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ORIGINAL PAPER

Quality Rating and Improvement Systems and Children's Cognitive Development

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Abstract
Background Providing enriched learning environments is important to stimulating children's development in early childhood. Early child-care policymakers in many states in the US have adopted Quality Rating and Improvement Systems (QRIS) as a way to verify quality of child care and to support children's school readiness.
Objective The purpose of this study was to examine associations between QRIS, a statewide government-funded early childhood care and education policy which integrates structural quality of child-care, and children's cognitive skills.
Methods A sample of randomly selected 313 children (mean age = 54.9 months, SD = 6.7) from 36 QRIS-participating early child-care programs was included in this study.
Results Multilevel analysis with a latent variable (i.e., observed cognitive skills consisting of vocabulary, phonological awareness, and mathematical skills) revealed that children in the highest level of QRIS programs demonstrated better cognitive skills after controlling for child demographics, and home and neighborhood environments. In addition, QRIS moderated a negative association between family socioeconomic risk and children's cognitive skills.
Conclusions The results suggest that policymakers may expect positive returns on QRIS investments in terms of children's early cognitive achievements that support their school readiness in later life.

Keywords Quality rating and improvement systems · Early education · Child-care quality · Cognitive development · School readiness

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Introduction

There are approximately 15 million children under age 6 in the US (64.5 % of all children) who require non-parental child-care while parents are working (Child Care Aware of America 2013). Therefore, child-care quality is a concern to many parents, researchers, and policy makers because preschoolers need enriched and stimulating learning environments to enhance their developmental outcomes (e.g., Belfield et al. 2006; Buyse et al. 2011). A number of experimental (e.g., Belfield et al. 2006; Reynolds et al. 2011; Schweinhart and Weikart 1981) and non-experimental (e.g., Early et al. 2007; Peisner-Feinberg et al. 2001) studies have established that child-care quality is associated with children's developmental outcomes. For example, the High/Scope Perry Preschool Study (Schweinhart and Weikart 1981), which was developed to implement high quality child-care for at risk African American 3- to 4-year-old children, provided an extensive curriculum that was designed to stimulate children's intellectual and social development, a small teacher-to-child ratio (1:6) and home visitation. The results showed that participants who were in the high quality program group had greater commitment to school, higher academic motivation and achievement, and less delinquent behaviors at age 15 (Schweinhart and Weikart 1981), and demonstrated higher rates of high-school graduation and employment, fewer crimes, and higher income at age 40 (Belfield et al. 2006) compared to participants in the control group. The Abecedarian Project, which provided full-time, high-quality child care for children from infancy to age 5, found that children in the treatment group attained better scores on cognitive and academic tests through age 21 than children in the control group (Campbell et al. 2001). Extensive non-experimental research also has demonstrated that there are consistent direct effects of child-care quality on children's cognitive development, especially for literacy and language development (e.g., Burchinal et al. 2000a, b; NICHD Early Child Care Research Network 2002a). For example, Peisner-Feinberg et al. (2001) found that global child-care quality was strongly associated with children's literacy skills and was associated with children's math skills with smaller effect sizes. A meta-analysis of studies on child-care quality and a variety of child outcomes using data from 20 large-scale studies of early childhood settings (Burchinal et al. 2011) found that on average, child-care quality had .081 of partial correlation with preschool-aged children's overall developmental outcomes. Specifically, the partial correlation was .085 for children's academic and cognitive development, and .122 for their language development.

Driven by the importance of high quality of early care and education for children, there have been a number of efforts across countries to improve the quality of child-care. For example, Australia piloted and implemented Quality Improvement and Accreditation System (QIAS) to oversee the quality of long day care for the last 20 years (Press and Hayes 2000); Finland established high levels of initial teacher qualifications and education for early child-care (Taguma et al. 2012a); New Zealand, Sweden, and Norway instituted integrated universal curriculum in early care and education settings (e.g., Taguma et al. 2012b); and several Asian counties (e.g., South Korea and Japan) plan on developing universal child-care programs covering a wide range of children's developmental outcomes (e.g., Taguma et al. 2012). Federal and local governments in the US also have developed several strategies to integrate early child-care structural quality indicators (e.g., teacher-to-child ratio, group size, and teachers' professional characteristics such as education, qualifications and training) and to promote access to higher levels of child-care through state level licensing and national accreditation (National Association for the Education of Young Children 2005). Among those strategies are quality rating and improvement systems (QRIS), which policymakers in almost every state in the US have recently launched

to verify and heighten the structural quality of preschools by defining quality standards (Sabol and Pianta 2014) and setting in place a system to recognize and encourage adoption of those standards. Despite the growing popularity of these quality rating systems, a limited number of studies have investigated the impacts of these efforts on child outcomes. This study, therefore, examined the associations between a QRIS, which globally measures the structural quality of preschool, on children's cognitive skills, above and beyond children's home and neighborhood environments. Although research describes links between child-care quality and children's cognitive outcomes, child-care quality may not be equally important for all children (Peisner-Feinberg et al. 2001). There is evidence that children from disadvantaged homes who attend high-quality child care programs have better outcomes than those attending lower-quality programs (e.g., Burchinal et al. 2008; Votruba-Drzal et al. 2004). Therefore, we also explored in the current study if high-quality child care, defined by QRIS, is more important for some children than others, depending on socioeconomic risks in their family.

Quality Rating and Improvement Systems

Statewide government-funded QRISs are designed to (a) provide transparent information to consumers (e.g., parents) regarding quality of child-care, (b) improve child-care quality through providing incentives/resources and coaching for child-care practitioners, and (c) facilitate children's developmental outcomes (Zellman and Perlman 2008). QRISs are completely voluntary for child-care programs in most states, while in some states, the QRISs assign the lowest rating level to all licensed programs and programs can voluntarily decide to attain higher ratings (Swenson-Klatt and Tout 2011). According to the QRIS logic model (Zellman and Perlman 2008), once the rating system is developed and disseminated across the state, parents are expected to learn about ratings and to use ratings in selecting higher quality programs for their children. The rationale is that if sufficient high-quality choices are available for parents, parents would be less likely to select low-quality programs. In this process, because programs would want to be a top choice of parents, programs are anticipated to apply to the voluntary systems to achieve a quality rating, and to improve program quality. As a result, low-quality programs or programs without ratings might be undersubscribed and eventually have to close. In this process, the system supports participating programs in their efforts to improve quality by providing incentives and staff development trainings (Child Trends 2010). In addition, the system provides advertisement materials for parents to help them understand the ratings and benchmarks, and the benefits to children's development. A greater availability of high quality child-care programs is expected to allow children to experience better quality in child-care, which in turn, would ultimately improve children's school readiness.

QRIS and Children's Cognitive Skills

Although the components of QRIS are varied across states, QRIS typically covers child-care structural quality indicators that are shown to have positive associations with a range of child outcomes. The QRIS which we examined, employed five quality benchmarks including staff education and qualifications, specialized training, teacher-to-child ratio and group sizes, early learning, and administrative practices (i.e., an overall stabilization and professionalization of the early childhood workforce), using three additive levels of quality

rating with level 3 representing the highest quality. For example, to obtain the highest rating level (i.e., level 3), all administrators and lead teachers were required to have at least an Associate of Arts (A.A.) degree in early childhood education (ECE), whereas the lowest rating level (i.e., level 1) required one lead teacher in a program to have an A.A. degree. Teacher-to-child ratio for preschool-age classrooms had to be less than 1:14, 1:12, and 1:10 to reach level 1, level 2, and level 3, respectively. Furthermore, level 3 programs had to systematically assess children via formal and informal methods to inform teachers and parents, whereas level 1 and 2 programs were only required to utilize a curriculum which was aligned with the states' early learning content standards (more details on study design are available from Jeon et al. 2014). According to previous research, children in smaller group sizes with lower teacher-to-child ratios had better cognitive development as a result of appropriate caregiving and creating a secure environment (Howes 1997). In addition, children with teachers who had at least an Associate of Arts degree or who held Child Development Associate (CDA) certificates were more ready to enter school (Early et al. 2006; Torquati et al. 2007) and teachers with higher numbers of training hours were predictive of children's better outcomes (Phillips et al. 2000). Further, children in more organized classrooms with specific early learning curriculum had better developmental outcomes in classrooms through clear cues and instructions from teachers (Mashburn et al. 2008).

Although there are a number of studies examining the associations between each component of child-care structural quality and children's outcomes, few studies have examined the effectiveness of integrated structural quality, such as QRIS, on children's cognitive skills. Sabol and Pianta (2014) found that a QRIS employing education, qualification and training, interactions, staff-to-child ratio and group size, and learning environment and instructional practices as quality standards had a positive effect on children's literacy growth using a sample of 2,488 children in 71 pre-kindergarten programs. The study of Colorado's QRIS found a few associations between individual QRIS components and children's cognitive outcomes; however, the overall ratings did not significantly predict child outcomes (Zellman et al. 2008).

Child-Care Quality as a Moderator

Although research studies have indicated that higher levels of child-care quality predict better school readiness in children, the effects of child-care quality may vary depending on a child's background (Burchinal et al. 2000; NICHD Early Child Care Research Network 2002b). Of particular interest for researchers is whether or not experiences in high-quality child care can help close the gap in school readiness from different family socioeconomic status (Rimm-Kaufman et al. 2009). In the literature, it has been hypothesized that high quality child-care will buffer negative influences of family socioeconomic risks such as poverty, parental educational attainment, and parents' marital status (e.g., NICHD Early Child Care Research Network 2000, 2002b; Votruba-Drzal et al. 2004). However, there are mixed results for this hypothesis. Some studies have demonstrated that high quality child-care is linked more strongly to cognitive development for children from low-income families than those from middle-class families (e.g., Caughy et al. 1994), for children with single mothers than for those with married parents (e.g., NICHD Early Child Care Research Network 2002b), or for children with less educated mothers than for those with more educated mothers (e.g., Lee 2010; Peisner-Feinberg et al. 2001). In studies of the moderating effects of child-care quality, however, it should be noted that there has also

been a large portion of studies that did not find moderating effects of child-care quality on the associations between family socioeconomic risks and children's cognitive skills (e.g., Burchinal and Nelson 2000; NICHD Early Child Care Research Network 2000; Zhai et al. 2010), indicating that child-care quality equally predicted children's outcomes regardless of home environments. For example, NICHD Early Child Care Research Network (2000) found that the overall quality of child-care was consistently related to children's cognitive skills and language-related school readiness at preschool age; however, they did not find any evidence that child-care quality to child outcomes varied as a function of family income, quality of home environment, or ethnic group. Otherwise, Bryant et al. (1994) found that children from better home environments seemed to benefit more from classroom quality in the area of problem solving and reasoning than did children from at-risk home environments.

Although there are studies investigating the moderating effects of child-care quality on the associations between family socioeconomic risk and children's cognitive skills, there is a lack of study particularly examining QRIS as moderator. In a study of Missouri's QRIS, Thornburg et al. (2009) found that children in higher quality programs had increased social and emotional skills, and children in poverty attending higher quality programs made significantly greater progress in school readiness outcomes compared to children from middle-class families, but they primarily focused on children's social–emotional functioning.

The Present Study

Although QRIS is a growing interest for early childhood research and policy, as stated previously, to date there are a limited number of studies that have found any association of these efforts with child outcomes. To provide more accurate information to consumers and to improve the features of the system, it is necessary to understand the associations between QRIS and child outcomes. Given the gap between research and practice in QRIS, in the current study we hypothesized that (1) children in the highest rated QRIS-participating programs will demonstrate better cognitive skills than those in lower QRIS rating levels after controlling for family and neighborhood socioeconomic disadvantage and home environments; and (2) the associations between QRIS and children's cognitive skills will be stronger for children from socioeconomically at risk family environments.

Methods

Participants

The data used in the current study is from a larger study that evaluated the effectiveness of a QRIS in a Midwestern US state. A total of 313 children from 36 randomly selected full-time child care centers participating in the QRIS were included in the current study. There were 101 children (32.3 %) from the 12 lowest-rated (i.e., level 1) programs, 111 children (35.5 %) from the 12 middle-rated (i.e., level 2) programs, and 101 (32.3 %) children from the 12 highest-rated (i.e., level 3) programs. More specific characteristic of children, home, and neighborhood are described in Table 1. As shown in Table 1, the results of comparisons between children in level 1 or 2, and level 3 revealed that children in level 1 or 2 programs had more disadvantaged home and neighborhood environments than children in

level 3 programs. The relationship of the parent questionnaire respondents with the participating children was primarily mothers (88.9 %), 8.8 % were fathers, 2.1 % were grandparents, and one respondent was a legal guardian.

Procedure

All research procedures in this study were approved by the university's institutional review board (IRB) and included obtaining written informed consent. After administrators in randomly selected child-care programs confirmed participation in the study, approximately ten children in preschool classrooms from each program were randomly selected for inclusion in the study. Parents received a consent form, a questionnaire, and a return envelope via the administrator, and children whose parents consented to participate in assessments (e.g., literacy and math skills) were observed by our trained research assistants. The QRIS parent/child dataset was linked to the 2006–2010 American Community Survey 5-year estimates data at the census tract level to characterize the neighborhood environments using children's addresses. Although we randomly sampled the same number of programs from each QRIS level, the number of programs in the state participating in QRIS were unevenly distributed across QRIS status (i.e., there were fewer programs in the higher quality level). Because unequal selection probabilities might bias parameter estimates (Stapleton 2002), we created a sampling weight to better generalize the study findings to the larger population of all preschool-aged children enrolled in QRIS-participating full-time child care centers in the state.

Measures

Children's Cognitive Skills

Trained research assistants measured children's literacy, language, and mathematical skills using three direct assessments. The *Peabody Picture Vocabulary Test Third Edition* (PPVT-III, Dunn and Dunn 1997) was used to measure children's receptive vocabulary, which represents verbal ability. This is a standardized test that reflects each child's vocabulary performance relative to the expected performance of children in the population who are at the same age, converting raw scores into standardized scores. The *Phonological Awareness Literacy Screening Pre-Kindergarten* (PALS-PreK, Invernizzi et al. 2004) was used to assess children's early literacy skills and phonological awareness that are shown to be predictive of later reading skills. We used a sum of six subtests of the PALS-PreK: upper- and lower-case alphabet recognition, letter sounds recognition, beginning sound awareness, print and word awareness, and rhyme awareness (Cronbach's $\alpha = .85$). A subtest in the *Woodcock-Johnson Test of Achievement III* (WJ-III, Woodcock et al. 2001), Applied Problems, measured children's mathematical abilities. The Applied Problems subtest scores on children's ability to analyze and solve practical math problems through deciding mathematical operation to be used, and conducting simple calculations. The WJ-III provides an age-standardized score, which can be converted from each raw score.

Child-Care Quality

Quality rating and improvement systems level was used to represent the integrated structural quality of the child-care programs. The QRIS that was employed in this study

Table 1 Demographics across QRIS levels

Variables		Total	QRIS levels		t/χ^2
	N	M (SD)/%	Level 1, 2 M (SD)/%	Level 3 M (SD)/ %	
Child characteristics					
Age (in months)	313	54.92 (6.67)	54.84 (6.66)	55.10 (6.73)	−.32
Sex (*girl*)	310	46.77	44.50	51.49	1.34
Ethnicity	311				
White, non-Hispanic		63.02	63.33	62.38	2.09
Black, non-Hispanic		17.68	18.10	16.83	
Hispanic		6.75	7.62	4.95	
Other race		12.54	10.95	15.84	
Home/neighborhood characteristics					
Income (<$30,000)	300	31.67	36.32	22.22	6.09*
Educational attainment (*At least an AA degree*)	311	59.81	54.76	70.30	6.85**
Single marital status	312	37.50	41.23	29.70	3.87*
Cognitive stimulation at home	308	8.85 (1.31)	8.69 (1.37)	9.19 (1.12)	−3.16**
Parental depression	306	3.38 (4.07)	3.46 (4.08)	3.2 (4.06)	.53
Neighborhood disadvantage	313	−.05 (.76)	−.03 (.74)	−.11 (.79)	.84

All analyses were weighted

AA Associate of Arts

* $p < .05$; ** $p < .01$

had three quality levels above state licensing standards (level 1, level 2, and level 3). A higher rating represents higher quality programs: fewer children per classroom; additional requirement for teacher qualifications (e.g., educational attainment or major in early childhood education) and annual specialized training for teachers; a more comprehensive early education curriculum and assessments for children; and increased workforce professionalization and stabilization efforts. A binary variable was created to represent child-care quality using QRIS levels (1 = *the highest level 3 programs* and 0 = *the lower level 1 or 2 programs*).

Family Socioeconomic Risk

Family socioeconomic risk was measured by counting the number of risks as reported by parents. We used the cumulative risk index because family socioeconomic risk factors are likely to be highly correlated (Burchinal et al. 2000a, b). Three indicators were singled out as an index: single parent status (dummy coded as 1 = *single, separated, divorced or widowed* and 0 = *married or cohabitating*), parents' educational level (dummy coded as 1 = *less than an Associate of Arts (AA) degree* and 0 = *at least an AA degree*), and family income (dummy coded as 1 = *annual income less than $30,000* and 0 = *more than $ 30,001*). The Cronbach's α for three indicators in the current study was .77.

Covariates

Several child characteristics and children's home and neighborhood environments that have been associated with children's cognitive development were included as covariates. First, child age, sex (dummy coded as 1 = *girls* and 0 = *boys*), and race/ethnicity (dummy coded into three binary variables, White, non-Hispanic as a reference category; *Black, non-Hispanic*; *Hispanic*; and *other race*) were included. Second, we included parent-reported quality of cognitive stimulation at home and parental depression. A degree of cognitive stimulation at home was measured by the Home Observation of the Environment-Short Form (HOME-SF, Center for Human Resources Research 1993). The HOME-SF measures parents' cognitive stimulation at home by ten items asking about literacy environments for a child. Ten items were summed to represent a total score of home cognitive stimulation (Cronbach's $\alpha = .54$). The short form of Center for Epidemiological Study of Depression Scale (CES-D, Radloff 1977) was used to measure parents' depression. Parents responded to a total of nine items describing the feelings that they had during the past week, using a 4-point scale [1 = *Rarely or none of the time (<1 day)*, 2 = *Some or a little of the time (1–2 days)*, 3 = *Occasionally or a moderate amount of time (3–4 days)*, 4 = *Most or all of the time (5–7 days)*]. We used a sum of nine items, higher scores representing more depressive symptoms (Cronbach's $\alpha = .76$). To control for neighborhood concentrated disadvantage (Sampson et al. 2002), six indicators were extracted from the US Census Bureau data: the percentage below the poverty line, the unemployment ratio, minority concentration, the percentage of female-headed households with children, the percentage of people receiving public assistance, and the percentage of people receiving food stamps (Cronbach's $\alpha = .75$). Indicators were standardized and averaged to represent neighborhood disadvantage.

Data Analytic Strategy

As a preliminary analysis, we conducted exploratory factor analysis (EFA) to examine whether three cognitive skills assessments could be represented by a single factor. We assessed the measurement model fit in the subsequent multilevel confirmatory factor analysis (CFA) by multiple goodness of fit indices: (1) a p value of Chi square statistic (χ^2) larger than .05; (2) a comparative fit index (CFI) of .90 or higher; and (3) a root mean square error of approximation (RMSEA) <.06 (Browne and Cudeck 1993). In the primary analysis, a two-level multilevel analysis with a latent variable representing cognitive skills was conducted in Mplus 7.0 (Muthén and Muthén 1998–2012) because the data was nested (i.e., children nested within child-care programs). Prior to examining the hypotheses, intraclass correlation (ICC), the variation in child cognitive skills between programs, from the unconditional baseline model was calculated (Raudenbush and Bryk 2002). Next, we added the family socioeconomic risk index and covariates in a model to compare with the subsequent model adding the QRIS level to estimate children's cognitive skills that are predicted by QRIS levels. The model fit was evaluated via a comparison of the log-likelihoods from two models. The log-likelihood ratio test statistics follow a Chi square distribution with the degrees of freedom of difference between the null model and the alternative model. If the null hypothesis of the Chi square test is rejected with a p value <.05, the alternative model, which added the QRIS indicator at between-level, was considered as having a better fit than the null model having within-level covariates. To estimate the cross-level interaction (QRIS × family socioeconomic risk), the random slope from level 1 was regressed on QRIS level at level 2 (Eq. 1–2).

$$Y_{ij\_cognitive} = \beta_{oj} + \beta_{1j}(\text{family socioeconomic risk}) + \beta_{2j...9j}(\text{covariates}) + r_{ij} \quad (1)$$

$$\begin{aligned} \beta_{oj} &= \gamma_{00} + \gamma_{01}(\text{QRIS level}) + u_{0j} \\ \beta_{1j} &= \gamma_{10} + \gamma_{11}(\text{QRIS level}) + u_{1j} \\ \beta_{2j...9j} &= \gamma_{20...90} \end{aligned} \quad (2)$$

where γ_{00} represents the intercept, average cognitive skills for children in lower level (i.e., level 1 or 2 programs); γ_{10} represents the effects of family risk on children's cognitive skills; γ_{01} represents the direct effects of QRIS on children's cognitive skills; γ_{11} represents the cross-level interaction between QRIS and family socioeconomic risk. The maximum likelihood with robust standard error (MLR) estimator was used to adjust non-normality of some indicators and the non-independence of observations due to the nested neighborhood census tracts. The sample weight was added at the between-program level in all analyses. Missing data (0.7–5.5 % of missing for each variable) was handled in the model using full information maximum likelihood (FIML) estimation, which is preferred due to the less biased estimators over other traditional approaches (Acock 2005).

Results

Preliminary Analyses

The EFA using children's cognitive outcomes suggested that three assessments measuring vocabulary, phonological awareness, and mathematical abilities could be reduced to a single factor. In the following multilevel CFA, one-factor model showed an excellent model fit, χ^2 (3, $N = 420$) = 5.12, $p > .05$, RMSEA = .04, CFI = .99. Table 2 shows bivariate correlations between variables including the cognitive skills latent variable. QRIS level was negatively correlated with family risk and positively correlated with children's cognitive skills. All family and neighborhood variables were significantly correlated with children's cognitive skills.

Multilevel Analysis

First, ICC was computed for the children's cognitive skills latent variable to determine the proportion of variance attributable to preschool- or child-level variance. There was a considerable variation in the intercepts for the sample—28 % variability in overall cognitive skills was found due to child-care programs (child-care level variance = 20.75; child level variance = 53.04). Next, we added covariates in the model to obtain the log-likelihoods. In addition, we tested our hypotheses by adding the QRIS variable. The first hypothesis testing a direct association between QRIS level and children's cognitive skills was supported. As shown in Table 3, children who were in the highest level of QRIS programs demonstrated better scores in cognitive assessments than those who in lower level programs after controlling for family/neighborhood disadvantage, cognitive stimulation at home, parental depression, child age, sex, and race/ethnicity ($\gamma_{01} = 2.56$, $SE = .05$, $p < .001$). To test the cross-level interaction in the second hypothesis, random slopes of family socioeconomic risk was regressed on QRIS status. The analysis revealed that there was a significant moderating effect of QRIS quality level on the association between family socioeconomic risk and children's cognitive skills after controlling for

Table 2 Bivariate correlations between variables

	1	2	3	4	5	6
1. QRIS level (1 = *level 3*)	–					
2. Family socioeconomic risk	−.12*	–				
3. Neighborhood risk	−.05	.37***	–			
4. Parental depression	−.03	.28***	.19***	–		
5. Cognitive stimulation	.18**	−.40***	−.22***	−.14**	–	
6. Cognitive skills	.25***	−.49***	−.37***	−.13**	.36***	–

* $p < .05$; ** $p < .01$; *** $p < .001$

neighborhood disadvantage, parental depression, cognitive stimulation at home, and other covariates ($\gamma_{11} = 1.30$, $SE = .05$, $p < .001$). Figure 1 shows that the negative association between family socioeconomic risk and children's cognitive skills is no longer significant for children in the highest QRIS level programs ($\gamma_{10} = .13$, $p = .76$), however, there is still a negative association between family socioeconomic risk and children's cognitive skills for children in the lower level programs ($\gamma_{10} = -1.16$, $p = .001$). The model fit comparison between the null model without the level 2 QRIS indicator and the cross-level interaction, and the alternative model adding the QRIS indicator and the interaction showed that the alternative model fit the data better (log-likelihood test statistics = 25.02, $df = 2$, $p < .001$).

Discussion

Preschool-aged children's cognitive skills have been related with success in the transition to formal schooling (Furnes and Samuelsson 2009; Mistry et al. 2010). Preschoolers who demonstrate greater language development and mathematical abilities experience better academic achievement (Duncan et al. 2007) and social–emotional functioning (Hair et al. 2006). In the literature, child-care has been considered a place where children can improve literacy, reasoning, problem-solving, and mathematical skills (Vandell et al. 2010) as many children spend a considerable amount of time in child-care. In response to the importance of high quality child-care experiences and its relation to children's better development, policymakers have engaged in efforts to identify, implement, and evaluate strategies that improve child-care quality (Blau and Hagy 1998; Love et al. 2003). The aim of this study was to examine the association between a recent state-funded early childhood care and education policy (QRIS) and children's cognitive skills, and to test whether the QRIS serves as a moderator of the association between family socioeconomic risk and child outcomes.

The first hypothesis, which tested the direct association between QRIS and children's cognitive skills, was supported. It is worthwhile to note that children in programs with the highest level of QRIS rating demonstrated better cognitive skills, which consisted of direct assessments of literacy, language and mathematical abilities, after controlling for family/neighborhood socioeconomic disadvantage, cognitive stimulation at home, parental depression, child age, gender and race/ethnicity. To date, this is the first study that simultaneously controls for family and neighborhood contexts in examining a QRIS. It is

Table 3 QRIS and children's cognitive development

Variables	Cognitive skills		
	B	*SE*	95 % *CI*
Within level			
Family socioeconomic risk	−1.16**	.34	[−1.86, −0.46]
Covariates			
Child age	.65***	.06	[.53, .78]
Child sex	.56	.55	[−.52, 1.64]
Ethnicity			
Black	−2.99*	1.41	[−5.76, −0.23]
Hispanic	−4.12**	1.36	[−6.79, −1.46]
Other race	−.20	.76	[−1.68, 1.29]
Neighborhood disadvantage	−1.94**	.58	[−3.08, −.79]
Cognitive stimulation	1.14 ***	.28	[.68, 1.70]
Parental depression	−.11	.07	[−.25, .03]
Between level			
QRIS quality level (1 = *3 level*)	2.56***	.05	[2.47, 2.65]
QRIS × family risk	1.30***	.34	[.64, 1.96]

$N = 313$; Unstandardized coefficients are reported

* $p < .05$; ** $p < .01$; *** $p < .001$

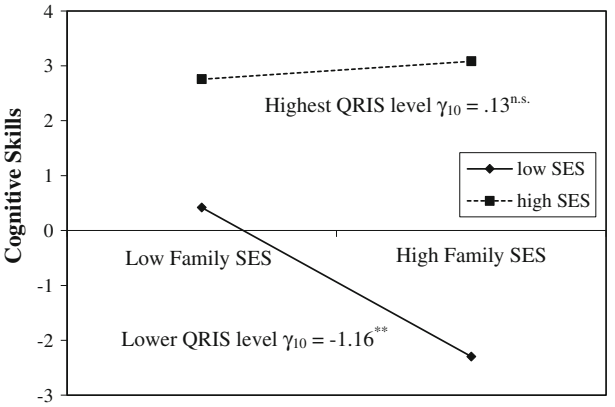

Fig. 1 Conditional direct effects of family socioeconomic risk on children's cognitive skills by QRIS rating level. SES = socioeconomic status. ** $p < .01$

important to consider neighborhood environment in child-care studies because the resources available in a neighborhood often impact parents' child-care selection (Burchinal et al. 2008), which might bias parameter estimates. It is also noted that we accounted for children's mathematical abilities in cognitive skills. Duncan et al. (2007) found from six longitudinal studies that children's math skills are the strongest predictor of children's later achievement, followed by reading skills, regardless of children's sex and socioeconomic backgrounds.

The association between QRIS and children's cognitive skills may be the result of lower ratios and smaller group sizes at higher levels of the quality-rating system; that is, children are able to receive more individualized instructions and learning activities because of the smaller group size (Howes 1997), and this, in turn, may allow children to better gain cognitive skills. Further, children in the highest level QRIS programs may more effectively learn vocabulary, literacy skills, or how to apply and solve mathematical problems from more highly trained teachers and a well-organized environment, both of which are components in the QRIS benchmarks. Otherwise, it is possible that formal or informal assessments tracking children's developmental growth that are required for the highest level 3 programs might have teachers who better understand children's developmental stages and provide appropriate learning materials, activities, and interactions for each child. In fact, there are a few studies finding that teachers in the higher levels of QRIS programs demonstrate better classroom organization, instructional support, or a global classroom quality than teachers in lower level programs (e.g., Jeon et al. 2014; Karoly et al. 2013; Ma et al. 2011), which might be a proxy that supports children's development.

The second hypothesis testing the QRIS level as a moderator was also supported, indicating that the negative association between family socioeconomic risk and children's cognitive skills was buffered for children who were in the highest level programs, after controlling for child, family, and neighborhood covariates. Although QRIS was not specifically developed to target children in poverty, the use of well-organized curriculums in the highest level of QRIS programs might stimulate cognitive development, especially for children at risk, because those children are less likely to have cognitively rich learning resources at home (Burchinal and Cryer 2003). In addition, teachers who had better training and smaller teacher-to-child ratio in the highest level programs as compared to the lower level programs might be more sensitive and responsive to low-income children's specific needs.

Limitations

The present study has several limitations. First, this study was a cross-sectional observational study that cannot establish the causal relationships between QRIS and child outcomes. There are potential selection biases and omitted or unexplained variable biases which might not be explained in this study. For example, although the state provides informative materials for all parents to learn about the system, it is possible that children who are in more advantaged family and neighborhood backgrounds might be in the higher QRIS level programs due to parental selection. Because QRIS does not particularly target disadvantaged children, parents in certain disadvantaged areas might not have enough access to QRIS highly rated programs. We, however, acknowledge that there are a number of QRIS-rated Head Start programs in disadvantaged areas and that states recognize the importance of accessibility for disadvantaged children and often make efforts to provide subsidy for children entering QRIS-rated programs. In addition, there could be teacher- or program-level unexplained variables in the current study, such as program size, Head Start status, and individual teachers' qualifications and education. Second, the effects of QRIS on children's cognitive skills may be overestimated because although the assessors were blind to the objectives of the study, they could not be blind to the QRIS levels. The banners indicating QRIS levels were displayed in front of each QRIS-participating program for advertisement. Third, a sample weight was utilized in this study to generalize the findings to the targeted population, preschool-aged children in full-time child care centers in the state. However, even though this study illustrates the associations between QRIS and

children's cognitive skills, the results cannot be generalized to other states' QRIS or other types of child-care programs such as part-time or home-based child care. Finally, most participants in this study were European American and middle-class parents. Although we found that QRIS moderates the association between family socioeconomic risk and children's cognitive skills, additional studies are needed to further test the moderating effects of QRIS in more diverse samples including those with more children from disadvantaged backgrounds.

Implications for Future Research and Practice

Despite limitations, the findings of the current study suggest several implications for future research and practice. The current study investigated the association between QRIS and children's cognitive skills. The mechanisms of this association can be an important topic for further exploration. For example, higher level rankings in a QRIS (better structural quality of child-care) might predict better teacher–child relationships or emotional support due to smaller group size and better professional development of teachers, which in turn, might predict children's outcomes. Furthermore, longitudinal studies are needed to test the lasting direct and buffering effect of QRIS on child outcomes and to establish a causal relationship between QRIS and children's development. In addition, a wider range of child outcomes such as social–emotional functioning or behavioral problems need to be investigated because children's social and emotional development is one important component of school readiness. Utilizing this study as a starting point, in future QRIS research, each benchmark in the QRIS can be separately investigated to determine specific structural indicators that influence particular child outcomes. This would be useful information for system modification.

At the policy level, even though the ultimate goal of the QRIS is to improve children's school readiness, there are only few studies examining the associations between QRIS and child outcomes because QRISs are in a stage of validating benchmarks and disseminating information on the system to child-care programs and parents. This study suggests that the QRIS model has the potential to influence children's developmental outcomes, especially in the area of academic achievement, so that QRISs may be a good place to allocate public dollars. Additionally, state funding might be used to reserve more slots for subsidized children in higher rated QRIS programs as a way to buffer the negative effects of family risk. Because there is an increasing number of low-income mothers entering the labor force and more children in poverty requiring out-of-home child care (Loeb et al. 2004), the quality of the child-care experience is particularly important for children at risk. Although QRIS is not particularly designed for vulnerable families and children, if QRIS helps at-risk children's development, it might be an important policy consideration to determine how the system can provide greater benefit to vulnerable children and how the system can be more available in disdavantaged areas. In addition, states might consider additional and varied outreach efforts with parents in disadvantaged areas so they are able to learn about QRIS (e.g., ratings, benchmarks, and benefits) and the importance of high quality of child-care experiences in early childhood. Finally, the findings of this study are expected to help the dissemination of QRIS by policymakers and child-care professionals.

Quality rating systems will take time to build and evaluate in terms of children's outcomes and school readiness (Zellman and Perlman 2008). Although this study suggests that outcomes may be positive, further research in the states adopting these systems is needed. Early-childhood care and education programs that facilitate children's development can be viewed as a long-term investment (Barnett 1985). Although not conclusive,

these early results suggest that federal and state policymakers may be able to expect positive returns on the current QRIS investments, which, in turn, may provide the impetus for more robust systems.

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