



Community-Level Social Determinants and Children's School Readiness

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Abstract

The current study examined links between social determinants across communities and school readiness of children attending kindergarten in each community, in literacy, math, self-regulation, and social skills. Four types of social determinants were explored: socioeconomic, crime/violence, health and well-being, and access to resources. Data came from the Oregon Kindergarten Assessment, with 40,652 entering kindergarteners attending 706 schools in the fall of 2014. The 706 schools were nested within 36 counties. Variables representing social determinants were drawn from a variety of publicly available data sources from the year(s) most recently prior to the 2014–2015 school year. Bayesian multilevel modeling was conducted with children nested within schools, within counties. Children's school readiness in all four domains was negatively predicted by economic disadvantage at the school-level (indicated by other children with whom they attend Kindergarten), accounting for economic disadvantage in their own household. Moreover, school-level economic disadvantage amplified the negative effects of children's economic disadvantage on their school readiness. Four county-level social determinants also predicted one or more of the four school readiness outcomes, accounting for child- and school-level factors: child care supply, behavioral crime, maternal smoking, and adult health. County-level findings should be interpreted with caution due to a small sample and exploratory approach. However, this study is a first step to helping leaders address critical questions about how community risk factors like crime, and resources like child care, relate to school readiness among children in their communities.

Keywords School readiness · Social determinants · Community

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Strengthening children's school readiness is a priority for many communities. Children who enter formal schooling with stronger skills in social, behavioral, and academic domains tend to experience greater educational success (Duncan et al. 2007; McClelland et al. 2013) and fewer problems with mental and

behavioral health and criminality (e.g., Reynolds and Ou 2011). Thus, children's school readiness has implications for economic growth and well-being in communities (Knudsen et al. 2006).

Leaders who are called upon to raise children's school readiness in their communities need to know which factors to target with limited resources. Policies and investments often seek to elevate the overall level of school readiness among children in entire counties, school districts, or school catchment areas (Dawson-McClure et al. 2015; Segal and Bruner 2004), and disparities in educational outcomes are often geographically linked (Coulton et al. 2016). However, although decades of research have identified effective ways of improving *individual* children's school readiness (e.g., Bierman et al. 2015; Reynolds and Ou 2011), little research has focused on improving school readiness at the *community* level, where many preventive interventions take place.

To accomplish such ambitious community-level change, experts are working to align ecological theory, public health, and population health approaches (e.g., Atkins et al. 2016; Kindig and Stoddart 2003; Nurse and Edmondson-Jones 2007).

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Ecological theory highlights the interplay between individuals and their environments, while a public health model specifies a continuum from primary prevention to targeted intervention (Atkins et al. 2016), and highlights the role of social determinants in life outcomes (Commission on Social Determinants of Health 2008). Population health examines factors that influence the health and well-being of entire populations (Kindig and Stoddart 2003). The current study draws upon these models to examine how community-level social determinants are linked with children's school readiness above and beyond individual-level factors such as economic disadvantage. Readiness includes literacy, math, self-regulation, and social skills. Four types of social determinants are explored: socioeconomic, crime/violence, health and well-being, and access to resources.

Socioeconomic Determinants

The consequences of socioeconomic status (SES) for children's cognitive, emotional, and behavioral functioning are well documented (e.g., Jeon et al. 2014). The socioeconomic conditions of the communities in which children live are also linked to school readiness (e.g., Hanson et al. 2011; Jeon et al. 2014). For example, in one study, an aggregate measure of neighborhood residents' education, income, and occupation was positively associated with children's vocabulary at age 5 to 6 years, accounting for family characteristics (Chase-Lansdale and Gordon 1996). Mechanisms linking socioeconomic conditions with children's school readiness and/or success include exposure to violence (McCoy et al. 2015), role models and resources (Dupere et al. 2010), and home environments and parenting (Jeon et al. 2014). The overall socioeconomic conditions of families served by a school are also important to understanding population-level school readiness (Lesaux et al. 2007). Little is known about how socioeconomic conditions of communities and individual children's families interact to influence achievement (Gustafsson et al. 2016; Morrissey and Vinopal 2018). This study takes a critical next step of examining whether community-level economic disadvantage amplifies the effects of child-level economic disadvantage on school readiness.

Crime and Violence Determinants

Despite important advances in violence prevention, approximately 60% of children in the USA experience maltreatment or family and/or community violence annually (Finkelhor et al. 2009). Children's exposure to community violence is negatively associated with school readiness skills such as cognition, social competence, attention, and impulse control (Farver et al. 2005; McCoy et al. 2015). Child maltreatment is also associated with a host of behavioral and academic challenges (Pears et al. 2013), and is linked with neighborhood violence, even after controlling for economic disadvantage (Hurlburt et al. 2017). Since children's exposure to violence varies by community, due to

potentially malleable factors such as norms, resources, and housing dynamics (Finno-Velasquez et al. 2017), it may represent an important community-level factor for understanding and strengthening children's school readiness.

Health and Well-being Determinants

Access to health insurance and care supports healthy development (American Academy of Pediatrics 2017; Bailey et al. 2016). Children with health insurance have shown higher reading scores than those without insurance (Levine and Schanzenbach 2009), perhaps because insurance type (along with other factors such as number of doctors and income) affects access to health services (Andersen et al. 2002). Access to health insurance may therefore be an important marker of health and well-being that explains differences in school readiness across communities. Adults' physical and mental health may also be important, as maternal depressive symptoms and maternal smoking are associated with lower cognitive and behavioral school readiness (Batstra et al. 2003; Petterson and Albers 2001). Food insecurity is also linked to emotional, social, and behavioral challenges (Belsky et al. 2010; Kimbo and Denney 2015) in school-aged children, after accounting for household income. Thus, recognizing the potentially supportive role of growing up in a community with good access to health insurance, health care providers, healthy foods, and adults who are mentally and physically healthy, the current study examines links between these factors and school readiness. The importance of community-level estimates for indicators of health and well-being to understanding and strengthening children's school readiness is not yet known.

Access to Resources as Determinants

Social services and other resources for families are linked with children's development and well-being (Layzer et al. 2001). Such supports include preventive interventions (e.g., home visiting), social safety net programs (e.g., cash assistance, food stamps), and more general family resources (e.g., child care, parenting classes, libraries). The current study focuses on this latter type of supports instead of family-level interventions or social safety net programs, which were included in this study's socioeconomic measures.

We examine child care as an indicator of social and family resources because of its established associations with school readiness, especially for children from disadvantaged backgrounds (e.g., Ansari 2018; Lipscomb et al. 2014), and its variation across communities (Hatfield et al. 2015). Although considering quality, type (center-based, home-based, Head Start, etc.), and quantity is key to fully understanding associations between child care and child outcomes (Ansari 2018), the overall availability of care may be a marker of resources for families at the community-level. A study in Italy linked child care supply in communities to both

maternal employment and children's language scores in early elementary school (Brilli et al. 2016). This study extends prior work by examining associations between communities' supply of licensed child care and multiple aspects of children's school readiness, controlling for economic disadvantage.

Present Study

To inform efforts that take a population-level approach to strengthening school readiness, the current study examines how social determinants (socioeconomic, crime/violence, health and well-being, and access to resources) help to explain school readiness across communities. We examine children's literacy, math, self-regulation, and social skills, because they are consistently identified as key facets of school readiness (Duncan et al. 2007; McClelland et al. 2013).

Our community-level approach is informed by evidence that children's peers contribute to their school readiness. The socioeconomic status, behavior, and experiences of children's classmates predict their academic and behavioral success in kindergarten (Reid and Ready 2013; Weiland and Yoshikawa 2014; Yudron et al. 2014). Thus, links between community factors like violence and a child's school readiness may be due to both the child's own exposure to violence and his/her peers' exposure to violence.

In the current study, school readiness scores are modeled at the individual-level, nested within schools and counties, both of which represent *communities*. Most social determinants variables are only available at the county-level, which represents a meaningful unit of measurement for many communities. Economic disadvantage is measurable at the school-level. Our exploratory hypothesis is that more positive social determinants (e.g., child care slots available countywide) across communities will predict higher school readiness scores, while accounting for individual-level factors. The nested design with a large number of schools also allows for an initial examination of how community-level factors (in this case the economic disadvantage of the school community) may amplify or attenuate the effects of individual factors (individual-level economic disadvantage). We hypothesize that more economic disadvantage at the school-level will amplify the negative effects of economic disadvantage at the individual-level. Although this work, conducted in one state, is preliminary, identifying malleable factors within communities that explain differences in school readiness may ultimately help to improve population-level health and well-being.

Method

Sample

Data come from the Oregon Kindergarten Assessment (OKA), a statewide effort by the Oregon Department of

Education (ODE) to measure the school readiness of Oregon's children upon kindergarten entry in public and charter (5.61%) schools. Data were collected from 40,652 entering kindergarteners attending 706 schools nested within 36 counties in the fall of 2014. An average of 57.11 kindergarteners were enrolled per school (SD = 29.41, range = 3–176) and an average of 54.29 schools were located in each county (SD = 36.86, range = 1–114). All OKA variables were missing for 1.01% of children overall, ranging from 0 to 25% at the school-level. Schools with fewer than three children who completed the OKA ($n = 22$) were omitted.

Procedures and Measures

School Readiness Outcomes

During the first 3 weeks of kindergarten in 2014, children were directly assessed on measures of literacy and math for approximately 15 min. Self-regulation and interpersonal skills were reported by teachers within the first 6 weeks of kindergarten, after familiarizing themselves with students' behavior.

Early Literacy Literacy skills were assessed with two standardized measures, easyCBM Letter Names and easyCBM Letter Sounds, averaged to create a composite ($r = 0.76$; Alonzo and Tindal 2007). For each assessment, children are shown a chart of upper- and lower-case letters and name as many letters/sounds as they can in 60 s. The total number of letters/sounds comprises the child's "per minute" fluency-based score. Possible scores for each assessment range from 0 to 100. These easyCBM literacy subtests have shown moderate to strong correlations with corresponding subtests on another literacy assessment (DIBELS; Lai et al. 2013).

Early Math The easyCBM Numbers and Operations assessment measured children's ability to understand numbers, number systems, relationships among numbers, and meanings of operations (Alonzo and Tindal 2009). The items require the children to count objects, add or subtract single-digit numbers, and insert the correct number into three-digit sequences that increase by one between 1 and 20. Children point to one of the three response options for each item; possible scores range from 0 to 16. In an examination of construct validity, the easyCBM scores accounted for approximately 39% of the total variance in, and were strongly correlated with ($r = 0.59$; Anderson et al. 2010) the TerraNova, a comparative math assessment.

Self-regulation Self-regulation was measured with a 10-item subscale ($\alpha = 0.97$) from a modified version of the Child Behavior Rating Scale (CBRS; Bronson et al. 1995). Teachers rated children's self-regulation using a 5-point Likert scale, from 1 = *never* to 5 = *always*. Example items include,

“Observes rules and follows directions without requiring repeated reminders” and “Completes tasks successfully.”

Interpersonal Skills The CBRS (Bronson et al. 1995) also includes five items ($\alpha = 0.96$) that measured children’s interpersonal skills, using the same teacher-rated 5-point Likert scale. Example items include, “Takes turns in a game situation with toys, materials, and other things without being told to do so” and “Complies with adult directives, giving little or no verbal or physical resistance, even with tasks that he/she dislikes.” The CBRS has shown strong construct validity with the Social Skills Rating System ($r = 0.50$ – 0.68 ; McClelland and Morrison 2003).

Social Determinants

Social determinants were available at the school (socioeconomic)- and county (socioeconomic, crime and violence, health and well-being, and resources)-levels. ODE provided data on children’s economic disadvantage. No other social determinants were available at the school-level. We explored publicly available federal, state, and local datasets, yielding 26 county-level variables from years prior to the 2014–2015 school year. Eleven of these 26 variables were retained for analysis because they had adequate variance across counties and were correlated with at least one of the four school readiness outcomes in a preliminary analysis.

Socioeconomic

Individual Economic Disadvantage (Child-Level) Children’s eligibility for free or reduced lunch during kindergarten was provided by ODE to measure child-level economic disadvantage.

Community Economic Disadvantage (School-Level) Child-level data were aggregated to create school-wide rates of economic disadvantage, with a range from 0 to 1 and a mean of 0.54 ($SD = 2.83$). Preliminary analysis indicated that using a school-wide versus sample-wide (i.e., kindergarteners who completed the OKA) rate yielded nearly identical findings.

Child Poverty (County-Level) The percent of children under 5 years old whose families had incomes below the federal poverty level in 2013 (5-year estimate), measured by the American Community Survey (ACS) ranged from 19.5 to 31.2% (U.S. Census Bureau 2014a). In 2013, the 5-year national estimate of child poverty was 27.2%.

Unemployment and/or Public Assistance Income (County-Level) Unemployment was measured by the ACS as the percent of the labor force age 16 and older not employed and actively seeking work (U.S. Census Bureau 2014d). Receipt of public assistance income was measured by the ACS as the percent of

children age 18 and under in households receiving social security income, cash public assistance income, food stamps, and/or Supplemental Nutrition Assistance Program (SNAP) assistance (U.S. Census Bureau 2014c). Unemployment and public assistance income ($r = 0.60$, $p < .001$) were averaged within each county and ranged from 14.6 to 32.8 in 2013 ACS 5-year estimates. The 2013 5-year estimates for unemployment and public assistance income were 9.7% and 27% nationally, and 11.6% and 35.7% in Oregon.

Crime and Violence

Abuse and Neglect (County-Level) The number of reported child abuse and neglect cases per 1000 children within each county ranged from 5.0 to 24.1 in 2012 (Oregon Department of Human Services 2014). The national rate was 28.3 per 1000 children in 2012 (Administration for Children and Families 2013).

Behavioral Crime (County-Level) Behavioral crime rate was measured as the number of documented behavioral crimes per 10,000 people in each county (Oregon Uniform Crime Reporting 2014), including weapons infractions, drug and/or liquor law violations, disorderly conduct, curfew violations, driving under the influence, and offenses against family. Rates ranged from 42.1 to 1422.1. Comparable estimates at the national level were unavailable.

Health and Well-being

Child Health Insurance (County-Level) The percent of children under age 6 without health insurance ranged from 0 to 25.40 in 2013 ACS 5-year estimates (U.S. Census Bureau 2014b). In 2013, the 5-year national estimate of child health insurance was 7.6%.

Maternal Smoking (County-Level) The percent of births for which mothers smoked during pregnancy ranged from 0 to 27.89 between 2007 and 2009 (Oregon Public Health Assessment Tool 2015). The average number of births for which mothers smoked during pregnancy between 2007 and 2009 nationally was 9.7% (U.S. Department of Health and Human Services 2018).

Low Birth Weight (County-Level) The percent of low weight births (< 2500 g) ranged from 0 to 8.87 between 2007 and 2009 (Oregon Public Health Assessment Tool 2015). The average number of low weight births between 2007 and 2009 nationally was 8.2% (U.S. Department of Health and Human Services 2018).

Primary Care Physicians (PCPs) and Dentists (County-Level) The ratio of the county population to the average number of

physicians and dentists ranged from 0 to 3748 in 2012 (County Health Rankings 2015a). National estimates from this source were unavailable.

Adult Physical Health (County-Level) The age-adjusted percent of adults in good physical health over the past 30 days was measured by the Oregon Behavioral Risk Factor Surveillance System (2012), and ranged from 59.6 to 76.4. A comparable national estimate was not available.

Positive Food Environment (County-Level) Positive food environment was measured by the County Health Rankings using a two-stage fixed effect model of two equally weighted indicators from the USDA Food Environment Atlas and Map The Meal: (1) the percent of the population below 200% of the Federal Poverty Line and whose households were over 10 miles (rural) or 1 mile (non-rural) from a grocery store, and (2) the percent of the population without access to a reliable food source. Scores from data representing 2010–2012 positive food environments were averaged, and ranged from 3.7 to 8.8 on a 0–10 scale (County Health Rankings 2015b). In 2012, the national average positive food environment index was 7.3.

Social and Family Resources

Child Care Supply (County-Level) The number of licensed child care slots per 100 children under age 13 ranged from 7 to 47 in Oregon's 2014 Child Care Market Price Study (Grobe and Weber 2014). Comparable national estimates were unavailable.

Covariates (Child-Level)

Child demographic data from 2014, provided by ODE, included racial/ethnic minority (any race or ethnicity other than White, non-Hispanic), English-language learner (ELL) status (based on language proficiency scores), gender, and eligibility for special education services.

Analytic Approach

Variables were examined for distributional normality. Two outliers (one each for behavioral crime and child care supply) were recoded to the next highest valid values. Group-mean centering was performed at the school-level, and county-level variables were standardized. Child-level variables were unadjusted. Multilevel modeling (MLM) was performed in Mplus (Muthén and Muthén 1998–2011) using a Bayesian framework, which provides the degree of certainty about the probability of a result, in contrast to models that identify the probability that a result is likely given the data. Bayesian estimation MLM produces more accurate standard errors in small sample sizes (Raudenbush and Bryk 2002), handles

multiple comparisons (Gelman et al. 2012), and is similar to FIML in the treatment of missing data.

Model building included four steps. First, unconditional models were estimated for each of the four school readiness outcomes. Second, child-level variables for ELL status, minority status, special education, and gender were added, and child-level economic disadvantage was specified with a random effect regressed on school-level economic disadvantage. Third, the 11 county-level variables were entered into models one at a time. Due to limited statistical power with 36 counties, only singly significant county-level variables proceeded to the final step. In the fourth and final step, county-level variables that significantly predicted one or more outcomes from step three were modeled simultaneously with the child- and school-level variables. Non-significant county-level effects were then trimmed one at a time; these estimates and Deviance Information Criteria (DIC) were utilized for final model selection.

Results

Descriptive statistics and correlations are shown in Tables 1 and 2. Unconditional multilevel model fit in step one of the analysis showed significant variance in all four outcomes across schools (9.4–12.9%) and counties (0.2–1.9%) (see Table 3). In the second step (available online), and throughout all final models (Table 3), children's economic disadvantage predicted lower school readiness. This effect varied significantly (random effect) across both schools and counties, and was explained in part by school-level economic disadvantage. The negative effects of child-level economic disadvantage on school readiness outcomes were larger for children attending schools with more economic disadvantage. Each 1% increase in school-level economic disadvantage increased the effect of child-level economic disadvantage on the outcomes anywhere from 0.43 points (interpersonal skills) to 5.60 points (early literacy), respectively (see Table 3).

County-level variables were included in step three of the analysis (available online); they were narrowed down to six variables that predicted school readiness outcomes, accounting for child- and school-level effects: child care supply, abuse and neglect, behavioral crime, unemployment and assisted income, maternal smoking, and adult health. These six county-level variables were included in the final step in the analysis. The final models (Table 3) including estimates for standardized county-level variables retained after non-significant county-level variables (abuse and neglect, behavioral crime, maternal smoking; also adult health for math and literacy outcomes) were trimmed. Child care supply was associated with higher literacy scores, and unemployment and assisted income were associated with lower literacy and math scores. A child's literacy score improved by half a point (0.48) for each additional county child care slot available per 100 children and decreased by one and a half points (1.49) for each

Table 1 Descriptive statistics and correlations among child-level variables

Variables	1	2	3	4	5	6	7	8	<i>M</i> (<i>SD</i>)
1. Early math	–								8.00 (3.20)
2. Early literacy	0.56*	–							12.10 (12.28)
3. Interpersonal skills	0.16*	0.16*	–						3.92 (0.88)
4. Self-regulation	0.31*	0.34*	0.74*	–					3.57 (0.86)
5. Economic disadvantage	–0.22*	–0.32*	–0.10*	–0.15*	–				0.56 (0.50)
6. ELL	–0.22*	–0.30*	–0.00	–0.07*	0.24*	–			0.54 (0.28)
7. Minority	–0.16*	–0.20*	–0.00	–0.05	0.23*	0.52*	–		0.37 (0.48)
8. Special education services	–0.14*	–0.13*	–0.19*	–0.23*	0.08*	0.00	–0.01	–	0.10 (0.30)
9. Gender (male)	0.02*	–0.04*	–0.18*	–0.22*	–0.00	0.00	0.00	0.12*	0.52 (0.50)

* $p < 0.001$

ELL English-language learner

percent increase in county unemployment and assisted income rates. None of the county-level variables significantly predicted interpersonal skills or self-regulation in the final models, neither of which had much variance to explain at the county-level.

Discussion

The current study examined community-level social determinants that helped to explain variation in children's school readiness. As expected, children from economically disadvantaged households scored lower on all four school readiness outcomes. The magnitude of these effects varied across communities (schools and counties), and school-level economic disadvantage amplified the effects of child-level economic

disadvantage. Less variation was seen across counties, accounting for child- and school-levels. Yet, some significant associations were detected for early literacy and math outcomes for six county-level social determinants: child care supply, abuse and neglect, behavioral crime, unemployment and assisted income, maternal smoking, and adult health. Findings from this initial study of community-level social determinants of school readiness should be interpreted with caution. However, this study sets an important foundation for future research to identify malleable, community-level factors that have promise to help strengthen population-level school readiness.

As expected, economic disadvantage was strongly predictive of school readiness scores. This builds upon consistent evidence of lower school readiness among children from families and/or neighborhoods with socioeconomic disadvantage (Hanson et al. 2011; Jeon et al. 2014). In the current study, the

Table 2 Descriptive statistics and correlations among county-level variables

Variables	1	2	3	4	5	6	7	8	9	10	<i>M</i> (<i>SD</i>)
1. Child care supply	–										18.03 (7.84)
2. Positive food environment	–0.25	–									6.82 (0.93)
3. Abuse and neglect	–0.02	–0.41*	–								13.58 (5.67)
4. Behavioral crimes	0.37*	0.02	0.21	–							465.54 (198.79)
5. Unemployment/assisted income	–0.23	–0.10	0.61***	0.23	–						23.68 (4.57)
6. Child health insurance	0.34*	–0.04	0.03	0.40*	0.09	–					8.02 (5.04)
7. Child poverty	0.43**	0.17	0.19	0.35*	0.06	0.36*	–				27.28 (2.02)
8. Maternal smoking	–0.28	–0.15	0.48**	0.32†	0.51**	0.28	–0.17	–			15.34 (6.26)
9. Low birth weight	–0.61***	0.32†	0.33†	–0.29†	0.48**	–0.11	–0.13	0.47**	–		5.69 (1.93)
10. PCPs and dentists	–0.66***	0.18	0.12	–0.21	0.35*	–0.10	–0.38*	0.31†	0.56***		1516.17 (718.59)
11. Adult physical health	0.20	–0.27	–0.39*	–0.53**	–0.46**	–0.14	–0.29†	–0.32†	–0.48**	–0.01	64.83 (3.86)

† $p < 0.10$ * $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

Table 3 Bayesian estimates for social determinants and children's school readiness

Models ^a	Mathematics Est. (SD)	Early literacy Est. (SD)	Interpersonal skills Est. (SD)	Self-regulation Est. (SD)
Child-level				
ELL status	-1.246* (0.048)	-6.763* (.174)	0.045* (0.013)	-0.093* (0.012)
Minority status	-0.253* (0.037)	-0.661* (0.140)	0.017 (0.010)	-0.005 (0.010)
Special education	-1.320* (0.050)	-4.051* (0.186)	-0.452* (0.014)	-0.553* (0.013)
Gender (male)	0.221* (0.027)	-0.668* (0.108)	-0.287* (0.008)	-0.339* (0.007)
School-level				
Economic disadvantage ^c	-1.368* (0.184)	-7.748* (0.749)	-0.324* (0.058)	-0.256* (0.056)
Random effect: child-level economic disadvantage	0.947* (0.206)	5.620* (0.815)	0.430* (0.051)	0.475* (0.049)
County-level				
Child care supply ^d	-	0.480* (0.218)	-	-
Unemployment/assisted income ^d	-0.213* (0.054)	-1.490* (0.284)	-	-
Mean effect of child-level economic disadvantage across counties	-0.667* (0.069)	-3.759* (0.337)	-0.122* (0.017)	-0.195* (0.017)
Intercept	8.745* (0.068)	16.109* (0.287)	4.138* (0.021)	3.882* (0.021)
DIC	201,618.75	304,019.04	97,818.79	93,600.83

*one-tailed p value presented for effects denoted as significant in Mplus at $p < 0.05$

SD posterior SD in parentheses, ELL English-language learner, DIC deviance information criterion, indicator of model fit useful with Bayesian MLM; lower values indicate better fit

^a Bayesian models used uninformative priors

^b ICCs for initial unconditional models without covariates using MLR estimator

^c School-level economic disadvantage group-mean centered

^d County-level variables standardized prior to analysis

links between economic disadvantage and school readiness account for the children's own economic disadvantage, the accumulation of economic disadvantage across kindergarteners within schools, and the effects of peers' economic background, through group dynamics (e.g., Weiland and Yoshikawa 2014). Teachers and administrators of elementary schools in economically disadvantaged areas must be supported to address the needs of their kindergarten populations, who are substantially less well-prepared in both early academic skills and self-regulatory/social skills than those in more advantaged areas. Likewise, findings affirm the disproportional need to support disadvantaged communities prior to children's school entry.

The finding that the effects of economic disadvantage on children's school readiness vary by community (school catchment areas and counties) has important implications. It suggests that communities may be able to strengthen children's school readiness despite economic disadvantage, such as by intervening in some of the underlying mechanisms linking disadvantage to school readiness, such as exposure to violence, resources, and home environments (Dupere et al. 2010; Jeon et al. 2014; McCoy et al. 2015). The current study did not have sufficient statistical power to examine interactions between county-level social determinants and children's economic disadvantage on school readiness. Yet, findings

documented that the effect of child-level economic disadvantage could be systematically predicted by a community indicator (economic disadvantage at the school-level). Furthermore, this study demonstrated that social determinants are linked with school readiness even at the relatively distant level of the county in which the children live. Together, these findings suggest the potential for future research to identify additional social determinants within communities that amplify or attenuate deleterious effects of economic disadvantage on school readiness outcomes.

Results are suggestive that some social determinants within communities may explain variance in school readiness beyond that accounted for by individual economic disadvantage. We are cautious about interpreting specific effects because the exploratory nature of the analysis required multiple comparisons, which increases the likelihood of detecting significant findings by chance. Although it is not possible to know whether or which estimates might occur by chance, the effect of child care supply on literacy has appeared consistently across alternate modeling of the data from preliminary analyses. Additionally, ample evidence documents positive effects of child care on early literacy (Ansari 2018). Negative effects of child care on social skills and self-regulation (Ansari 2018) were not detected, possibly due to insufficient variance in these aspects of readiness at the county-level, at which child

care supply was measured. The effects of unemployment and assisted income on math and literacy build from the evidence that socioeconomic disadvantage compromises school readiness (Jeon et al. 2014) and suggests that it may be important across the various levels of children's environments (individual/family, and community). One likely explanation for an effect of unemployment and assisted income only for math and literacy is that these two outcomes had more (although still relatively little) variance to explain at the county-level after accounting for child- and school-levels than the other two outcomes.

Limitations, Strengths, and Future Directions

Statistical power for estimating effects of social determinants was limited by a small sample of 36 counties, which also prevented formal corrections for multiple comparisons; we recommend readers exercise caution in the interpretation of county-level findings. Additionally, although we were careful to select data sources for social determinants closest to the 2014–2015 OKA assessment, uniformity in timing of measurement was not possible. Measuring social determinants consistently across time, at the level of school catchment areas, would increase precision and statistical power in future research. It would also allow for examining additional cross-level interactions to identify social determinants that attenuate the link between economic disadvantage and school readiness. Measuring a broader array of social and family resources, as well as utilization rates, would further our understanding of their potential contributions to school readiness. Given that community factors often covary, it will be important to detect factors most *directly* linked with school readiness. The current study has a number of strengths, particularly the inclusion of social determinants across multiple areas, the measurement of four domains of school readiness, and the nesting of children within schools and counties.

Implications and Conclusions

A better understanding of social determinants within communities may ultimately increase knowledge of how to support children's readiness for the academic, social, and self-regulatory demands of school. The accumulation of economic disadvantage in a child's community (indicated by other children with whom they attend Kindergarten) is linked with their school readiness skills, even after accounting for the economic disadvantage in their own household. That school-level economic disadvantage also amplifies the negative effects of children's economic disadvantage on their school readiness, indicates that disproportionately more resources may be required to support children in schools with more disadvantage. School spending relates to student outcomes (Jackson et al. 2016), yet schools or districts with more economic disadvantage often

receive *less* funding per student than others (U.S. Department of Education 2011). Higher funding for child care may be one promising avenue to support quality early learning opportunities in disadvantaged communities (Hatfield et al. 2015). Further research on community-level social determinants is needed, including the investigation of how *improving* social determinants might elevate school readiness, and ultimately economic prosperity and well-being.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

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References

- Alonzo, J., & Tindal, G. (2007). *Examining the technical adequacy of early literacy measures in a progress monitoring assessment system: Letter names, letter sounds, and phoneme segmenting (Technical Report No. 39)*. Eugene, OR: University of Oregon.
- Alonzo, J., & Tindal, G. (2009). *The development of K-8 progress monitoring measures in mathematics for use with the 2% and general education populations: Kindergarten (Technical Report No. 0921)*. Eugene, OR: University of Oregon.
- American Academy of Pediatrics (2017). *Bright Futures guidelines for health supervision of infants, children, and adolescents: Evidence and rationale*. Retrieved from: https://brightfutures.aap.org/Bright%20Futures%20Documents/BF4_Evidence_Rationale.pdf
- Andersen, R. M., Yu, H., Wyn, R., Davidson, P. L., Brown, E. R., & Teleki, S. (2002). Access to medical care for low-income persons: How do communities make a difference? *Medical Care Research & Review*, 59, 384–411. <https://doi.org/10.1177/107755802237808>.
- Anderson, D., Lai, C. F., Nese, J. F., Park, B. J., Sáez, L., Jamgochian, E. M., ... & Tindal, G. (2010). *Technical adequacy of the easyCBM® primary-level mathematics measures (Grades K-2), 2009–2010 version (Technical Report No. 1006)*. Eugene, OR: University of Oregon.
- Ansari, A. (2018). The persistence of preschool effects from early childhood through adolescence. *Journal of Educational Psychology*, 110, 952–973. <https://doi.org/10.1037/edu0000255>.
- Atkins, M. S., Rusch, D., Mehta, T. G., & Lakind, D. (2016). Future directions for dissemination and implementation science: Aligning ecological theory and public health to close the research to practice gap. *Journal of Clinical Child and Adolescent Psychology*, 45, 215–226. <https://doi.org/10.1080/15374416.2015.1050724>.
- Bailey, S. R., Marino, M., Hoopes, M., Heintzman, J., Gold, R., Angier, H., O'Malley, J. P., & DeVoe, J. E. (2016). Healthcare utilization after a children's health insurance program expansion in Oregon. *Maternal and Child Health*, 20, 946–954. <https://doi.org/10.1007/s10995-016-1971-7>.

- Batstra, L., Hadders-Algra, M., & Neeleman, J. (2003). Effect of antenatal exposure to maternal smoking on behavioural problems and academic achievement in childhood: Prospective evidence from a Dutch birth cohort. *Early Human Development*, *75*, 21–33. <https://doi.org/10.1016/j.earlhumdev.2003.09.001>.
- Belsky, D. W., Moffitt, T. E., Arseneault, L., Melchior, M., & Caspi, A. (2010). Context and sequelae of food insecurity in children's development. *American Journal of Epidemiology*, *172*, 809–818. <https://doi.org/10.1093/aje/kwq201>.
- Bierman, K. L., Welsh, J. A., Heinrichs, B. S., Nix, R. L., & Mathis, E. T. (2015). Helping Head Start parents promote their children's kindergarten adjustment: The REDI parent program. *Child Development*, *86*, 1877–1891. <https://doi.org/10.1111/cdev.12448>.
- Brilli, Y., Boca, D., & Pronzato, C. (2016). Does child care availability play a role in maternal employment and children's development? Evidence from Italy. *Review of Economics of the Household*, *14*, 27–51.
- Bronson, M. B., Tivnan, T., & Seppanen, P. S. (1995). Relations between teacher and classroom activity variables and the classroom behaviors of prekindergarten children in Chapter 1 funded programs. *Journal of Applied Developmental Psychology*, *16*, 253–282.
- Chase-Lansdale, L., & Gordon, R. A. (1996). Economic hardship and the development of five- and six-year-olds: Neighborhood and regional perspectives. *Child Development*, *67*, 3338–3367.
- Commission on Social Determinants of Health (2008). *Closing the gap in a generation: health equity through action on the social determinants of health*. Final Report of the Commission on Social Determinants of Health. Geneva, World Health Organization. Retrieved from: https://www.who.int/social_determinants/thecommission/finalreport/en/
- Coulton, C. J., Richter, F., Seok-Joo, K., Fischer, R., & Youngmin, C. (2016). Temporal effects of distressed housing on early childhood risk factors and kindergarten readiness. *Children and Youth Services Review*, *68*, 59–72. <https://doi.org/10.1016/j.childyouth.2016.06.017>.
- County Health Rankings (2015a). *Primary Care Physicians*. Retrieved from <http://www.countyhealthrankings.org/app/oregon/2015/measure/factors/4/description>. Accessed 23 Sept 2016.
- County Health Rankings. (2015b). *Food Environment Index*. Retrieved from <http://www.countyhealthrankings.org/app/oregon/2015/measure/factors/133/data>. Accessed 23 Sept 2016.
- Dawson-McClure, S., Calzada, E., Huaung, K., Kamboukos, D., Rhule, D., Kolawole, B., & Brotman, L. (2015). A population-level approach to promoting healthy child development and school success in low-income, urban neighborhoods: Impact on parenting and child conduct problems. *Prevention Science*, *16*, 279–290. <https://doi.org/10.1007/s11121-014-0473-3>.
- Duncan, G. J., Dowsett, C. J., Claessens, A., Magnuson, K., Huston, A. C., Klebanov, P., & Japel, C. (2007). School readiness and later achievement. *Developmental Psychology*, *43*, 1428–1446. <https://doi.org/10.1037/0012-1649.43.6.1428>.
- Dupere, V., Leventhal, T., Crosnoe, R., & Dion, E. (2010). Understanding the positive role of neighborhood socioeconomic advantage in achievement: The contribution of the home, child care and school environments. *Developmental Psychology*, *46*, 1227–1244. <https://doi.org/10.1037/a0020211>.
- Farver, J. A. M., Xu, Y., Eppe, S., Fernandez, A., & Schwartz, D. (2005). Community violence, family conflict, and preschoolers' socioemotional functioning. *Developmental Psychology*, *41*, 160–170. <https://doi.org/10.1037/0012-1649.41.1.160>.
- Finkelhor, D., Turner, H., Ormrod, R., Hamby, S., & Kracke, K. (2009). Children's exposure to violence: A comprehensive national survey. *Juvenile Justice Bulletin*. Washington, DC: U.S. Department of Justice. In *Office of Justice Programs*.
- Finno-Velasquez, M., He, A. S., Perrigo, J. L., & Hurlburt, M. S. (2017). Community informant explanations for unusual neighborhood rates of child maltreatment reports. *Child and Adolescent Social Work Journal*, *34*, 191–204. <https://doi.org/10.1007/s10560-016-0463-3>.
- Gelman, A., Hill, J., & Yajima, M. (2012). Why we (usually) don't have to worry about multiple comparisons. *Journal of Research on Educational Effectiveness*, *5*, 189–211. <https://doi.org/10.1080/19345747.2011.618213>.
- Grobe, D. & Weber, R.B. (2014). 2014 Oregon child care market price study. Retrieved from: www.oregon.gov/DHS/ASSISTANCE/CHILD-CARE/.../2014-Market-Rate-Study.pdf
- Gustafsson, J. E., Nilsen, T., & Hansen, K. Y. (2016). School characteristics moderating the relation between student socio-economic status and mathematics achievement in grade 8. Evidence from 50 countries in TIMSS 2011. *Studies in Educational Evaluation*, *57*, 16–30. <https://doi.org/10.1016/j.stueduc.2016.09.004>.
- Hanson, M. J., Miller, A. D., Diamond, K., Odom, S., Lieber, J., Butera, G., & Fleming, K. (2011). Neighborhood community risk influences on preschool children's development and school readiness. *Infants & Young Children*, *24*, 87–100.
- Hatfield, B. E., Lower, J. K., Cassidy, D., & Faldowski, R. (2015). Inequities in access to quality early care and education: Associations with funding and community context. *Early Childhood Research*, *30*, 316–326. <https://doi.org/10.1016/j.ecresq.2014.01.00hjm>.
- Hurlburt, M.S., Finno-Velasquez, M., He, A.S., Supranovich, R., (2017). *Social contextual differences in neighborhood areas with atypically high and atypically low rates of child maltreatment referrals*. Paper Presented at the Society for Social Work Annual Conference. New Orleans, LA.
- Jackson, C. K., Johnson, R. C., & Persico, C. (2016). The effects of school spending on educational and economic outcomes: evidence from school finance reforms. *The Quarterly Journal of Economics*, *131*, 157–218.
- Jeon, L., Buettner, C. K., & Hur, E. (2014). Family and neighborhood disadvantage, home environment, and children's school readiness. *Journal of Family Psychology*, *28*, 718–727. <https://doi.org/10.1037/fam0000022>.
- Kimbo, R. T., & Denney, J. T. (2015). Transitions into food insecurity associated with behavioral problems and worse overall health among children. *Health Affairs*, *34*, 1949–1955. <https://doi.org/10.1377/hlthaff.2015.0626>.
- Kindig, D., & Stoddart, G. (2003). What is population health? *American Journal of Public Health*, *93*, 380–383 <http://ajph.aphapublications.org/doi/full/10.2105/AJPH.93.3.380>.
- Knudsen, E. L., Heckman, J. J., Cameron, J. L., & Shonkoff, J. P. (2006). Economic, neurobiological, and behavioral perspectives on building America's future workforce. *Proceedings from the National Academy of Sciences*, *103*, 10155–10162. <https://doi.org/10.1073/pnas.0600888103>.
- Lai, C. F., Alonzo, J., & Tindal, G. (2013). *EasyCBM® reading criterion related validity evidence: Grades K-1 (Technical Report No.1309)*. Eugene, OR: Behavioral Research and Teaching, University of Oregon.
- Layzer, J. I., Goodson, B. D., Bernstein, L., & Price, C. (2001). National evaluation of family support programs. *Final report volume A: The meta-analysis*. Retrieved from <http://files.eric.ed.gov/fulltext/ED462186.pdf>
- Lesaux, N. K., Vukovic, R. K., Hertzman, C., & Siegel, L. S. (2007). Context matters: the interrelatedness of early literacy skills, developmental health, and community demographics. *Early Education and Development*, *18*, 497–518. <https://doi.org/10.1080/10409280701610861>.
- Levine, P. B., & Schanzenbach, D. W. (2009). The impact of children's public health insurance expansions on educational outcomes. Retrieved from: www.nber.org/papers/w14671
- Lipscomb, S. T., Schmitt, S. A., Pratt, M., Acock, A., & Pears, K. (2014). Living in non-parental care moderates effects of prekindergarten experiences on externalizing behavior problems in school. *Children and Youth Services Review*, *40*, 41–50.

- McClelland, M. M., & Morrison, F. J. (2003). The emergence of learning-related social skills in preschool children. *Early Childhood Research Quarterly*, *18*, 206–224.
- McClelland, M. M., Acock, A. C., Piccinin, A., Rhea, S. A., & Stallings, M. C. (2013). Relations between preschool attention span-persistence and age 25 educational outcomes. *Early Childhood Research Quarterly*, *28*, 314–324. <https://doi.org/10.1016/j.ecresq.2012.07.008>.
- McCoy, D. C., Raver, C. C., & Sharkey, P. (2015). Children's cognitive performance and selective attention following recent community violence. *Journal of Health and Social Behavior*, *56*, 19–36. <https://doi.org/10.1177/0022146514567576>.
- Morrissey, T. W., & Vinopal, K. M. (2018). Neighborhood poverty and children's academic skills and behavior in early elementary school. *Journal of Marriage and Family*, *80*(1), 182–197. <https://doi.org/10.1111/jomf.12430>.
- Muthén, B. O., & Muthén, L. K. (1998–2011). *Mplus [Computer software]*. Los Angeles, CA.
- Nurse, J., & Edmondson-Jones, P. (2007). A framework for the delivery of public health: An ecological approach. *Journal of Epidemiology and Community Health*, *61*, 555–558. <https://doi.org/10.1136/jech.2005.039073>.
- Oregon Behavioral Risk Factor Surveillance System. (2012). *Selected Topics by County, 2008–2011*. Retrieved from <https://public.health.oregon.gov/BirthDeathCertificates/Surveys/AdultBehaviorRisk/county/Pages/0811.aspx>
- Oregon Department of Human Services. (2014). *2013 Child Welfare Data Book*. Retrieved from <https://www.oregon.gov/DHS/CHILDREN/CHILD-ABUSE/Documents/2013-data-book.pdf>
- Oregon Public Health Assessment Tool. (2015). *Birth risk factors: Percent of births for which birth risk factor is present*. Retrieved from <https://ophat.public.health.oregon.gov>
- Oregon Uniform Crime Reporting. (2014). *Section 4 Statewide Behavioral Crimes Offense and Arrest Profile*. Retrieved from <https://www.oregon.gov/osp/CJIS/docs/2012/Section%204%20Statewide%20Behavioral%20Crimes%202012.pdf>. Accessed 15 July 2015.
- Pears, K. C., Kim, H. K., Fisher, P. A., & Yoerger, K. (2013). Early school engagement and late elementary outcomes for maltreated children in foster care. *Developmental Psychology*, *49*, 2201–2211. <https://doi.org/10.1037/a0032218>.
- Pettersson, M., & Albers, A. B. (2001). Effects of poverty and maternal depression on early child development. *Child Development*, *72*, 1794–1813. <https://doi.org/10.1111/1467-8624.00379>.
- Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models*. Thousand Oaks, CA: Sage Publications.
- Reid, J. L., & Ready, D. D. (2013). High-quality preschool: The socio-economic composition of preschool classrooms and children's learning. *Early Education and Development*, *24*, 1082–1111. <https://doi.org/10.1080/10409289.2012.757519>.
- Reynolds, A. J., & Ou, S. (2011). Paths of effects from preschool to adult well-being: A confirmatory analysis of the Child-Parent Center Program. *Child Development*, *82*, 555–582.
- Segal, A., & Bruner, C. (2004). *Improving school readiness outcomes: Lessons from six communities*. Baltimore, MD: Annie E. Casey Foundation Retrieved from: <http://www.aecf.org/m/resourcedoc/aecf-ImprovingSchoolReadinessOutcomesLessonsfromSixCommunities-2004.pdf>.
- U.S. Department of Health and Human Services. (2018). *Centers for Disease Control and Prevention, National Center for Health Statistics, Division of Vital Statistics, Natality public-use data 2007–2016, on CDC WONDER Online Database*. Available from <http://wonder.cdc.gov/natality-current.html>
- U.S. Census Bureau. (2014a). *Poverty status of related children under 18 years, 2009–2013 American Community Survey 5-year estimates*. Retrieved from https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_5YR_B17006&prodType=table. Accessed 26 August 2015.
- U.S. Census Bureau. (2014b). *Health insurance, 2009–2013 American Community Survey 5-year estimates*. Retrieved from https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_5YR_B27001&prodType=table. Accessed 9 July 2015.
- U.S. Census Bureau. (2014c). *Receipt of supplemental security income, cash public assistance income, or food stamps/SNAP, 2009–2013 American Community Survey 5-year estimates*. Retrieved from https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_5YR_B09010&prodType=table. Accessed 9 July 2015.
- U.S. Census Bureau (2014d). *Unemployment, 2009–2013 American Community Survey 5-year estimates*. Retrieved from https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_15_5YR_S2301&prodType=table. Accessed 8 July 2015.
- U.S. Department of Education. (2011). *Comparability of state and local expenditures among schools within districts: A report from the study of school-level expenditures*. <https://www2.ed.gov/rschstat/eval/title-i/school-level-expenditures/school-level-expenditures.pdf>
- U.S. Department of Health and Human Services. (2013). Administration for Children and Families, Administration on Children, Youth and Families, Children's Bureau. *Child maltreatment 2012*. Available from <http://www.acf.hhs.gov/programs/cb/research-data-technology/statistics-research/child-maltreatment>.
- Weiland, C., & Yoshikawa, H. (2014). Does higher peer socio-economic status predict children's language and executive function skills gains in prekindergarten. *Journal of Applied Developmental Psychology*, *35*, 422–432. <https://doi.org/10.1016/j.appdev.2014.07.001>.
- Yudron, M., Jones, S. M., & Raver, C. C. (2014). Implications of different methods for specifying classroom composition of externalizing behavior and its relationship to social-emotional outcomes. *Early Childhood Research Quarterly*, *29*, 982–991. <https://doi.org/10.1016/j.ecresq.2014.07.007>.