Health Care Utilization and Expenditures Associated With Child Care Attendance: A Nationally Representative Sample

Michael Silverstein, MD*‡; Anne E. Sales, PhD§; and Thomas D. Koepsell, MD, MPH*

ABSTRACT. Objective. Participation in center-based child care among preschool-aged children is associated with an increased incidence of communicable illness. Although estimates of health care utilization and costs associated with child care attendance exist in other countries with different health care systems, nationally representative data for the United States are lacking. The objective of this study was to determine the patterns of health care utilization and costs associated with attendance at different types of child care, among a nationally representative sample of preschool-aged children.

Methods. A nationally representative sample of children aged 0 to 5 years enrolled in the Medical Expenditure Panel Survey, 1997 Cohort were studied. Data were analyzed by cross-sectional analysis within a single calendar year. The Rand Health Insurance experiment 2-part multivariate regression model was used to accommodate skewed expenditure data.

Results. A total of 871 children were included in the study. A total of 484 (56%) attended no child care provided by anyone other than their primary caregiver; 134 (15%) attended center-based child care; 76 (9%) attended friend or neighbor care; and 170 (20%) attended in-home or relative care. In a weighted multivariate model, children in center-based child care were more likely than those not in child care to have attended at least 1 office-based visit (adjusted odds ratio [aOR]: 2.8; 95% confidence interval [CI]: 1.0–7.9) and emergency department visit (aOR: 2.0; 95% CI: 1.1–3.6) and to have received a medication prescription (aOR: 2.8; 95% CI: 1.2–6.1). The adjusted 2-part model predicted total health care expenditures for those not attending child care to be $642 (95% CI: 508–813), versus $985 (95% CI: 714–1336) for a similar size that this pattern of utilization and expenditure is escribed these trends.

Conclusion. In the immediate term, children in center-based child care tend to use more health care services. This increased utilization translates into modest per-child differences in health care expenditures. We hypothesize that this pattern of utilization and expenditure is attributable primarily to a higher incidence of minor, self-limited, communicable illness among children in center-based child care. Pediatrics 2003;111:e371–e375. URL: http://www.pediatrics.org/cgi/content/full/111/4/e371; child care, children, costs, expenditures, utilization, Medical Expenditure Panel Survey.

ABBREVIATIONS. MEPS, Medical Expenditure Panel Survey; FPL, federal poverty level; CI, confidence interval; aOR, adjusted odds ratio.

More than half of all preschool-aged children in the United States attend out-of-home child care.1 Numerous studies have described an increased incidence of viral illness associated with center-based child care and preschool attendance—primarily upper respiratory infection and diarrhea.2,3 Such illness, although typically self-limited, is responsible for a large number of physician visits, missed parental workdays, and medication prescriptions.4,5 Attendance at child care centers has also been associated with other, more significant entities such as hepatitis,6 injuries,7 and chronic otitis media.8,9

Center-based child care, however, has become a necessity in the United States, as single-parent and dual-income families currently constitute a significant proportion of American households. Furthermore, educational child care has proven social and educational benefits for both medically fragile10–12 and low-income children.13–18 Participation in center-based child care has also been reported to protect against subsequent illness, presumably through acquired immunity.19,20 Characterizing the immediate and long-term costs and benefits of different types of child care is therefore important from both family and societal standpoints.

Although increased disease incidence associated with child care attendance has been characterized, it is unclear the extent to which this increased disease burden translates into increased health care utilization and costs. In 1989, Bell et al21 reported increased hospitalization rates, physician office visits, and total health care costs among child care attendees enrolled in a single prepaid health plan; however, their analysis failed to adjust for other potential contributors to these outcomes. More recent studies have described child care-associated health care costs in Canada22 and Finland.23 Recent, nationally representative data for the United States, however, are lacking.

Using the 1997 Medical Expenditure Panel Survey (MEPS), we sought to characterize health care utilization and expenditures among a nationally representative sample of 0- to 5-year-old children attending 1) center-based child care, 2) child care provided in a separate private home (termed friend/neighbor care), and 3) child care provided by a relative, as contrasted with 4) those attending no child care pro-
vided by anyone other than the child’s primary caregiver.

METHODS

Data Source

We extracted data from the household component of the 1997 and 1998 MEPS. MEPS is a project of the Agency for Healthcare Research and Quality and draws from a nationally representative sample of noninstitutionalized, nonmilitary Americans to estimate utilization and expenditures of inpatient, outpatient, emergency, and pharmacy services. MEPS’s subjects are followed for 2 years with regular face-to-face interviews; information is verified by cross-checking claims and utilization data.

Sample

We restricted our study sample to the 1997 MEPS Panel 2 (approximately half of the 1997 cohort) because only subjects were asked questions regarding child care arrangements. We further restricted our sample to children aged 0 to 5 and selected only the youngest child from each household. To this sample of 871 children, we merged the 1998 MEPS Household Component variables that reflected child care attendance in 1997. We eliminated 1 extreme outlier from the analysis, whose 1997 total health care expenditures of nearly $100,000 were unsupported by any corresponding explanatory diagnosis from the MEPS diagnostic file, and were therefore considered an error.

Child Care Exposure

Respondents were asked whether any of the children in the household required child care arrangements other than school attendance during 1997 because their primary caregiver was working. If so, they were asked whether the child was usually in the care of a relative or nonrelative. Those who responded nonrelative were then asked about child care settings. Because the above questions were asked specifically with reference to the youngest child in the home, we selected only this child from each household. We grouped child care exposure into 4 mutually exclusive categories: 1) no child care; 2) center-based child care, including child care centers, preschools/nursery schools, and before/after school programs; 3) friend/neighbor care, including care provided by a nonrelative at a private home other than the child’s; and 4) relative/home care, including care provided by a nonrelative in the home or a relative in any setting.

Child Data

We extracted the following data on each subject: age, insurance status (dichotomized as uninsured all year or not), Medicaid status (dichotomized relative to ever receiving publicly funded health insurance in 1997), number of people in the home, poverty status (categorized as <100% federal poverty level [FPL], 100% to <125% FPL, 125% to <200% FPL, 200% to <400% FPL, 400% or greater FPL), and the child’s parent-perceived health status. In addition, we used a dichotomized measure created by MEPS to reflect the presence of any physical or social limitations. This variable was based on whether the child had any limitations in activity or play, or required any special schooling as a result of physical or mental impairment.

Parent/Guardian Data

We linked each subject to an adult (>16 years old) guardian who, by definition, lived in the same home as the child. In cases in which the subject’s mother was identified as living in the household, we assigned guardian status to the mother (biological, adoptive, or step). When the mother was not identified, we assigned guardian status to the father, and then to the household reference person, defined as the individual who either owned or rented the home.

The following data were collected on each guardian: age, education (dichotomized relative to having a high school diploma), and employment status (operationalized as having no job all year, different jobs over the year, or the same job continuously all year). We considered families to be marital dual-parent when the guardian indicated a marital partner living at home. (Because of limitations of the MEPS data, we were unable to define cohabitating, nonmarried parents or caregivers.)

Health Care Utilization and Expenditures

Our primary outcome measure was total 1997 health care expenditures. We also extracted data individually for office-based, emergency department, inpatient, and prescription drug utilization and expenditures. MEPS defines expenditures as the sum of direct payments for care provided, including both out-of-pocket and insurance payments.

Data Analysis

We used the individual level weights from the MEPS data to yield valid national estimates. On weighted data, we performed a cross-sectional analysis of 1997 expenditures using the Rand Health Insurance experiment 2-part model.27 We selected the 2-part model because of its accuracy in accommodating expenditure data in which 1) a large proportion of subjects have no expenditures, 2) the distribution among those with nonzero expenditures is skewed to the right but can be nearly normalized with log transformation, and 3) assumptions of linearity pertaining to ordinary least squares regression are typically violated.28,29

Variables were selected for inclusion in the model because of their documented or theoretical relevance to the outcomes of interest. We used model diagnostics to check the model’s validity.

Part I: Multivariate Logistic Regression

We estimated a weighted logistic regression model to predict the probability of incurring any health care expenditure or utilization in 1997 for each of the health care domains listed above.

Part II: Multivariate Linear Regression

Only children with nonzero expenditures were selected and were modeled using the natural logarithm of expenditures as the outcome variable. This part of the model predicted expenditures conditional on whether the individual used any health care services. Adjusted cost ratios were obtained from the exponentiated regression coefficients. For later combination with the results of part I, the weighted predictions were then retransformed from log dollars to dollars using Duan’s smearing estimator,30 which uses regression residuals to control for retransformation biases. We used both the homoscedastic and heteroscedastic versions of the smearing estimator where appropriate.31,32

Assembling the 2-Part Model

The 2 model parts were recombined by multiplying the results of part I (probability of incurring any expenditure) by the results of part II (predicted expenditure conditional on any utilization), yielding an individual’s predicted total health care expenditures. We used the 2-part model to make adjusted expenditure estimates among a standardized population (the no child care group) for center-based child care, friend/neighbor care, and relative/home care.

Confidence Intervals

Ninety-five percent confidence intervals (CIs) on the final estimates were calculated by bootstrapping the full 2-part model 1000 times on weighted data for each of the outcome categories.33 We performed all analyses using Stata 7.0. Because MEPS is a public use data set devoid of unique identifiers, the University of Washington granted official exemption from institutional board review.

RESULTS

Sample Description by Child Care Group

MEPS sample sizes and the population that they represent are shown in Table 1. Compared with the no child care group, children who attended center-based child care were less likely to be below the 200% federal poverty level (29% vs 51%), to be uninsured (7% vs 10%), or to be covered by Medicaid (28% vs 40%; Table 1). Children in center-based child care were more likely to have parents with a high school
diploma (94% vs 70%) and less likely to have parents unemployed all year (6% vs 43%). A slightly lower proportion of children in center-based child care came from marital dual-parent households (71% vs 77%).

Unadjusted Outcomes

In an unadjusted analysis, children in center-based care incurred the greatest mean total health care expenditures ($887) in 1997 of all of the child care exposure categories (Table 1). This trend held individually for office-based, emergency department, and prescription drug expenditures. Utilization for each health care delivery site followed the same pattern.

Adjusted Likelihood of Utilization

We estimated a weighted multivariate logistic regression model for likelihood of any utilization for each of the health care delivery sites (Table 2). Children in center-based child care were more likely to have at least 1 office-based (adjusted odds ratio [aOR]: 2.8; 95% CI: 1.0–7.9) or emergency department (aOR: 2.0; 95% CI: 1.1–3.6) visit than children out of child care. These children were also more likely to receive a medication prescription (aOR: 2.8; 95% CI: 1.2–6.1). There was no statistically significant difference in the likelihood to have an inpatient admission across child care groups.

2-Part Model

The results of the 2 parts of the model are shown individually in Table 3. Within each of the health care delivery sites, the odds of having any expenditures differed slightly from the odds of having any utilization because of uncompensated care. Among children with nonzero health care expenditures, those attending center-based child care had increased total health care expenditures relative to those not in child care (adjusted cost ratio: 1.48; 95% CI: 1.04–2.12; Table 3).

Using the no child care group as a standard pop-

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**TABLE 1.** Sociodemographic Features and Health Care Expenditures of MEPS’s Preschool-Aged Children by Child Care Type*

<table>
<thead>
<tr>
<th>Population estimate (weighted n)</th>
<th>Total (n = 871)</th>
<th>No Child Care (n = 484)</th>
<th>Center-Based Care (n = 134)</th>
<th>Friend/Neighbor Care (n = 76)</th>
<th>Child’s Home/Relative (n = 170)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Child demographics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (y, SD)</td>
<td>2.11 (1.62)</td>
<td>2.14 (1.63)</td>
<td>2.12 (1.56)</td>
<td>2.03 (1.48)</td>
<td>2.07 (1.69)</td>
</tr>
<tr>
<td>Male</td>
<td>54%</td>
<td>50%</td>
<td>62%</td>
<td>47%</td>
<td>57%</td>
</tr>
<tr>
<td>Medicaid</td>
<td>34%</td>
<td>40%</td>
<td>28%</td>
<td>25%</td>
<td>30%</td>
</tr>
<tr>
<td>Uninsured all 1997</td>
<td>10%</td>
<td>10%</td>
<td>7%</td>
<td>11%</td>
<td>11%</td>
</tr>
<tr>
<td>Parent-perceived health status is good</td>
<td>97%</td>
<td>96%</td>
<td>97%</td>
<td>99%</td>
<td>98%</td>
</tr>
<tr>
<td>Physical or social limitations</td>
<td>7%</td>
<td>7%</td>
<td>8%</td>
<td>7%</td>
<td>5%</td>
</tr>
<tr>
<td><strong>Parent/household demographics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother is guardian</td>
<td>96%</td>
<td>96%</td>
<td>94%</td>
<td>92%</td>
<td>98%</td>
</tr>
<tr>
<td>Age (y, SD)</td>
<td>30.33 (6.73)</td>
<td>30.83 (7.21)</td>
<td>30.13 (6.49)</td>
<td>30.66 (5.28)</td>
<td>28.95 (6.09)</td>
</tr>
<tr>
<td>High school diploma</td>
<td>78%</td>
<td>70%</td>
<td>94%</td>
<td>88%</td>
<td>78%</td>
</tr>
<tr>
<td>Unemployed all year</td>
<td>25%</td>
<td>43%</td>
<td>6%</td>
<td>3%</td>
<td>8%</td>
</tr>
<tr>
<td>Marital dual-parent family</td>
<td>71%</td>
<td>77%</td>
<td>71%</td>
<td>68%</td>
<td>56%</td>
</tr>
<tr>
<td>&lt;200% FPL</td>
<td>43%</td>
<td>51%</td>
<td>29%</td>
<td>28%</td>
<td>48%</td>
</tr>
<tr>
<td>Household size (SD)</td>
<td>4.03 (1.32)</td>
<td>4.35 (1.42)</td>
<td>3.76 (1.01)</td>
<td>3.63 (1.06)</td>
<td>3.68 (1.27)</td>
</tr>
</tbody>
</table>

Outcomes

| Utilization (SD)                |                |                        |                             |                               |                               |
| Medication prescriptions (SD)   | 2.76 (4.50)    | 2.54 (4.72)            | 3.34 (4.18)                 | 2.70 (4.45)                   | 2.76 (3.76)                   |
| Office-based visits (SD)        | 4.10 (6.31)    | 3.90 (6.88)            | 5.13 (7.95)                 | 3.61 (3.67)                   | 3.96 (3.56)                   |
| Used emergency department       | 18%            | 15%                    | 23%                         | 10%                           | 24%                           |
| Admitted to hospital            | 5%             | 5%                     | 6%                          | 1%                            | 8%                            |

Expenditures (SD)

| Total                           | $697 (1635)    | $749 (1999)            | $887 (1573)                 | $431 (791)                    | $529 (704)                    |
| Office-based                    | $275 (552)    | $257 (567)             | $370 (791)                  | $209 (235)                    | $270 (310)                    |
| Emergency department            | $58 (219)     | $48 (199)              | $112 (318)                  | $25 (85)                      | $54 (201)                     |
| Inpatient                       | $157 (972)    | $203 (1231)            | $158 (806)                  | $40 (347)                     | $98 (415)                     |
| Prescription drugs              | $63 (220)     | $62 (266)              | $69 (123)                   | $66 (241)                     | $53 (110)                     |

* Table represents weighted estimates.

SD indicates standard deviation.
ulation, the 2-part model predicted adjusted mean total health care expenditures for children in center-based child care to be $985 (95% CI: $714–$1336), compared with $642 (95% CI: $508–$813) for those out of child care (Table 4). Expenditures for office-based visits and prescription drugs showed trends in the same direction. Because hospital admission and emergency department visits were relatively rare events and the number of children included in the sample was fairly small, the 2-part model was unable to predict these expenditures accurately.

**DISCUSSION**

Among this nationally representative sample of preschool-aged children, we found that attendance at center-based child care was associated with increased utilization of health care services relative to children not in child care. Specifically, children in center-based child care were 2 to 3 times more likely to use any emergency department, office-based, or pharmacy services than nonattendees. This increased utilization translated into an estimated difference of $343 per child in total annual health care expenditures.

Our results are consistent with previously published reports concerning child care-associated health care utilization. Previous studies reporting health care costs, however, have done so in the context of international health care systems different from the United States’ or among children within a single health maintenance organization. Our study is the first to address the issue of cost with an adjusted analysis among a nationally representative US population.

On the basis of this and other studies, we hypothesize that increased use of health care services among child care attendees reflects a combination of causes. Foremost is a higher incidence of minor communicable illness among these children. In addition, child care policies that require physician authorization for symptomatic children to return to the center, as well as a theoretical tendency among working parents to seek medical care more promptly for their children (so that they may return to work), may augment the repercussions of this increased disease burden.

Although children in center-based child care tend to use more health care services, these services—for a primarily healthy population—are relatively inexpensive or rare. As a result, a proportional increase in health care expenditures for these children is not seen. In our study, the $343 per-child difference in total health care expenditures between those in center-based child care and those not in child care reached only borderline statistical significance.

Our study was limited by a number of factors. The high variability of expenditure data demands large sample sizes to demonstrate statistically significant differences. Because we had a relatively small sample, our study was likely unable to detect modest differences in health care expenditures across child care groups. Therefore, the borderline significant increase in total health care expenditures from $642 among nonattendees to $985 among center-based attendees and the increase in prescription drug expenditures from $42 to $73 likely represent authentic, if modest, differences in health care expenditures.

Sample size limitations also precluded an analysis of possible effect modification by age. Previous re-

### TABLE 3. AORs and Cost Ratios on Expenditure Data for Individual Parts of the 2-Part Model*

<table>
<thead>
<tr>
<th>Healthcare Delivery Site</th>
<th>No Child Care</th>
<th>Center-Based Care</th>
<th>Friend/Neighbor Care</th>
<th>Child’s Home/Relative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part I: adjusted odds of having any health care expenditure</td>
<td>Reference</td>
<td>1.9 (0.6–5.8)†</td>
<td>2.7 (0.7–9.6)</td>
<td>1.4 (0.6–3.3)</td>
</tr>
<tr>
<td>Total</td>
<td>Reference</td>
<td>1.48 (1.04–2.12)</td>
<td>0.82 (0.55–1.23)</td>
<td>1.14 (0.81–1.57)</td>
</tr>
<tr>
<td>Office-based</td>
<td>Reference</td>
<td>1.06 (0.78–1.45)</td>
<td>0.74 (0.60–1.26)</td>
<td>1.11 (0.63–1.96)</td>
</tr>
<tr>
<td>Emergency department</td>
<td>Reference</td>
<td>2.7 (1.2–6.1)</td>
<td>1.1 (0.6–2.2)</td>
<td>1.5 (0.8–2.5)</td>
</tr>
<tr>
<td>Inpatient</td>
<td>Reference</td>
<td>1.9 (0.7–4.7)</td>
<td>0.4 (0.1–2.6)</td>
<td>1.8 (0.7–5.1)</td>
</tr>
<tr>
<td>Prescription drugs</td>
<td>Reference</td>
<td>2.6 (1.0–6.7)</td>
<td>2.4 (0.9–6.5)</td>
<td>1.6 (0.8–3.2)</td>
</tr>
</tbody>
</table>

| Part II: adjusted cost ratios among children with non-zero health care expenditures | Reference | 1.36 (0.91–2.03) | 1.61 (0.82–3.04) | 2.12 (0.82–5.46) |
| Total | Reference | 1.48 (1.04–2.12) | 0.82 (0.55–1.23) | 1.14 (0.81–1.57) |
| Office-based | Reference | 1.06 (0.78–1.45) | 0.84 (0.61–1.16) | 1.25 (0.96–1.62) |
| Prescription drugs | Reference | 1.36 (0.91–2.03) | 1.61 (0.82–3.04) | 2.12 (0.82–5.46) |

* Adjusted for gender, household size, child’s and parent’s age, poverty status, insurance and Medicaid status, health perception, presence of social or physical limitations, marital dual-parent family, parental education, and employment. 
† Parentheses represent 95% CIs on weighted data.

### TABLE 4. Adjusted Health Care Expenditures Predicted in Dollars Among a Standardized Population, as Predicted by the 2-Part Model*

<table>
<thead>
<tr>
<th>Health Care Delivery Site</th>
<th>No Child Care (Standard Population)</th>
<th>Center-Based Care</th>
<th>Friend/Neighbor Care</th>
<th>Child’s Home/Relative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>$642 (508–813)†</td>
<td>$985 (714–1336)</td>
<td>$557 (380–882)</td>
<td>$743 (526–1054)</td>
</tr>
<tr>
<td>Prescription drugs</td>
<td>$42 (29–56)</td>
<td>$73 (45–114)</td>
<td>$70 (42–119)</td>
<td>$56 (35–87)</td>
</tr>
</tbody>
</table>

* Adjusted for gender, household size, child’s and parent’s age, poverty status, insurance and Medicaid status, health perception, presence of social or physical limitations, marital dual-parent family, parental education, and employment. 
† Parentheses represent 95% CIs on weighted data.
ports have suggested that the increased disease burden of children in center-based child care is carried disproportionately by those under 2 years of age. Because of sample size limitations, we were unable to analyze these children separately. Similarly, because emergency department and inpatient use both are relatively rare among children, our sample left the linear regression portion (part 2) of the 2-part model with too few nonzero observations to calculate these outcomes accurately.

MEPS's exposure and outcome measurements introduce 2 final limitations to the study. First, MEPS fails to account for either hours per week of child care attendance or number of children in each child care setting—2 factors that are known to be associated with disease transmission in this context. This limitation likely introduces a conservative bias by underestimating differences in cost and utilization associated with being in full-time child care. Second, although emergency department and prescription drug utilization can be attributed justifiably to an increased disease burden associated with child care attendance, the increased use of office-based services may reflect, in part, better adherence to well-child care guidelines among children enrolled in child care centers.

Although children in center-based child care tend to use more health care services than nonattendees, these differences are insufficient to cause proportional increases in associated health care expenditures. Assuming that the $343 dollar differential in health care expenditures between child care attendees and nonattendees represents a true difference, center-based child care attendance does seem to carry a modest per-child societal cost. Its costs, however, must be viewed in the context of its known benefits—particularly those involving early childhood development, socialization, immune system maturation, and parent job flexibility.

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http://pediatrics.aappublications.org/content/111/4/e371