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Little Evidence That Time in Child Care Causes Externalizing Problems During Early Childhood in Norway

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Abstract

Associations between maternal reports of hours in child care and children's externalizing problems at 18 and 36 months of age were examined in a population-based Norwegian sample (n = 75,271). Within a sociopolitical context of homogenously high-quality child care, there was little evidence that high quantity of care causes externalizing problems. Using conventional approaches to handling selection bias and listwise deletion for substantial attrition in this sample, more hours in care predicted higher problem levels, yet with small effect sizes. The finding, however, was not robust to using multiple imputation for missing values. Moreover, when sibling and individual fixed-effects models for handling selection bias were used, no relation between hours and problems was evident.

The impact of time spent in early child care on social-emotional development is a contentious issue among social scientists and the public alike. Indeed, there remains a lack of empirical consensus on the topic. One review of the cumulative work in the U.S. concludes that, among child care predictors of socio-emotional problems, quantity of care is the strongest and most consistent, with more hours predicting more problems (Jacob, 2009). Yet, more recently, researchers have found this prediction to be sporadically evident, but not robust, when using conservative controls for potential selection bias (McCartney et al., 2010).

The scientific and public debate has, to date, relied heavily on child care studies in the United States and on one longitudinal study in particular - the NICHD Study of Early Child Care and Youth Development (NICHD SECCYD). For this reason, sociopolitical context must be considered; quantity findings in U.S. samples must be interpreted with attention to the lack of regulatory standards at the federal level for child care quality and professional development (Love et al., 2003), and a relatively early average age of entry into non-parental care due to the relatively short average length of parental leave (UNICEF Innocenti Research Center, 2008). A greater scientific focus on child care in countries with publicly subsidized and regulated child care is the next logical step for the field. In the present study,

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we examined associations between hours in child care and externalizing behavior problems in a large, population-based longitudinal Norwegian study.

Norway: Child Care in Sociopolitical Context

According to UNICEF, Norway meets or exceeds 8 of 10 benchmarks for early childhood service regulation, standards, and quality (examples of benchmarks are: Subsidized and regulated child care services for 25% of children under 3, 1.0% of GDP spent on early childhood services; UNICEF Innocenti Research Center, 2008). The U.S., in contrast, meets 3 out of the 10 benchmarks. Whereas child care in U.S. policy is generally treated as an unintended or unfortunate consequence of workforce participation among women, child care in the Norwegian corporatist economy is part of a broader family policy to promote maternal workforce participation and employment rights (Mandel & Semyonov, 2005). Norwegian female workforce participation is among the highest in the OECD, with 74.4% of women being employed in 2009, compared to 63.4% in the U.S., and most Norwegian children are cared for outside of their homes; in 2009, 79% of all 1–2 year olds, and 97% of all 3–5 year olds attended publicly subsidized center care (Statistics Norway, 2011). Nonetheless, there is considerable variability in the number of hours children spend in child care in Norway (Statistics Norway, 2011), making it ideal for examining links between quantity of care and externalizing problems within a sociopolitical context of regulated, near universal and homogenously high-quality care.

In Norway, parents have about one year parental leave at nearly full pay (Ministry of Education, 2011). All children have the right to center care or family day care from age one, which is heavily subsidized, with maximum fees of NOK 2000 (app. USD 333/month), reduced according to family income. Quality standards (teacher education and child-staff ratios) and curriculum are regulated by law (Ministry of Education, 2010). In center care, adult: child ratios cannot exceed 3:10 for children younger than 3 and 3:19 for those older; at least one of these adults has to be a trained child care teacher. Family day care is limited to ten children and adult: child ratios of 1:5 for children older than 3, and lower for younger children; caregivers must receive weekly supervision from a teacher responsible for pedagogical planning (Ministry of Education, 2006). While standards are currently not entirely met in all centers (Brenna et al., 2001; UNICEF Innocenti Research Center, 2008), quality is relatively high and homogenous (Winsvold & Guldbrandsen, 2009). However, it is noteworthy that, at least in the U.S., only modest correlations have been observed between structural indicators of quality and observed quality of caregiver-child interactions (e.g., NICHD Early Child Care Research Network, 2002).

Child Care Quantity and Externalizing Problems: Theory and Empirical Work

Developmental contexts have an impact on children's behavioral problems. For instance, contexts characterized by chaos, high stress, or including antisocial role models, increase the likelihood of children developing externalizing problems, a domain which includes aggressive, destructive, and hyperactive behaviors (e.g., Hinshaw, 2002). In the early 1980's, following a large increase in women's participation in the labor force, U.S. researchers began documenting associations between hours in non-maternal care and externalizing problems (Belsky, 1986; Clarke-Stewart & Fein, 1983). In response, theoretical explanations were offered, most based on attachment or social learning theory, yet none have received consistent empirical support (for a review, see McCartney et al., 2010).

A number of studies have continued to document positive associations between hours in child care and externalizing problems in samples of children from the U.S. (for a review, see NICHD Early Child Care Research Network, 2003). Using child care provider and teacher reports of externalizing problems, associations with child care quantity, repeatedly measured throughout early childhood, have been documented in the SECCYD when children were 2 and 4 years of age, and once they were in kindergarten, but not when children were 3 (NICHD Early Child Care Research Network, 1998; NICHD Early Child Care Research Network, 2003). Associations with maternal reports of externalizing problems were also found, but only in kindergarten. These associations remained evident after adjusting for a host of family and child care factors, including quality, measured repeatedly. These findings were less consistent when child care quantity at specific ages was considered. Further analyses indicated associations between more hours in care prior to age 4, and teacher-reported externalizing behavior up to age 12 (Belsky et al., 2007) and self-reported risk taking and impulsivity at age 15 (Vandell, Belsky, Burchinal, Steinberg, & Vandergrift, 2010).

Evidence from other U.S. studies support the main conclusion from the SECCYD. Higher amounts of non-maternal care across early childhood have been found to predict negative adjustment reported by teachers and observers at age 5 (Bates et al., 1994) and in third grade (Vandell & Corasaniti, 1990), and maternal reports of behavior problems at ages 3 and 5 (Belsky, 1999). Further, Loeb et al. (Loeb, Bridges, Bassok, Fuller, & Rumberger, 2007) found that hours in center care, rather than hours in any non-maternal care, in the year prior to kindergarten, was associated with poor teacher-rated social skills in kindergarten.

In studies outside of the U.S., results have been more mixed. In a recent Australian study, full-time center care (more than 20 hrs per week) throughout the child's early years, as well as between age 2 and 3, was associated with higher levels of parental reports of difficult temperament at age 3, compared to children in part-time care (Yamauchi & Leigh, 2011). In a sample of Dutch twins, children in low and medium amounts of nonparental care were also rated by mothers and fathers as having more externalizing problems at age 3, compared with those exclusively in parental care (Van Beijsterveldt, Hudziak, & Boomsma, 2005). Children in high amounts of nonparental care displayed low problem levels similar to those in parental care. Amount of care was defined as proportion of full time care across the first three years.

In a British study, high levels of group care across early childhood were associated with higher levels of teacher-rated antisocial behavior up to age 7, yet the association was not evident at age 10 (Melhuish, 2010). Moreover, in another British sample, no association between average hours in care across early childhood and mother-reported disruptive behaviors was evident at age three (Barnes, Leach, Malmberg, Stein, & Sylva, 2009). Similarly, a Canadian study found no association between quantity of non-maternal care and contemporaneous mother-reported behavior problems in 4–5 year olds (Romano, Kohen, & Findlay, 2010). In Japan, researchers found no association between time spent in "Baby Hotels", child care centers open 24-hrs a day, and observer-rated social competence (Anme & Segal, 2004).

In a Nordic context, two studies have been focused on child care quantity and child outcomes. More hours in center care at age 3 was associated with higher levels of behavior problems reported by mothers at age 7 in a large Danish sample (Gupta & Simonsen, 2009). In addition, in a Norwegian study using maternal employment across the child's first four years as a proxy for early child care, associations were found with teacher-reported problem behavior in 10 year olds (Borge & Melhuish, 1995), but not with mother reports of behavior problems at ages four to seven.

These previous findings on child care quantity and externalizing problems vary considerably, as do the designs and measurement across studies. Associations are more consistent in studies using caregiver or teacher reports (e.g., Loeb et al., 2007) than maternal reports (e.g., Barnes et al., 2009) or observer ratings (Anme & Segal, 2004), although associations with maternal reports are found in several studies (e.g., Yamauchi & Leigh, 2011; Gupta & Simonsen, 2009). Furthermore, associations appear largest and most robust when analyses are based on cumulative hours in care across multiple years in infancy and early childhood (e.g., Vandell & Corasaniti, 1990), although they are also found when quantity is measured at a single time point (e.g., Loeb et al., 2007). Notably, varying findings across design features, including reporter of externalizing problems and operationalization of quantity, are consistent with the report by the NICHD Early Child Care Research Network (2003). Associations were also present, although less consistently, when maternal reports and observer ratings of externalizing problems as well as quantity across more limited time periods were considered.

International Variations in Parental Leave and the Average Age of Entry into Care

When considering international studies, variations in sociopolitical context with regard to parental leave policies and average age of entry into care must be noted. In the U.S., parents are granted 12-week unpaid parental leave, with 10 states paying temporary disability benefits for 10 weeks (OECD Early Childhood Education and Care Home Page, 2004). This results in a relatively early average age of entry into nonmaternal care in the U.S., with approximately 42% of all children entering care in their first year of life in 2005 (National Center for Educational Statistics, 2011).

In the Netherlands, where Van Beijsterveldt, et al. (2005) found some associations between quantity and parent-reported behavior problems, parents are offered 16 weeks of paid leave followed by six months of unpaid leave. In Denmark, where Gupta and Simonsen (2009) found associations between quantity of care at age 3 and parent reported behavior problems at age 7, parents may take about 6 months leave paid at the unemployment benefit rate, and another six months at reduced rate. The UK, from where findings are mixed, offers six months maternity leave with almost full pay, followed by one year of unpaid leave. This is reflected in the age of entry in the sample for which Barnes et al. (Barnes et al., 2009; Sylva et al., 2011) report no association between quantity and parent reported problems: almost 50% of children had no nonparental care during their first year of life, while about 20% entered care from age 6 months for more than 30 hrs per week.

It is difficult based on the existing literature to plot a precise pattern of association between policy and whether researchers did or did not detect associations between child care quantity and externalizing behavior problems, primarily because: (a) of the various ways in which nations structure policies; (b) the limited number of studies outside the United States; and (c) differences in study design and measurement. Nonetheless, it is clear that a one-year parental leave policy with pay makes Norway an uncommon context to study relations between child care quantity and behavior problems, because this policy results in almost no children entering nonparental care before age one.

With this in mind, high quantity specifically in the first year of life has been associated with later antisocial behavior (Melhuish, 2010), and problem behaviors (Van Beijsterveldt, et al, 2005). Yet, entry into child care during the first year has been associated with lower levels of maternal reports of physical aggression in children of low-educated mothers (Coté, et al, 2007). It is also worth noting that children receiving high quantities of child care during the first years of life are also likely to receive high quantities at later ages making it difficult to

differentiate the effect of entering care at an early age from the cumulative effect of high quantity of care across early childhood.

Potential Selection Effects: Analytical Approaches and Logical Propositions

Existing studies on child care quantity and children's emotional-behavioral problems are not randomized controlled experiments, but rather correlations estimated within observational designs. One serious concern regarding internal validity is the potential for selection–omitted variables–to bias estimated associations (Duncan, Magnuson, & Ludwig, 2004; Foster, 2010; McCartney, Bub, & Burchinal, 2006). Unmeasured child or family factors may influence both family child care choices and children's behavior, biasing the estimated effects of child care quantity per se, by either artificially inflating or deflating the findings.

All of the studies we have discussed, thus far, share an approach to adjusting for potential selection bias: general linear models that include measured child, family, and often also child care variables as covariates. Even large covariate sets, however, cannot capture all potential sources of selection (Duncan et al., 2004), and improperly specified covariates can bias associations upwardly (Foster, 2010). More conservative approaches to handling selection bias in non-experimental designs have been recommended, including the study of within-family variation (i.e., sibling fixed-effects models) and within-child variation across time (i.e., individual fixed-effects models; Duncan et al., 2004; McCartney et al., 2006).

Extending these recommendations, McCartney et al. (2010) use logical propositions to test whether associations of child care quantity and problems are evident in ways consistent with causal hypotheses. In a re-examination of SECCYD data, these authors tested five propositions, four of which move beyond the measured covariate approach used in prior studies. Two of these four tests provided evidence consistent with causality: (1) when conditioning on time spent in child care after age 2, time spent in child care in infancy and toddlerhood was associated with externalizing behavior in kindergarten and (2) amount of time spent in child care was associated with externalizing behaviors, controlling for earlier problems. However, when estimating within-child change–individual fixed-effects models–the evidence was mixed: changes in child care hours between 36 and 54 months predicted changes in externalizing problems, but changes in hours between 24 and 54 months did not. Moreover, in a dose-response analysis, increased hours did not predict increased problems.

In the present study, we follow McCartney and colleagues in taking a rigorous data analytic approach toward demonstrating associations that are more or less consistent with the causal hypothesis that more hours in care leads to more problems, extending this methodological practice to a non-U.S. sample. We add to the international evidence on child care quantity and externalizing problems using a longitudinal, population-based sample in Norway, where care quality is relatively high and homogenous, and the typical age of entry is after 1 year.

The Present Study

In the present study, we examined associations between hours in child care and maternal reports of externalizing problems at 18 and 36 months of age in a sample of 75,271 Norwegian children, 17,910 of whom were siblings. Specifically, we took three general approaches to examining these associations. First, we examined contemporaneous, lagged, and cumulative hours of care as predictors of externalizing problems, using estimates of between-child differences as has become conventional in the field. By estimating contemporaneous, lagged, and cumulative hours in care as predictors, we allowed for three possible ways in which child care quantity can predict externalizing problems. Our

contemporaneous models assume acute effects of higher hours in care, with rapid onset of externalizing behavior. Our lagged models assume delayed onset of externalizing problems. In turn, our cumulative models (average hours in care across 18 and 36 months) assume additive effects of hours in care, with consequences accumulating across time. Also note, by comparing results from this first set of modeling approaches, we were able to make inferences concerning a dose-response hypothesis. If a higher dosage of child care mattered, then our cumulative models should evidence larger associations than our contemporaneous or lagged models.

Second, we estimated sibling fixed-effects models, examining whether differences between siblings in number of hours in care at the two ages of interest are associated with differences between siblings in levels of externalizing problems. For these sibling fixed-effects models, we also examined contemporaneous, lagged, and cumulative specifications. One advantage of this method (compared with conventional nonexperimental comparisons of children from different families), is that bias caused by omitted variables shared by siblings could be ruled out. In particular, sibling fixed-effects models are useful for ruling out bias caused by persistent, shared parent and family characteristics that are unobserved. Notably, sibling influence constitutes a potential source of bias in these models. It is therefore pertinent to test for sufficient variability in both hours in care and in externalizing problems within sibling pairs.

Third, and finally, we estimated individual fixed-effects models, using within-child variations in hours of care as a predictor of within-child variations in externalizing problems across the two ages of interest. One advantage of this method, compared with conventional non-experimental comparisons of children, is that all unmeasured sources of bias that are constant over time are eliminated. For example, time-invariant characteristics of children and their parents can be ruled out as potential sources of bias. Note, however, that all techniques for causal modeling in observational data, including sibling- and individual fixed-effects models, rely on assumptions that cannot be empirically tested.

For all three of our modeling approaches, we examined (a) both linear and non-linear associations between hours in care and externalizing problems, with a particular interest in the potential for this association to become increasingly large at increasingly higher levels of hours; and (b) estimates before and after imputation of missing data, which, to the best of our knowledge, has been done in only one of the previous studies discussed (Vandell et al, 2010). We interpret our findings within the context of both the strengths and limitations of these data. In particular, we note the value of conservative approaches to selection bias and estimates based on a large and population-based sample from Norway, while keeping in mind that these estimates were based exclusively on maternal report of externalizing problems, only two assessments of child care quantity and no assessment of quantity prior to 18 months of age (due to the ecology of child care in Norway, i.e., extended parental leave and minimal child care utilization before age 1), and a sample with considerable attrition.

Method

Participants

Data from the population-based Norwegian Mother and Child Cohort Study (MoBa; for a complete description, see Magnus et al., 2006, and www.fhi.no/morogbarn) were used in the present study. All women in Norway giving birth between late 1999 and 2010 at hospitals and maternity units with more than 100 births annually, altogether 52 units, were eligible for the study–there are no exclusion criteria for participation. Women were invited to participate when they attended routine ultrasound examinations offered to all pregnant women in Norway at the 17th week of gestation. Information on health, lifestyle, and child

development was collected by questionnaire during pregnancy at the 17th, 22nd and 30th weeks of gestation and after birth by mail when the child was six, 18 and 36 months of age.

As of October 2010, 90,725 mothers of 108,639 children had enrolled and completed baseline assessments, which represented 42.1 % of all eligible mothers in Norway. Of the eligible children whose mothers enrolled, 69.3% (n = 75,271, including 17,910 siblings) were born by October 2007, making them eligible for inclusion in the present analyses because they were old enough for mothers to complete the 6-, 18-, and 36-month questionnaires. Among these children eligible for analyses, maternal questionnaire response rates at 18 and 36 months (the ages when hours in child care were assessed) were 72.4% and 59.3%, respectively.

Potential self-selection bias in the MoBa was examined by means of differences in prevalence estimates and association measures between MoBa participants and all women giving birth in Norway on demographics, health-related behaviors, and on a number of pregnancy- and birth-related variables (Nilsen et al., 2009). There were some differences between MoBa participants and non-participants. Young mothers (<25 years) and those living alone are under-represented relative to the Norwegian population. Moreover, mothers participating have fewer health related risks like smoking, and their children have higher birth weights and in general better neonatal health (including Apgar score) than children of those not participating. However, the relative differences were small (0.3–1.2%). Importantly, Nilsen et al. (2009) have demonstrated that despite risk prevalence differences between the MoBa sample and the population, associations between risk exposures and child development outcomes available through public registries are not statistically different when MoBa participants are compared with the population of Norway.

Measures

Externalizing problems—These were measured at 18 and 36 months by using selected items (9 items at 18 months and 11 items at 36 months were included in the MoBa) from the mother reported *Child Behavior Checklist for ages 2–3* (CBCL/2–3; Achenbach, 1992). Items were selected by a team of four clinical and developmental psychologists, based on clinical and theoretical standards, as well as empirical representativeness (high factor loadings) for externalizing behavior. Mothers rated whether each item statement reflected their child's behavior during the last two months from "1 – not true" to "3 – very true or often true".

At 18 months, three items from the attention problems scale (out of a total of five items) were used: "Punishment doesn't change his/her behavior", "Can't sit still, restless or hyperactive", and "Quickly shifts from one activity to another." In addition, at 18 months, six items from the aggressive behavior scale (out of 20 items) were used: "Defiant", "Doesn't seem to feel guilty after misbehaving", "Gets into many fights", "Gets into everything", "Hits others", "Punishment doesn't change his/her behavior." At 36 months, one item was added from the attention problems scale: "Poorly coordinated or clumsy", and one item was added from the aggressive behavior scale: "Demands must be met immediately." (Note that for our individual fixed effects models, we used a shorter scale at 36 months, based on the 9 items used at both assessments.) Scale reliability was adequate at both time points (Cronbach's α = .62 at 18 months and .74 at 36 months), with confirmatory factor analyses indicating adequate fit at 36 months (CFI/TLI= .866/.832, RMSEA= .086), but somewhat less adequate fit at 18 months (CFI/TLI= .798/.731, RMSEA= .092). We examined whether the subset of the 11 items used at 36 months was representative of the full externalizing broad band scale of the CBCL in the NICHD SECCYD data, and found a correlation of .92. In accordance with recommendations by Achenbach (1992) for when a

selection of items from the CBCL (rather than the complete scale) is used, we report raw scores rather than *T* scores.

As a complement to the CBCL, four items from the *Infant-Toddler Social and Emotional Assessment* (ITSEA; Carter, Briggs-Gowan, Jones, & Little, 2003) were also used to assess child social-emotional problems at 36 moths. See Appendix A.

Child care—The number of hours per week that children spent in nonparental child care was reported by the mothers when their children were 18 and 36 months of age. At these time-points, mothers also reported on the type of child care arrangement (home care by mother or father, unqualified child minder, family day care or outdoor nursery, or center care) that represented the child's primary care arrangement. At 18 months, mothers additionally reported retrospectively which of these types of care the child had experienced from 0 to 18 months of age (in the intervals 0–6, 7–9, 10–12, 13–15, and 16–18 months).

Risk factors for externalizing problems—Family and child risk factors were considered as covariates for relations between child care hours and externalizing problems.

Family and prenatal risk factors: Maternal and paternal education, partner status (single vs. partnered), non-Norwegian family background, and family income (adjusted for consumer price index with 2005 as reference year) were reported by the mothers at 17th gestational week. Perceptions of economic hardship were assessed at 6 and 18 months after birth, using Likert-type responses to the question "Have you found it difficult sometimes during the last six months to cope with running expenses for food, transport, rent, etc.". Mothers also reported on their psychological distress (anxiety and depression) using the *Hopkins Symptom Checklist* (SCL; Hesbacher, Rickels, Morris, Newman, & Rosenfeld, 1980), at 17th gestational week and when their child was 6, 18 and 36 months old. Parental locus of control was measured at 36 months with five questions from the *Parental Locus of Control* scale (Campis, Lyman, & Prenticedunn, 1986) and four supplementary questions developed for the MoBa. In addition, adverse life events were measures at 18 and 36 months by a checklist of 11 events, including "problems at work" and "have you had problems or conflicts with your family, friends, or neighbors." Medical Birth Registries' information on number of cigarettes smoked per week during pregnancy was included.

Child risk factors: Medical Birth Registries' information on child gender, multiple births, birth weight (dichotomized; < 2500 and >2500 grams), APGAR scores five minutes after birth, and congenital syndromes (including Down syndrome, cleft lip and palate, and limb malformations) was retrieved.

Statistical Analysis

Analytic approach 1: Between-child OLS models—As a first analytical approach we estimated associations between contemporaneous, lagged, and cumulative hours in child care and externalizing problems in a series of ordinary least-squares regression models, conditioned on the set of 30 child and family risk covariates listed in Table 1. For example, the following equation is a summary of the conditional models in which the linear association between hours in care and externalizing problems is estimated while controlling for study covariates: $Ext_i = \beta_{00} + \beta_{01}\,(CCHours_i) + \beta_{02}\,(CovX_i) + \ldots + u_i$. We also estimated non-linear associations in these models by including a quadratic term for child care hours.

In the contemporaneous models, externalizing behavior problems at 18 months were regressed on child care hours at 18 months and, similarly, problems at 36 months was regressed on hours at 36 months. In the lagged models, externalizing behavior problems at

36 months were regressed on child care hours at 18 months, conditioning on child care hours at 36 months. In the cumulative models, externalizing behavior problems at 36 months were regressed on children's cumulative hours in care at 18 and 36 months, operationalized as their mean level of hours across these two time points. In the contemporaneous model for externalizing problems at 18 months, we included only covariates that were measured at 18 months or earlier. In all other models, we included the full covariate set.

Analytic approach 2: Sibling fixed-effects models—For the more than 17,000 siblings in the sample, we estimated within-family associations between hours in child care and externalizing problems as sibling fixed-effects. Consider, for example, the following equation for linear hours in care (simplified in this example to include only sibling pairs, ignoring covariates and the error term): $Ext_{sib1} - Ext_{sib2} = \beta_{10} (CCHours_{sib1} - CCHours_{sib2})$. In this model, $CCHours_{sib1}$ is the value of child care hours for the first sibling and $CCHours_{sib2}$ is the value of child care hours for the second sibling. As such, β_{10} should be interpreted as the average within-family association between hours and externalizing problems. Our sibling fixed-effects models parallel the OLS between-child models in that we estimated contemporaneous, lagged, and cumulative hours in care as predictors of externalizing problems. In addition, we estimated both linear and non-linear specifications of hours, in the latter case adding a quadratic child care term to the model. These sibling fixed-effects models controlled for potential bias by unobserved variables that were fixed within families (i.e., constant across siblings) such as shared family environments. In addition, we included 30 covariates that could differ across siblings.

Analytic approach 3: Individual fixed-effects models—Within-child associations between changes in hours in child care and changes in externalizing problems (between 18 and 36 months) were estimated in individual fixed-effects models. Consider, for example, the following model: $Ext_{it1} - Ext_{it2} = \beta_{10} (CCHours_{it1} - CCHours_{it2})$. In this model (ignoring covariates and error term), $CCHours_{it1}$ is the quantity of hours for child i at 18 months and $CCHours_{it2}$ is this child's quantity of hours at time 2. As such, β_{10} should be interpreted as the average within-person association between child care hours and externalizing problems. As with our other two modeling approaches, we estimated both linear and non-linear specifications of hours, in the latter case adding a quadratic child care term to the model. Compared with our other modeling approaches, these individual fixed-effects models controlled for potential bias caused by time-invariant unobserved variables – unmeasured child and family characteristics, or other features of developmental context, that were constant over time. These models were also conditioned on all time varying covariates.

Missing data—In Table 1, we present descriptives for study variables, along with the percentage of complete, non-missing values. The percentage of missing data due to item non-response was less than two percent across all items, with only two exceptions: externalizing behavior items at 18 months (6.5%) and adverse events at 18 and 36 months (14% and 22%). We replaced missing items in scales with the scale mean.

Missing data due to attrition, however, was more considerable. In total, 65.0% of children (n= 49,000) had complete data on both child care and externalizing problems at 18 months, and 52.8% of children (n= 39,807) at 36 months, and 44% (n=33,092) across 18 and 36 months. Across all variables and all time points, 78.4% percent of the data was complete, including 70.3% at 18 months, and 55.8% at 36 months. Statistically significant differences between respondents and non-respondents were evident, but the effect sizes ranged from small to very small. At the 17th gestational week, for instance, those not dropping out by 36 months had higher family income (d =.14), more educated mothers (d =.07), and less depressed and anxious mothers (d = .12); at 18 months, those dropping out at 36 mo spent,

on average, more hours in nonparental care (d =.06) and had higher levels of externalizing problems (d =.02).

Given these missing data, we took two primary approaches to our analyses. First, we estimated models using listwise deletion (i.e., only children with complete data on all study variables were included in the analyses, and children with one or more missing values were excluded). Non-overlapping patterns of missing values across child care, externalizing problems, and covariates led to estimation sample sizes ranging from 24,804 to 35,831 children for the between-child OLS models, 2,042 to 2,796 families in the sibling fixed effects models, and 31,150 children in the individual fixed effects model.

Second, following best practice recommendations for handling moderate to large amounts of missing data, we used multiple imputation (MI; Graham, 2009). We estimated 20 datasets based on all covariates in Table 1, including quadratic terms of hours in care, using PASW 17.0 (SPSS Inc., 2009), with fully conditional specification of the multivariate model by a series of conditional linear models, one for each incomplete variable (van Buuren, 2007).

Results

Descriptive Statistics and Preliminary Analyses

Three points based on the descriptive data in Table 1 are worth noting. First, on average, at 18 months compared to 36 months, children were more likely to be exclusively in parental care (27.2% vs. 5.2%) and, on average, were in fewer hours of nonparental care (24.25 hrs vs. 29.45 hrs). Nonetheless, there was substantial between-child variability at both time points; at 36 months, for example, children one standard deviation below the mean were in nonparental child care for approximately 18 hours per week, and children one standard deviation above the mean were in nonparental care for about 40 hours.

Second, although children in nonparental care were distributed across settings, most were in center care (47.1% at 18 months and 88.7% at 36 months), with smaller percentages in family daycare (19.9% and 5.1%, respectively), and even fewer with unqualified child minders (5.8% and 0.9%, respectively). Third, as displayed in Table A1, in Appendix B, hours in care and externalizing problems demonstrated notable instability over time, at least with regard to children's rank order. Although hours of care at 18 and 36 months were moderately correlated (r = .37 for the nearly 40,000 children with complete data at both time points), over 85% of the variance was non-overlapping across time. Similarly, for children's levels of externalizing problems across time, the association was moderate in size (r = .45, for children with complete data), regardless of whether 9 or 11 items were used at 36 month.

There were no detectable associations between hours in care and externalizing problems at either 18 or 36 months (see Table A1); all of the correlation coefficients were nearly zero. However, these correlations assume a linear relation. As such, we also fit fractional polynomials to the data in an effort to determine whether the best fitting curve was linear or non-linear. In particular, we were concerned that the association between hours and problems could be increasingly stronger at increasingly higher levels of hours.

As can be seen in Figure A1, in Appendix C, the association between hours and externalizing behavior problems took a quadratic form; at both 18 and 36 months, there was little association between hours and externalizing problems at the low end of the hours' distribution, but an increasingly large association at the high end of the distribution. The strength of this non-linear association appeared greater prior to using multiple imputation, but the effect size was relatively small in either case at 36 months. Using listwise deletion at 36 months, for example, the estimated difference in externalizing problems between children

in 45 hrs of care–approximately 1.5 standard deviations above the mean–and those in 30 or fewer hours of care was less than 15% of one standard deviation. The effect size was larger at 18 months, at least at the highest end of the distribution for hours when using listwise deletion; yet, the estimated difference in problems between children in 45 hours of care and those in 30 or fewer hours was still less than 20% of a standard deviation.

Two points regarding these unconditional patterns are worth noting, however. First, less than 4% of children were in nonparental care for more than 40 hours per week at 18 or 36 months, and less than 1% were in nonparental care for more than 50 hours. Second, the unconditional estimates were primarily for purposes of determining the shape of association; they were not adjusted for potential selection effects.

Estimating the Consequences of Contemporaneous, Lagged, and Cumulative Hours

Following up on our preliminary estimates of the shape of association, we more rigorously examined relations between hours in child care and child problems by using conditional between-child OLS models in which we statistically controlled for the set of family and child risk factors detailed in Table 1. Specifically, we estimated contemporaneous, lagged, and cumulative measures of hours in care in these conditional OLS models. In the contemporaneous models, externalizing problems at 18 months were regressed on hours at 18 months, and a parallel model was estimated for these variables at 36 months. Problems at 36 months were regressed on hours at 18 months in the lagged models and on average hours at 18 and 36 months in the cumulative models. For these analyses, we first used listwise deletion for missing values and then estimated our models using 20 multiple imputation data sets. (We also estimated our models using 5 and 100 multiple imputation data sets, with substantively identical results to those presented here.) For all of our models, we estimated two specifications of hours in child care: (1) a linear and (2) a non-linear specification (i.e., the non-linear specification included both a linear and quadratic term for hours in the equation). An overview of results from these OLS models is provided in Table 2; note that coefficients for hours in care correspond to 10-hour increments of child care and are presented for raw and standardized externalizing scores.

There were statistically significant linear associations between hours and child problems in all three models using listwise deletion (i.e., contemporaneous, lagged, and cumulative specifications) and two of the three models using multiple imputation (i.e., contemporaneous and cumulative specifications). The linear effect sizes were, however, very small such that a 10-hour difference in hours was associated with four percent of a standard deviation difference in externalizing problems (i.e., .01 points) or less. Yet, as expected based on our fitted fractional polynomial curves, hours in care also demonstrated non-linear relations with externalizing problems, at least when using listwise deletion for missing values.

In Figure 1, based on estimates from both the listwise deletion and multiple imputation models, we display the non-linear association at 18 months as well as the non-linear contemporaneous, lagged, and cumulative associations at 36 months. In all of the listwise-deletion models, there was a slight decrease in externalizing problems when comparing children in no child care with those in increasing hours of care, up to approximately 20 hours. Beginning at about 20 hours of care, however, a higher quantity of care was associated with an increasingly higher level of externalizing problems in the listwise-deletion models. This non-linearity was most pronounced for the contemporaneous estimate at 36 months, although children in 45 hours of care displayed problem levels only 15% of a standard deviation higher than those in 20 hours of care. Note that few children spend more than 40 hours in care.

In addition, as can also be seen in Figure 1, none of these non-linear findings proved to be robust when we estimated using multiple imputation for missing values. Although estimate precision (i.e., the standard errors) was fairly similar or better in multiple imputation models compared with listwise-deletion models, the quadratic coefficients were, at most, only 15% as large in multiple imputation models.

Sibling Fixed Effects: Within-family Estimates

We also estimated sibling fixed effects for associations between hours in child care and externalizing problems taking advantage of the 17,910 siblings in the dataset (of these 2,627 are twins or triplets). That is, we estimated within-family associations, examining whether differences between siblings' hours in child care predicted differences in their levels of externalizing problems. These models closely paralleled our other models in that we examined contemporaneous, lagged, and cumulative hours in care. And, we estimated these models using listwise deletion and multiple imputation for missing data.

The sibling models were conditioned on twin or triplet status, number of siblings in the family, as well as on all child and family background factors that varied across siblings (i.e., a total of 30 child and family covariates were included). It is worth noting that one assumption of sibling fixed effects models is that there is variability across siblings, in this case with regard to hours in care and externalizing problems. In the present study, there were considerable differences in the quantity of child care experienced by siblings; at 18 and 36 months, standard deviations for within-family differences in hours in care were 10.34 and 9.48 hours, respectively, and for externalizing problems 0.22 and 0.22, respectively.

A summary of our sibling fixed effects results are presented in Table 3. In short, the estimated effects of hours in child care were null in all of the sibling models; levels of externalizing behavior problems for siblings in more or less hours of care were statistically indistinguishable from one another. Beyond statistical significance, the direction of association between hours and externalizing problems varied across specifications – compare the contemporaneous and lagged models with the cumulative models – and effect sizes were very small (i.e., a 10-hour difference in child care was associated with less than 5% of a standard deviation difference in externalizing behavior problems between siblings).

Individual Fixed Effects: Within-child Estimates of Change

In addition to sibling fixed-effects, we estimated individual fixed-effects for the association between hours in care and externalizing problems. In other words, we examined whether within-child changes in hours predicted within-child changes in externalizing problems. These models were conditioned on time-varying covariates (i.e., a total of seven child and family factors that varied over time), and we examined both linear and non-linear specifications for hours in child care. And, again, we estimated both listwise deletion and multiple imputation specifications. It is also worth noting that unconditional individual fixed effects in the present study demonstrated considerable within-person change in hours of care, with a standard deviation of 11.3 hours from 18 to 36 months.

In short, we found no evidence that changes in hours of care predicted changes in externalizing problems (see Table 3), despite substantial statistical power even in the listwise deletion models; indeed, in the individual fixed effects models using multiple imputation for missing data, the coefficients for hours in care were all very close to zero in absolute value.

As a final step in our analytic plan we conducted robustness checks and examined potential moderators of associations between child care hours and behavior problems. As can be seen in Appendix A, the robustness checks did not reveal substantive differences from the

analyses presented here, and we did not find child gender or age of entry to moderate the association between quantity and externalizing problems.

Discussion

Debate over the prospect that time spent in early child care may increase children's risk of developing externalizing behavior problems has led researchers to call for two advances in the field. First, there has been a call for more conservative approaches to controlling for potential selection effects (McCartney et al., 2010). Second, the value of increased study of child care in countries that have progressive child care policies has been emphasized (Love et al., 2003). In response to these calls, the purpose of the current study was to examine associations between hours in child care and externalizing behavior problems during early childhood for a large sample of Norwegian children.

We applied a variety of statistical approaches with the dual goals of: (a) taking increasingly conservative steps towards control for potential selection bias and (b) covering an array of theoretical forms that relations between hours in care and externalizing problems might take if, in fact, such relations were causal. With considerable missing data, we estimated all models using listwise deletion and multiple imputation. Using conventional covariate adjustment for selection bias, effect sizes from models based on listwise deletion were relatively larger than those from models based on multiple imputation, albeit small in either case. When we used more conservative adjustments for selection bias, associations between child care hours and externalizing problems were consistently very close to zero and null, regardless of approach to missing data. Given Norway's comprehensive early childhood policy focused extended paid parental leave through the child's first year of life and on near universal high-quality care, these results contribute to the cumulative knowledge on child care in a sociopolitical context of quality standards and oversight.

Regardless of modeling strategy, there was very little evidence that hours in child care had much of an influence on externalizing problems at levels of 40 hours or less. Across the lower half of the distribution on hours, from those children who were exclusively in parental care through those who were in approximately 40 hours of nonparental child care, there were only very small differences in externalizing problems, differences that were statistically significant in only one of our models. In some models, however, especially those based on listwise deletion, we did observe somewhat larger externalizing problem differences at increments of greater than 40 hours. Yet, even in our least conservative models using listwise deletion, less than 20% of a standard deviation in externalizing problems separated children in fewer than 30 hours of child care from those in 45 hours of care. Beyond small effect sizes, the practical significance of finding slightly elevated problem levels among those in the most hours of care was further limited by the fact that fewer than 4% of children in this sample were in child care for more than 40 hours.

Moreover, it is worth noting that differences in externalizing behaviors of up to 20% of one standard deviation are very far from what is considered "clinical" levels of externalizing behavior problems. These are typically characterized by elevations above 1.5 or 2 standard deviations (corresponding to "borderline" or "clinical" levels; Achenbach, 1992). Thus, even in our least conservative models, the differences in levels of externalizing behavior problems between children in very few hours of care and those in 45 or more hours of care were variations within the normal range, rather than pathological manifestations.

One of the most important findings in the present study was the lack of evidence from our sibling or individual fixed-effects analyses that variations in hours–either within families or within children, over time–predicted externalizing problems, regardless of whether these

models adjusted for attrition using multiple imputation or not. Given considerable statistical power in these models and considerable variability in hours of child care across siblings and across time for individual children, these null results were not consistent with the causal hypothesis that more hours in child care leads to more externalizing problems. None of our modeling approaches provided a panacea for the internal validity questions inherent to non-experimental work, but one potential explanation for the null results is that the sibling models held constant any persistent unobserved factors within families and the individual fixed-effects models held constant any persistent unobserved factors across time that were otherwise upwardly biasing estimates in our OLS models. Interestingly, in a U.S. sample, Jaffe and colleagues also found that associations between age of entry into nonparental care and externalizing problems evident in between-child regression models disappear when more conservative sibling fixed-effects models are applied (Jaffee, Van Hulle, & Rodgers, 2011).

Our current study, juxtaposed with the works of McCartney et al. (2010) and Jaffee et al. (2011) should caution child care researchers against drawing definite conclusions from between-child regression models that employ covariate adjustment to control for selection (also see Yamauchi & Leigh, 2011, for an argument on the extent to which covariate adjustment underestimates selection effects in child care research). This is further underscored by a study on preschool center attendance and externalizing behavior of children from low-income families (Crosby, Dowsett, Gennetian, & Huston, 2010). Using covariate-adjusted OLS models, these authors found that center attendance was associated with a small increase in externalizing problems. In contrast, when more conservative control for selection was used–instrumental variable estimates–these authors find the opposite: center attendance was associated with fewer problems.

A second methodological issue worth considering for the present study, and the field, is the handling of missing data. Although effect sizes were always quite small, significant associations between hours in child care and externalizing problems were most often evident prior to using multiple imputation. Perhaps because best practice recommendations for handling missing data have only recently become well known, we found only two studies in the extant literature that approached missing data with methods other than listwise deletion, namely Vandell et al. (2010) using Full Information Maximum Likelihood estimation, and McCarthey et al. (2010) using a dummy variable approach to missing data (M. Burchinal, personal communication, May 7, 2012). To the best of our knowledge, all other reports from the SECCYD, for example, have employed listwise deletion when investigating links between child care quantity and externalizing problems. Attrition, however, has not been as high in the SECCYD as it was in the study reported here.

Attrition in the current dataset was considerable (more than 45% by 36 months), but it was similar to what has been observed in other population-based cohort studies of this size (Szklo, 1998). It appears that children whose mothers dropped out of the study were those likely to exhibit relatively high levels of externalizing problems at low doses of child care and those likely to exhibit relatively low externalizing problems at high doses of child care. In light of our findings, it is worth considering whether selective attrition in child care studies may upwardly bias associations between hours and externalizing problems.

Beyond analytic approaches to controlling potential selection bias, another pattern evident in our results is worth noting with regard to the causal hypothesis. Our models for cumulative hours in care resulted in somewhat smaller effect sizes than did our models for contemporaneous hours in care. These results seem inconsistent with the causal hypothesis; if hours in child care influences children's externalizing behavior, then one might expect a dose-response relation, with higher total "dosages" of child care hours resulting in higher

externalizing behavior “responses”. It is possible that hours in child care influence externalizing problems in an acute manner best detected in the contemporaneous models, but our results differ from other researchers (e.g., for a review, see NICHD Early Child Care Research Network, 2003) who have reported particularly robust associations for cumulative hours. Contemporaneous associations may have been strongest in the present study because they were most susceptible to simultaneity bias (i.e., externalizing problems influencing hours in child care). Regardless, beyond statistical issues, we want to emphasize the potential role of sociopolitical context when comparing our findings with those in the United States.

Child Care in Norwegian Context

The sociopolitical context of Norway is considerably different from the U.S. as well as most other countries in which associations between child care quantity and child socio-emotional outcomes have been examined (e.g., Canada), particularly with regard to child and family policy. Consider, for example, three Norwegian policies with potential implications for child outcomes and the results of the present study: near universal access to center care, regulated child care quality standards, and parental leave policies.

Norway provides near universal access to center care from age one. The goal of universal access has the explicit purpose of reducing social selection into regulated child care (Ministry of Education, 2007). This policy leads most parents to choose center care for their children, yet age of entry is varying. This is illustrated by the fact that in the present study, 67% of 18 month olds, and nearly 94% of 36 month olds attend center care or family day care. In contrast, for instance in the SECCYD, 38% of the 36-month olds attended center care (NICHD Early Child Care Research Network, 1999). The coverage of center care and family daycare in itself should, given previous findings, exacerbate the association between hours in care and externalizing problems. In a reanalysis of the SECCYD, van IJzendoorn et al. (2004, cited in Belsky et al., 2007) found that time in non-relative care, and especially center care, was associated with externalizing problems. However, the common use of center care and family daycare must be considered in conjunction with the Norwegian regulation of standards for caregiver education and child-caregiver ratios. At least with regard to structural features of child care quality, Norwegian child care centers are of relatively high and homogenous quality (Winsvold & Guldbrandsen, 2009), with a maximum adult:child ratio of 3:10 for one and two year olds, and 3:19 for those older. In comparison, standards for child care centers vary considerably across states in the United States, with adult:child ratio standards for 3-year olds ranging, for instance, from 1:7 to as high as 1:17, with the additional complication that few centers meet these standards (NICHD Early Child Care Research Network, 1999). Given this variability, it is important to note that findings on the influence of child care quality on associations between child care quantity and externalizing problems have been mixed, even within the SECCYD (McCartney et al., 2010; NICHD Early Child Care Research Network; 2003). Yet, with higher structural quality standards in Norway than in the US, homogenously high-quality care in Norway may help explain the null findings in this present study.

It is also of note that Norwegian parental leave policy ensures that most children enter nonparental care near one year of age. Findings by the NICHD Early Child Care Research Network (2003) suggest that it is the initiation of high quantities very early in life that have consequences for development. Yet, in our review of the literature, we could not identify a systematic pattern of associations between child care quantity and externalizing problems being more common in sociopolitical contexts where children enter nonparental care in their first year. In the present study, a small proportion of children entered nonparental care in their first year, but this did not moderate associations between quantity and problem levels.

In sum, the sociopolitical context, including federal policies of comprehensive early childhood and generous parental leave, is likelyone reason hours in child care was unrelated to externalizing problems in this population-based sample of Norwegian children. Near universal access to quality care combined with an age of entry at about one year of age may provide a context in which there are, on average, no detrimental consequences of high quantity of care. This conclusion is supported by the work of Love et al. (2003), who draw on evidence from the SECCYD, the evaluation of Head Start, and data from Israel and Australia when they argue that when "standards for good-quality care are enforced through government regulator mechanisms, the risk for behavior problems may be explained by factors other than time in care" (Love et al., 2003, p. 1031). While it is worth noting that a study from Denmark, where early childhood policies are very similar to Norway, demonstrated associations between hours in care at age 3 and behavior problems at age 7 (Gupta & Simonsen, 2009), these authors relied exclusively on models that are statistically most similar to those in which we (and others) also find child care effects, OLS models in which selection is controlled via child and family covariates and attrition is addressed using listwise deletion.

Study Limitations

A number of limitations to our study must be noted. The baseline participation rate of approximately 40% is a serious issue, for example. This may have introduced bias, with regard to who participated in the study. It is, nonetheless, important to note that these rates are comparable to other population-based studies (Szklo, 1998), and that the baseline participation is 40% of the Norwegian population, excluding mothers giving birth in very small birth units. As a comparison, the NICHD SECCYD had approximately a 50% baseline participation rate (e.g., McCartney et al., 2010), after families within the ten catchment areas were preemptively excluded from the sampling for a variety of observable risk factors (i.e., characteristics of children, mothers, and communities). Although low participation rates are a serious limitation, it does not seem that this is a greater limitation to our findings than previous findings on this topic. A related limitation is attrition, with missing data for key study variables nearing 50% by 36 months. Despite our efforts to address this issue, including following best practice recommendations that have yet to become commonplace in this area of study, there remains a risk that our findings were influenced by missing data.

We also note four additional limitations to the study. First, we relied solely on maternal reports of externalizing problems. Although several other studies that have reported associations between maternal reports of child care quantity and socio-emotional outcomes (e.g., Belsky, 1999; Yamauchi & Leigh, 2011), including a study in a Nordic context (Gupta & Simonsen, 2009), evidence of child care quantity associations with externalizing problems have been less consistent in SECCYD when maternal reports have been compared with caregiver or teacher reports (e.g., NICHD Early Child Care Research Network, 2003). A common tradeoff in epidemiological cohort studies is sacrificing multiple informant sources in favor of a very large population-based sample. Nonetheless, given the low correlations observed for maternal- and caregiver-rated behavior problems, our findings may have been different had we been able to examine caregiver reports.

Second, we were not able to examine any later emerging consequences of child care quantity beyond early childhood. In the SECCYD, 36 months of age was one time point at which there were no associations between child care quantity and externalizing problems. Confirming our null results at later ages will be useful.

Third, our measures of child care quantity were restricted to maternal reports at 18 and 36 months. This is problematic if hours reported at these time points do not provide an unbiased representation of amount of time spent in child care during early childhood. This is of

particular concern for our estimates of "cumulative" hours, an average of hours spent in care measured at these two time points which is fewer observations of care than used to define cumulative care in the NICHD SECCYD, for example.

Fourth, we did not have assessments of child care quality, a potential moderator of the effects of hours in care. Given uniform standards for child care in Norway, however, we do not see this as a major weakness of the study. Given such a large sample of care arrangements from a country with homogeneously high quality care, a null finding averaged across settings is useful. The lack of direct observations of quality data would have been more concerning if, in fact, we had found evidence that quantity, on average, predicted more problems.

Conclusions

Child care policy in Norway is a significant component of more general progressive family policy designed to promote maternal workforce participation and employment rights as well as universal access to high-quality environments for learning and development beginning in the second year of life (Mandel & Semyonov, 2005; Ministry of Education, 2009). In this sociopolitical context, we found very little support for the hypothesis that a high quantity of care leads to externalizing behavior problems in early childhood. Given public attention to past claims that early child care may pose a developmental risk, our findings should contribute to a reconsideration of existing evidence on this topic with special attention to the methods employed and the sociopolitical context of studies.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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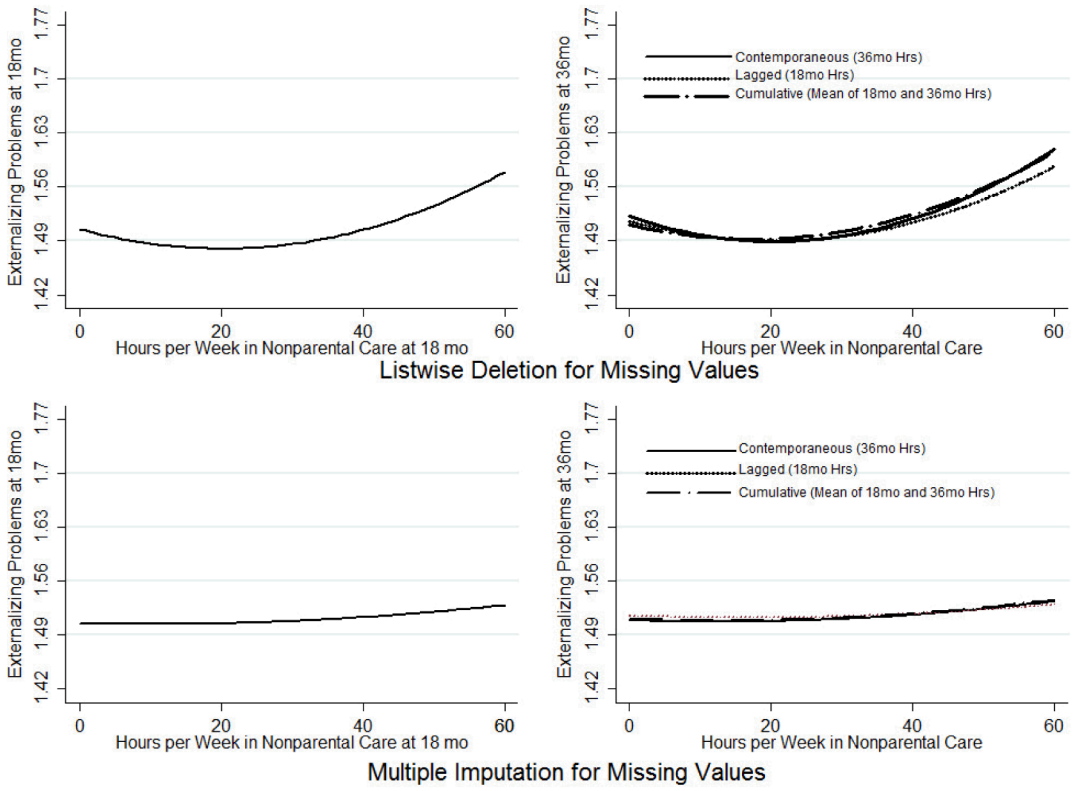

Figure 1.

Associations Between Hours in Child Care and Externalizing Problems

Between-child OLS estimates of the conditional non-linear associations between hours in child care and externalizing problems at 18 and 36 months, using listwise deletion (top two graphs) and multiple imputation for missing values (bottom two graphs). As in Figure 1, the range on the Y-axis represents approximately one standard deviation on externalizing problems, and the distance between horizontal bars originating on this axis is approximately 20% of a standard deviation.

Table 1

Summary of Means, Standard Deviations, and % of Complete Data Coverage (N = 75,271)

Variable	M (SD)/%	Range	% Covered
Child care quantity			
Hours in nonmaternal care 18 mo	24.25 (14.44)	0–80	65.1
Hours in nonmaternal care 36 mo	29.45 (11.11)	0–99	53.2
Externalizing behavior			
18 months 9 items	1.48 (.28)	1–3	72.9
36 months 11 items	1.51 (.29)	1–3	58.3
36 months 9 items	1.49 (.30)	1–3	58.3
Child care variables			
Entry			
< 7 mo	0.1%		72.3
7–9 mo	1.1%		72.4
10–12 mo	11.6%		72.5
13–15 mo	51.7%		72.6
Type of care at 18 months			
Home with mother or father	27.2%		72.5
Unqualified child minder	5.8%		72.5
Family daycare	19.9%		72.5
Center care	47.1%		72.5
Type of care at 36 months			
Home with mother or father	5.2%		57.2
Unqualified child minder	0.9%		57.2
Family daycare	5.1%		57.2
Center care	88.7%		57.2
Child risk factors			
Boys	51.1%		100
Twins or triplets	3.5%		100
Congenital syndromes	4.98%		100
Serious malformation at birth	2.9%		100
Birthweight < 2500 g	4.3%		100
APGAR 5 min	9.41 (.79)	0–10	100
Family risk factors			
Maternal education (years)	14.58 (2.50)	8–18	94.1
Paternal education (years)	14.02 (2.74)	8–18	89.9
Family income (1000 NOK)	594 (196)	0–1144	87.6
Non-Norwegian family background	10.3%		94.4
Mother single at 17th gestational week	2.0%		95.9
Mother single at age 6 mo	2.0%		83.1
Mother single at age 18 mo	3.5%		71.9
Mother single at age 36 mo	3.1%		56.7

Variable	M (SD)/%	Range	% Covered
Other children in the family	1.34 (.77)	0–8	65.2
Cigarettes smoked weekly during pregnancy	2.11 (8.43)	0–268	100
Economic hardship 6 mo	1.28 (.62)	1–4	83.7
Economic hardship 18 mo	1.33 (.65)	1–4	68.0
Maternal distress 17th gestational week	1.27 (.40)	1–4	95.2
Maternal distress at age 6 mo	1.24 (.35)	1–4	84.1
Maternal distress at age 18 mo	1.28 (.37)	1–4	70.9
Maternal distress at age 36 mo	1.28 (.39)	1–4	56.5
Parental locus of control	2.34 (.76)	1–5	54.9
Parental love	4.25 (.50)	1–5	54.9
Parental inefficacy	1.32 (.61)	1–5	54.9
Adverse events 18 mo	0.82 (1.26)	0–11	70.9
Adverse events 36 mo	0.33 (1.38)	0–11	56.5

Table 2

Summary of OLS Regression of Hours in Child Care as Predictors of Child Externalizing Problems

	Listwise Deletion Models			Multiple Imputation Models (n = 75,271)		
	Contemporaneous B (se) [STDY]	**Lagged B (se) [STDY]**	**Cumulative B (se) [STDY]**	**Contemporaneous B (se) [STDY]**	**Lagged B (se) [STDY]**	**Cumulative B (se) [STDY]**
18 month CBCL	n=35,831					
Linear Estimate	.005 **(.001) [.016]			.001(.001) [.004]		
Nonlinear Estimate						
Hours	−.025 ***(.005) [−.089]			−.002 (.002) [−.006]		
Hours^2	.006 ***(.001) [.022]			.001 *(.001) [.003]		
36 month CBCL	n=28,822	n=24,804	n=26,290			
Linear Estimate	.007 ***(.002) [.024]	.004 *(.002) [.014]	.010 ***(.006) [.035]	.005 **(.001) [.013]	.002(.001) [.006]	.004 *(.001) [.011]
Nonlinear Estimate						
Hours	−.032 ***(.007) [−.109]	−.025 ***(.007) [−.086]	−.022 **(.008) [−.074]	−.003 (.006) [−.008]	−.003(.004) [−.008]	−.003(.008) [−.008]
Hours^2	.008 ***(.001) [.026]	.006 ***(.001) [.021]	.006 ***(.002) [.021]	.001 (.001) [.004]	.001(.001) [.003]	.001(.001) [.003]

Note. Standardized coefficients (change in *SD* units of problems given 10 hr increase) are in brackets. All MI models are based on 20 imputed datasets. Covariates at 18 months: type of child care, parental education, family income, non-Norwegian background, number of siblings, single parent (average to 18 mo), smoking during pregnancy, economic hardship (average 6 and 18 mo), maternal depression (average to 18 mo), adverse events at 18, gender, multiple births, congenital syndromes and serious malformation, low birthweight, Apgar score, and year of birth. Covariates at 36 months, the lagged models, and the cumulative models: type of child care at 18 and 36 months, parental education, family income, non-Norwegian background, child single parent (average to 36 mo), number of children in the family, smoking during pregnancy, economic hardship (average 6 and 18 mo), maternal depression (average to 36 mo), adverse events (average 18 and 36 mo), parenting (36 mo), gender, multiple births, congenital syndromes and serious malformation, low birthweight, Apgar score, and year of birth.

*** p<.001

** p<.01

* p<.05.

Table 3

Summary of Sibling and Individual Fixed-Effects Models

	Listwise Deletion Models		Multiple Imputation Models	
	Sibling Fixed-Effects B (se) [STDY]	**Individual Fixed-Effects B (se) [STDY]**	**Sibling Fixed-Effects B (se) [STDY]**	**Individual Fixed-Effects B (se) [STDY]**
18 month CBCL	n=5,592			
Linear Estimate	.007(.005) [.025]		.001(.003) [.004]	
Nonlinear Estimate				
Hours	.012(020) [.042]		−.002(005) [−.004]	
Hours^2	−.001(.004) [−.004]		.001(.001) [.003]	
36 month CBCL	n=4,084			
Linear Estimate	−.003(.007) [−.011]		.001(.004) [.002]	
Nonlinear Estimate				
Hours	.015(.025) [.050]		.008(.016) [.024]	
Hours^2	−.004(.004) [−.013]		−.001(.003) [−.004]	
Lagged				
Linear Estimate	−.002(.013) [−.007]		−.001(.004) [−.003]	
Nonlinear Estimate				
Hours	.006(.042) [.021]		−.002(.005) [−.005]	
Hours^2	−.002(.009) [−.006]		.000(.000) [.000]	
18–36 month CBCL	Cumulative	Within-child Change n=31,150	Cumulative	Within-child Change
Linear Estimate	−.008(.015) [−.026]	−.001(.001) [−.003]	−.001(.004) [−.003]	−.001(.001) [−.002]
Nonlinear Estimate				
Hours	−.016(.056) [−.054]	−.006(.005) [−.020]	−.001(.005) [−.003]	−.000(.005) [−.001]
Hours^2	.002(.011) [−006]	.001(.001) [.004]	.000(.001) [.000]	−.000(.001) [−.000]

Note. Standardized coefficients (change in *SD* units of problems given 10 hr increase) are in brackets. MI models were based on 20 imputed datasets. Sibling fixed effects were restricted to families with siblings and modeled sibling differences in outcomes as a function of sibling differences in hours. Covariates for the sibling fixed effects models at 18 and 36 months were the same as those included in between-child OLS analyses. Individual fixed effects modeled differences in outcomes over time as a function of differences in hours over time; covariates included changes from 18 to 36 months in: child single parent, adverse events, maternal depression, and type of child care.

*** $p<.001$

** $p<.01$

* $p<.05$