood.

**Keywords** Childcare · Child health · Communicable illnesses · Asthma

## Introduction

Dramatic increases in maternal labor force participation have led to a corresponding increase in the demand for and use of non-parental child care over the past decades. In the United States, approximately 60 % of children younger than 5 years (12 million children) spend a portion of their day in non-parental care settings [1]. The shift from the home environment to out-of-home care can have a significant impact on a child's well-being and physical health [2–4].

Social epidemiologists posit that childcare facilities provide a setting conducive to the transmission of diseases. Childcare centers function as social foci that bring children of families with different health behaviors and health conditions together. Increasing contact with other children leads to an increase in a child's exposure to pathogens and viruses, thus resulting in a greater chance of illnesses [5]. Over the past decade, various researchers have widely tested this childcare contagion hypothesis using various data from the United States [6–13] and European countries [14, 15]. Not surprisingly, these studies generally found a strong association between childcare use and common infectious diseases, such as colds, diarrhea, and ear infections, in children. In recent years, an increasing number of studies have focused on the characteristics of childcare centers that affect the epidemiology of infections and diseases. For example, several studies found that the number of children, rather than the length of time in the childcare setting, was responsible for the link between center care and infectious diseases [16]; children's likelihood of illnesses greatly increases in the presence of six or more other

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children [16]. Significantly, another growing line of inquiry focuses on the interactive effects between demographic characteristics and childcare use, which may help to identify the at-risk population or vulnerable groups among early childcare users. For example, Ball et al. [17] found that childcare attendance during early infancy (i.e., less than 6 months old) can protect against the development of asthma during the school years.

However, extant research on the relationship between childcare use and child health exclusively focuses on primary-care arrangements while revealing little about the relationship between the complexity of childcare configurations and children's health outcomes. One important dimension of childcare configurations is *multiple childcare arrangements*, which is defined as “the number of arrangements that children experience at the same time” [18, 19]. During the past decades, the increasing prevalence of jobs with nonstandard work schedules and single-parent households has led to the increasing popularity of multiple arrangements [18]. In the United States, recent estimates indicate that approximately 15 % of children younger than 5 years regularly participate in more than one childcare arrangement, usually involving a combination of formal and informal care [20]. As the fraction of children in non-parental care increases with the children's ages, so does the number of children in multiple arrangements [19, 21]. Furthermore, children with employed mothers find themselves in multiple childcare arrangements more commonly [19, 22]. Among four- to five-year-old children with employed mothers, approximately 40 % have two or more childcare arrangements [19]. Given the substantial proportion of U.S. children who experience multiple childcare arrangements, reports from studies of these experiences and their relationships to children's health will have important implications for childcare policies and health programs.

To date, there is only one published study that has examined the potential impact of multiple childcare arrangements on children's health outcomes [23]. Beijers et al. found that multiple arrangements was associated with increases in skin illnesses but a decreased likelihood of respiratory illnesses among infants less than 1 year of age. However, the study used a small, non-representative, and relatively advantaged sample of children from the Netherlands, making it difficult to generalize the findings to other populations. Furthermore, the study did not account for family characteristics that are associated with both child care selection and child outcomes; the results may be biased due to these unobserved confounders. Evidence from the U.S. suggests that some families might use multiple arrangements to expose their children to a variety of peers, caregivers, and settings [19, 21], as some studies reveal that families using multiple arrangements report

higher maternal education than those using single arrangements [24]. Conversely, instability in other areas of family life often leads to multiple childcare arrangements [18]. Maternal employment patterns, such as nonstandard work schedules and part-time work, relate positively to multiple arrangements [21, 22, 24]. Children in low-income households with single parents experience more childcare settings [21, 25]. Many of these selection factors also relate to children's health outcomes, such as maternal employment [26, 27] and family structure [28, 29], which make them potential confounders between multiple childcare arrangements and health outcomes. Thus, studies that investigate the relationship between multiple arrangements and child health outcomes must control for potential social confounders to obtain unbiased estimates.

Using the nationally representative sample from the Early Childhood Longitudinal Study—Birth Cohort (ECLS-B), this study examined the link between multiple childcare arrangements and children's health from birth until school-entry age. The ECLS-B data have a wealth of information about children and families, as well as detailed childcare history and children's health information. The longitudinal data allow for examination of the relationship between multiple care arrangements and children's health at different points in early childhood and provide better estimates by addressing the selection of multiple arrangements. Findings from this paper provide one of the first systematic analyses of multiple childcare use and early childhood health in a nationally representative sample of U.S. children.

## Methods

### Sample

This analysis drew data from the ECLS-B, a nationally representative sample of approximately 10,000 U.S. children born in the year 2000. The ECLS-B collected data from a range of topics, including detailed information about children's physical health and patterns of childcare arrangements. Interviews with the families began when the children reached 9 months of age and continued at 2 years of age, during their preschool year, and during their kindergarten year. Because children spend less time in child care after beginning formal schooling, the present study relies on the first three sweeps of data. In addition, this study excludes the twin subsample from the analysis. In the third wave of the survey, much of the original ECLS-B sample is lost due to attrition or missing data for the dependent variables and key explanatory variables of interest. The study used multiple imputation (MI) to account for potential biases resulting from missing data in

the control variables. MI involves replacing missing values with predictions based on other observed variables using the Monte Carlo technique [30]. In contrast to single imputation, which replaces each missing value with a predicted value, MI replaces several missing values with repeated imputation inference, creating several complete datasets. The combined results produce better estimates of the missing values that create uncertainty around the missing data [31]. Given the restricted-use license of the ECLS-B, researchers are required to round the sample to the nearest fifty when reporting sample size. The final analytical sample of the present study included approximately 7,150 children. Weighting was used to make an inference to the national population.

## Measures

### *Multiple Childcare Arrangements*

In the childcare literature [18, 19, 23, 32], multiple arrangements is measured by the number of concurrent care arrangements. Non-parental child care arrangements typically include care by grandparents, in-home care, family child care, and center care. During the respective interviews, each mother reported the number of regular childcare arrangements that she had at the time of the interview and differentiated between three different types of arrangements: relative care, non-relative care, and center-based care. At each time point, the number of non-parental arrangements reported was summed to create a total number of childcare arrangements. Table 1 presents the distribution of childcare arrangements for children in the final analytical sample ( $N = 7,150$ ) over time. Consistent with prior studies, the proportion of children in multiple arrangements grew with age. During the preschool year, approximately 20 % of the children experienced multiple arrangements. Multiple childcare arrangements occurred commonly among this recent cohort of U.S. children (as the sample indicates).

**Table 1** Proportions of children attending different numbers of childcare arrangements by age

	Number of concurrent non-parental child care arrangements		
	None (%)	One (%)	Two or more (%)
9 months	49.52	39.80	10.68
2 years old	50.24	41.72	8.05
Preschool year	28.46	52.12	19.41

Given the restricted-use license of the ECLS-B, researchers are required to round the sample to the nearest fifty when reporting sample size

### *Early Childhood Health*

Mothers also reported their children's health outcomes during each wave of interviews. The interviewers asked mothers whether their children had experienced common infectious diseases, including ear infections and gastrointestinal illnesses, since the previous interview. Additionally, the ECLS-B questionnaire elicited information on other health conditions, such as diagnosed asthma and unintentional injuries. In the United States, asthma represents the most common chronic illness in children [33]; unintentional injuries comprise a leading cause of emergency room visits and hospitalizations for children [34]. Because these two health conditions make up pressing public concerns for children's health and may also fall under the influence of multiple arrangements, I included them in the analysis. Thus, this study examined four common health conditions in early childhood: ear infections, gastrointestinal illnesses, asthma, and unintentional injuries. All four outcome variables were coded dichotomously.

### *Covariates*

Because certain characteristics of children and their families are associated with selection into multiple-care arrangements and the child health outcomes of interest, the analysis includes several potential confounding variables. As previously mentioned, research has demonstrated that family socioeconomic status, race and ethnicity, immigration status, family structure, and maternal employment are related to childcare use. The ECLS-B collected a wide range of information about the children and their families in each wave of the survey. Accordingly, this study controlled for a wide range of time-invariant characteristics, including the child's age, gender, birth weight status, race and ethnicity, maternal education, maternal immigration status, and the existence of older siblings. Time-varying control variables include the family structure, socioeconomic index, maternal employment, maternal health status, and maternal smoking habits. Finally, the following regression analyses also include a self-constructed parenting index. At each time point, the mother was asked to report the frequency with which she read books to the child, sang songs with the child, and told stories to the child in a typical week on a four-point scale, ranging from "not at all" (1) to "every day" (4). The parenting index (ranging from 1 to 4) was created by averaging these three variables. The higher the index, the greater the level of parenting quality was assumed to be. Prior studies have demonstrated that parenting quality is a significant predictor of early childhood health [35–37]. Because the ECLS-B has no parenting scale available, the self-constructed index served as a proxy for assessing the parenting quality and maternal attentiveness.

Statistical Methods

To estimate the relationship between multiple childcare arrangements and health outcomes, I began with longitudinal logistic regression with random effects. The random effects model allows the intercepts (and sometimes slopes) to vary as a function of child and family characteristics and a random error component. Nonetheless, the use and choice of non-parental care is not a random process. Because random effects models assume that the error terms and regressors are independent, unobserved factors that correlate with both the multiple arrangements and the children’s health may bias estimates. Thus, to better estimate the effects and minimize the selection bias, I also employed the fixed effects model and compared the results to those from the random effects model. The fixed effects model minimizes the bias due to unmeasured confounders by predicting changes in the outcome from changes in the explanatory variable. Although the fixed effects model does not eliminate potential bias due to time-varying, unobserved characteristics, it provides more conservative estimates than the random effects model for examining the relationship between childcare arrangements and health outcomes.

Results

Summary Statistics

Table 2 provides descriptive information on the background variables. As presented in the first column, females comprised 51 % of the full analytical sample. The sample consisted of approximately 56 % Whites, 13 % African Americans, 24 % Hispanics, and 2 % Asian Americans. Approximately 18 % of the mothers did not have a high school diploma at the first wave of the survey, and 12 % were foreign born. Nearly one-third of the children lived in single-parent families at the baseline wave of the survey; 30 % of the mothers considered themselves to be in poor health, and 10 % smoked.

The remaining columns in Table 2 display descriptive statistics by children’s multiple arrangement experiences: (1) children without multiple-care arrangements over the three waves of the survey (column 2), and (2) children with multiple-care experience (column 3). Children without prior multiple childcare experiences had a greater chance of coming from economically disadvantaged backgrounds. Foreign-born, low-socioeconomic status and low-educated

**Table 2** Descriptive statistics by number of arrangements at baseline year (N = 7,150; standard deviations in parentheses; weighted)

	Total sample (mean or %)	By multiple arrangements experience	
		No multiple care experience (mean or %)	With multiple care experience (mean or %)
Male	50.91	51.58	49.34
Low birth weight	5.95	5.69	6.56
Race			
White	55.88	54.09	60.00
African American	12.75	12.36	13.64
Hispanic	24.38	26.61	19.25
Asian	2.53	2.53	2.52
Others	4.47	4.41	4.58
Mother immigrant	12.08	13.90	7.89
Maternal education			
Less than HS	17.54	19.73	12.47
HS	28.24	28.11	28.52
Some college	27.47	27.16	28.19
College	16.80	16.27	18.02
More than college	9.95	8.72	12.79
Number of siblings	0.96 (1.09)	1.05 (1.14)	0.76 (0.93)
Having older siblings	58.53	61.92	50.70
Maternal employment	53.6	46.18	70.63
Socioeconomic index	−0.02	−0.06	0.07
Income	53,570 (50,591)	51,530 (48,208)	58,278 (54,518)
Single-parent family	30.60	28.97	34.37
Mother in poor health	29.99	30.48	28.87
Mother smokes at home	10.31	10.26	10.41
Number of observations	7,150	4,950 (69.22 %)	2,200 (30.23 %)

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mothers were less likely to use multiple childcare arrangements. Children with older siblings were also less likely to have multiple childcare arrangements. Patterns of maternal employment varied substantially by childcare use. Among the children with multiple childcare arrangements, 70 % had employed mothers; in contrast, only 46 % of the mothers of children without multiple-care experience were employed.

### Regression Results

Table 3 presents the results from multivariate regression models relating the numbers of childcare arrangements to the children's health outcomes. The first column for each outcome presents the results from Model 1, which tested the relationships using the random effects model with full sets of time-invariant and time-varying covariates. The second model for each health measure, Model 2, examined the relationship using more conservative fixed effect models.

Results from Model 1 reveal an association between the number of arrangements and a greater incidence of all four health outcomes. Increases in the number of arrangements were associated with increases in children's ear infections (Odds Ratio = 1.22,  $p < 0.001$ ), gastrointestinal illnesses (Odds Ratio = 1.11,  $p < 0.05$ ), cases of diagnosed asthma (Odds Ratio = 1.20,  $p < 0.001$ ), and major injuries (Odds Ratio = 1.10,  $p < 0.01$ ). Several demographic characteristics were strong predictors of early childhood health. Boys were more likely to have infectious diseases, asthma, and injuries. Low-birth weight children had a greater likelihood of getting infectious diseases and asthma. Maternal health status and health behaviors also related to early childhood health. Poor maternal health status was positively associated with the incidence of ear infections, gastrointestinal illnesses, cases of diagnosed asthma, and major injuries. Children with smoking mothers also experienced a greater likelihood of ear infections, asthma, and injuries.

Model 2, with the application of the fixed effects model, provides more conservative estimates by accounting for the time-invariant unobserved characteristics of the family. The results are similar to those from the random effects model. The number of arrangements remained a strong and statistically significant predictor of ear infections, gastrointestinal illnesses, and cases of asthma, and the effect size changed very little when moving to the fixed effects model. More specifically, Table 3 indicates that an increase in non-parental care arrangements led to an increase in a child's risk of ear infection by 17 % ( $p < 0.001$ ) and gastrointestinal illness by 15 % ( $p < 0.05$ ). Children's odds of being diagnosed with asthma were 19 % ( $p < 0.01$ ) greater with each additional childcare arrangement.

However, in the fixed effects model, multiple childcare arrangements had no association with the incidence of unintentional injury, and the effect size dropped nearly to zero. Because estimates from the random effects and fixed effects models are quite consistent, results suggest that the number of childcare arrangements is a risk factor for early childhood health, particularly in the cases of ear infections, gastrointestinal illnesses, and childhood asthma.

Finally, to better understand the mechanism through which multiple childcare arrangements influence children's health, this study further distinguished the effects of multiple arrangements by the types of arrangements. The ECLS-B includes information about the total number of relative care, non-relative care, and center care arrangements, which allows for testing the relative importance of each type of care. I expected that the number of center care arrangements would be the driving force for the increased incidence of early childhood health conditions, as childcare centers greatly increase children's social contacts. Because a fixed effects model provides more conservative estimates, it is the preferred statistical model for the following analysis; Table 4 displays the results. As expected, increases in the number of childcare centers had a strong association with ear infections, gastrointestinal illnesses, and asthma diagnoses in children. For example, an increase in center-based childcare arrangements increased a child's odds of having an ear infection by 64 % ( $p < 0.001$ ) and gastrointestinal illnesses by 25 % ( $p < 0.05$ ). Interestingly, Table 4 also indicates that increases in the number of non-relative care arrangements had a strong association with the increased incidence of asthma in children, separate from the effects of relative care and center care. This result suggests that the detrimental effects of multiple arrangements may extend beyond mothers who use multiple center-based arrangements. Simple increases in the number of non-relative arrangements may also affect children's health. However, because Table 4 only reveals a statistically significant effect from the number of non-relative care arrangements for one health outcome (i.e., asthma), further research is required to better identify the role of multiple non-relative childcare arrangements in determining children's health outcomes.

### Discussion

While this study took advantage of the rich family, child care, and health outcome measures available in a longitudinal dataset to explore associations between changes in the number of childcare arrangements and changes in children's health outcomes, it has several limitations. First, this study used non-experimental data, and I therefore cannot interpret the findings as causal relationships. Even

**Table 3** Multiple child care arrangements in predicting child health outcomes (N = 7,150)<sup>a</sup>

	Ear infection		Gastrointestinal illness		Asthma		Major injuries	
	(1) Random effects	(2) Fixed effects	(1) Random effects	(2) Fixed effects	(1) Random effects	(2) Fixed effects	(1) Random effects	(2) Fixed effects
Number of arrangements	1.22*** (1.16, 1.28)	1.17*** (1.10, 1.24)	1.11* (1.00, 1.22)	1.15* (1.01, 1.31)	1.20*** (1.09, 1.32)	1.19** (1.05, 1.34)	1.10** (1.03, 1.17)	1.04 (0.96, 1.13)
Maternal employment	1.18*** (1.09, 1.28)	1.07 (0.96, 1.20)	1.01 (0.86, 1.19)	1.06 (0.82, 1.36)	1.03 (0.87, 1.22)	0.89 (0.71, 1.11)	0.90 (0.81, 1.01)	0.85 (0.72, 1.01)
SES	0.98 (0.90, 1.07)	0.94 (0.82, 1.08)	1.02 (0.87, 1.19)	0.97 (0.74, 1.30)	0.81* (0.68, 0.96)	1.01 (0.78, 1.33)	1.03 (0.93, 1.15)	0.94 (0.77, 1.15)
Single-parent family	1.12 (1.01, 1.25)	1.05 (0.86, 1.28)	0.96 (0.78, 1.17)	1.05 (0.68, 1.61)	1.45*** (1.18, 1.79)	1.10 (0.76, 1.60)	1.11 (0.98, 1.26)	0.97 (0.73, 1.29)
Maternal health status	1.28*** (1.18, 1.39)	1.14* (1.03, 1.27)	1.55*** (1.33, 1.81)	1.14 (0.91, 1.42)	1.46*** (1.25, 1.71)	1.20 (0.97, 1.49)	1.31*** (1.19, 1.45)	1.15 (0.99, 1.34)
Mother smokes at home	1.12* (1.01, 1.25)	1.27* (1.04, 1.54)	0.95 (0.78, 1.17)	0.85 (0.55, 1.29)	1.55*** (1.25, 1.92)	2.16*** (1.45, 3.11)	1.20** (1.05, 1.26)	1.17 (0.89, 1.56)
Parenting index	1.06* (1.00, 1.12)	1.03 (0.96, 1.11)	0.95 (0.85, 1.06)	0.84* (0.72, 0.99)	1.10 (0.98, 1.23)	0.91 (0.78, 1.06)	1.04 (0.97, 1.12)	0.94 (0.84, 1.06)
Age	1.05*** (1.04, 1.06)	1.05*** (1.04, 1.06)	0.96*** (0.94, 0.98)	0.96** (0.94, 0.98)	1.09*** (1.07, 1.11)	1.11*** (1.08, 1.13)	1.11*** (1.10, 1.13)	1.12*** (1.11, 1.14)
Age square	0.99*** (0.99, 0.99)	0.99*** (0.99, 0.99)	1.00** (1.00, 1.00)	1.00* (1.00, 1.00)	0.99*** (0.99, 0.99)	0.99*** (0.99, 0.99)	0.99*** (0.99, 0.99)	0.99*** (0.99, 0.99)
Male	1.26*** (1.16, 1.37)		1.36*** (1.16, 1.56)		1.96*** (1.62, 2.37)		1.47*** (1.33, 1.63)	
Low birth weight	1.19** (1.07, 1.33)		1.95*** (1.63, 2.33)		3.28*** (2.64, 4.10)		0.82** (0.72, 0.93)	
Race								
African American	0.52*** (0.45, 0.60)		0.66*** (0.51, 0.85)		4.13*** (3.11, 5.48)		0.59*** (0.50, 0.70)	
Hispanic	0.68*** (0.60, 0.77)		0.63*** (0.50, 0.80)		1.61** (1.21, 2.14)		0.64*** (0.55, 0.75)	
Asian	0.32*** (0.26, 0.38)		0.64** (0.46, 0.88)		1.16 (0.76, 1.77)		0.47*** (0.38, 0.59)	
Other	0.85* (0.74, 0.98)		0.83 (0.64, 1.07)		1.81*** (1.32, 2.47)		0.85* (0.72, 0.99)	
Mother immigrant	0.93 (0.81, 1.08)		0.86 (0.66, 1.13)		0.60** (0.43, 0.83)		0.77** (0.65, 0.92)	
Maternal education								
HS	0.88 (0.77, 1.01)		0.76* (0.59, 0.98)		0.83 (0.63, 1.10)		1.15 (0.98, 0.36)	
Some college	1.07 (0.92, 1.26)		1.16 (0.88, 1.54)		0.96 (0.70, 1.33)		1.26* (1.05, 1.52)	
College	1.08 (0.88, 1.32)		0.99 (0.69, 1.43)		0.80 (0.52, 1.24)		1.23 (0.97, 1.56)	
More than college	1.07 (0.84, 1.34)		1.18 (0.75, 1.84)		0.88 (0.52, 1.51)		1.20 (0.90, 1.61)	
Older siblings	1.09 (0.99, 1.19)		0.98 (0.84, 1.15)		1.70*** (1.39, 2.07)		1.00 (0.90, 1.10)	

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<sup>a</sup> The table reports odds ratios, and 95 % confidence intervals are in parentheses

\*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$

**Table 4** Types of multiple arrangements in predicting child health outcomes: results from fixed effects regression (N = 7,150)<sup>a</sup>

	Ear infection	Gastrointestinal illness	Asthma	Major injuries
Number of relative arrangements	1.02 (0.94, 1.10)	1.17 (0.98, 1.40)	0.94 (0.81, 1.09)	1.03 (0.92, 1.14)
Number of non-relative arrangements	1.07 (0.95, 1.20)	1.04 (0.83, 1.31)	1.39* (1.07, 1.79)	1.05 (0.90, 1.23)
Number of center-based arrangements	1.64*** (1.48, 1.82)	1.25* (1.01, 1.56)	1.85*** (1.49, 2.30)	1.05 (0.92, 1.21)
Maternal employment	1.10 (0.98, 1.23)	1.06 (0.82, 1.37)	0.89 (0.71, 1.11)	0.82 (0.72, 1.01)
SES	0.94 (0.82, 1.08)	0.97 (0.73, 1.29)	1.01 (0.77, 1.31)	0.94 (0.77, 1.15)
Single-parent family	1.04 (0.85, 1.27)	1.04 (0.68, 1.61)	1.08 (0.74, 1.58)	0.97 (0.73, 1.29)
Maternal health status	1.14* (1.02, 1.26)	1.14 (0.91, 1.43)	1.19 (0.96, 1.49)	1.15 (0.99, 1.33)
Mother smokes at home	1.30** (1.07, 1.57)	0.85 (0.55, 1.30)	2.17*** (1.46, 3.23)	1.18 (0.89, 1.56)
Parenting index	1.04 (0.96, 1.12)	0.84* (0.71, 0.99)	0.92 (0.79, 1.08)	0.94 (0.84, 1.06)
Age	1.04*** (1.03, 1.06)	0.96*** (0.94, 0.98)	1.10*** (1.08, 1.13)	1.12*** (1.10, 1.14)
Age square	0.99*** (0.99, 0.99)	1.00* (1.00, 1.00)	0.99*** (0.99, 0.99)	0.99*** (0.99, 0.99)

Given the restricted-use license of the ECLS-B, researchers are required to report to the nearest fifty when reporting sample size

<sup>a</sup> The table reports odds ratios, and 95 % confidence intervals are in parentheses

\*  $p < 0.05$ ; \*\*  $p < 0.01$ ;

\*\*\*  $p < 0.001$

with the large set of potential confounding child and family characteristics included and using the fixed effects method, the results may still be subject to bias due to unmeasured, time-varying factors. It is possible that unobserved changes in family functioning or family dynamics resulted in changes in both the childcare arrangements and child health.

Findings from this study suggest a reconsideration of the ways in which childcare policy can promote children's health in early life. The results from prior epidemiological studies on childcare and children's health often suggest a "center-based" solution whose targets are the childcare settings and the primary goals are to improve the quality of childcare facilities and to train staffs to better monitor children's health and health behaviors in childcare settings [5]. Findings from this paper suggest a "family-based" alternative whose targets are the families and the goals are to reduce parents' reliance on multiple childcare arrangements. In other words, childcare policy should also address the issue of why parents use multiple arrangements, along with the traditional concerns about the quality of childcare settings. Because an increase in the number of arrangements represents a threat to early childhood health, simply improving the hygiene and quality of childcare settings appears to be inadequate for protecting children's health.

Future programs and policies should address the broader social contexts and factors that lead to reliance on multiple childcare arrangements [18]. Strategies that effectively reduce parents' need for multiple arrangements could complement existing and continuous governmental efforts to improve the quality of childcare settings to better safeguard young children's health.

This study is one of the first systematic analyses of multiple childcare use and early childhood health using a nationally representative sample of U.S. children. The results demonstrate the importance of childcare configurations, and in this case, the multiplicity of arrangements, in determining health outcomes in early childhood. Studies on child care and children's health should adopt a contextual and dynamic perspective by carefully considering the patterns of continuity and change and their corresponding effects on health outcomes in children. These findings elucidate the positive relationship between multiple arrangements and the incidence of ear infections, gastrointestinal illnesses, and asthma cases, and the results are robust to different model specifications. Furthermore, while increases in center-based care comprise the primary risk factor, this study also found suggestive evidence that increases in the number of non-relative care arrangements may be a risk factor for asthma diagnoses. This issue

requires additional research to better understand the role of multiple childcare arrangements and the pathways generating these differential outcomes.

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