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Social Ecological Factors Influencing Children's School Readiness in Low-Income South African Communities

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ABSTRACT

Research Findings: School readiness is highly salient in South Africa (SA), a country with extreme and persistent inequities that undermine early childhood development. The aim of this short-term longitudinal study was to identify social ecological factors associated with school readiness in young children from low-income settings in Cape Town, SA. Participants were 152 3–5-year-old children (55% female, not attending early childhood care and education (ECCE) settings at recruitment) and their primary adult caregiver from low-income settings. Linear regressions found that, compared to home- and community-level factors, child-level factors were the strongest predictors of scores on the International Development and Early Learning Assessment (IDELA, total and subscale scores for literacy, numeracy, social emotional, and motor). At the child level, attending ECCE services was the strongest predictor, followed by early numeracy and age. Household socioeconomic status positively predicted social emotional scores; dysfunction in the parent–child relationship negatively predicted literacy and total school readiness scores. *Practice or Policy:* These findings contribute to a contextually relevant understanding of school readiness in low-income SA settings. Greater understanding can lead to more effective mitigation of risks and amplification of protective factors within policy and practice so that early childhood development can be optimized in these settings.

Introduction

The early years of life, from birth to approximately five years old, are a critical period for the development of children (Black et al., 2017). It is crucial for children to receive nurturing care at this age, which includes responsive caregiving, as well as health, nutrition, early learning, safety, and security (Britto et al., 2017). However, children in low- and middle-income countries (LMICs) experience multiple risks that can negatively impact their developmental and educational outcomes (Lu et al., 2020). It is estimated that 250 million young children are at the risk of not meeting their developmental potential (Black et al., 2017), and approximately 53 million children, mostly in LMICs, have a developmental disability (Global Research on Developmental Disabilities Collaborators, 2018). More recent evidence indicates that 181.9 million 3–4-year-old children are not receiving the minimally adequate nurturing care that is needed to mitigate these risks to development in LMICs (McCoy et al., 2022).

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While this evidence distinguishes between high-income countries (HICs) and LMICs, there is an increasing preference to instead refer to Minority and Majority World countries; the term Majority World refers to countries which, combined, contain most of the global population (Alam, 2019; Khan et al., 2022). This is also preferred to non-WEIRD (Western, Educated, Industrialized, Rich, Democratic) versus WEIRD countries (Henrich et al., 2010a, 2010b). While there is indeed overlap across these characterizations, the Majority/Minority World distinction better highlights the under-representation of the majority of children in global child development resourcing, research, and the publication biases that arise from this (Draper et al., 2022).

School Readiness: Definition and Influencing Factors

School readiness is a holistic concept that captures various domains of development in early childhood (National Research Council, 2008, Pisani et al., 2018). Although many definitions exist (UNICEF, 2012), school readiness has been described as knowledge, skills, and abilities that children need to succeed at school (Carlton Latorre & Winsler, 1999; Lemelin et al., 2007). The domains encompassed in school readiness often entail early numeracy, language and literacy skills (Duncan et al., 2007), cognitive skills, self-regulation, social emotional skills, sustained attention skills, and motivation (Blair & Raver, 2015; Duncan et al., 2018; Lin et al., 2003; Pisani et al., 2018). Bronfenbrenner's social ecological model of human development (Bronfenbrenner, 1977) provides a useful theoretical framework for understanding how school readiness is influenced by individual (child) level factors, as well as factors in the home and community contexts. Such an ecological perspective provides insights into how the provision of nurturing care can positively impact developmental trajectories through increasing developmentally beneficial experiences, reducing the harmful impacts of multiple adversities, and augmenting resilience (Tomlinson et al., 2019, 2021).

Much of what is known about school readiness is from Minority World countries, although there is an emerging body of evidence on factors influencing school readiness in Majority World countries. A frequently studied child factor influencing school readiness in this literature, for instance, is executive function (EF), which has been shown to be positively associated with school readiness in mostly Minority World countries (Becker et al., 2014; Fitzpatrick et al., 2014; Nayfeld et al., 2013; Pellicano et al., 2017; Willoughby et al., 2019), and in some Majority World countries (Cook et al., 2023). Child exposure to early childhood care and education (ECCE) services has also been shown to be positively associated with child school readiness in Majority World countries (Baker-Henningham, 2014; T. W. Brown et al., 2014; McCoy et al., 2017; Rao et al., 2017; Yoshikawa & Kabay, 2015). In terms of home (and family-related) factors in these countries, maternal supportive discipline has been found to positively correlate with school readiness (Lohndorf et al., 2021). Conversely, physical punishment (Cuartas, 2021; Cuartas et al., 2019, 2021), exposure to household violence (Jeong et al., 2020; Laurenzi et al., 2020) and exposure to community violence show detrimental associations with children's development in Majority World countries (Falconer et al., 2021).

School Readiness in the South African Context

School readiness is a highly salient issue in South Africa (SA), a Majority World country (and LMIC) with extreme and persistent inequities that undermine early child development. Similar to other Majority World countries (Draper et al., 2022), child development research from SA is underrepresented in the literature. There is also good reason to believe that extant findings from Minority World contexts cannot simply be assumed to apply to this context. In SA, legacies of colonialism and apartheid continue to contribute to the vulnerability of low-income communities (Strauss, 2019) where intergenerational trauma is frequently experienced (Adonis, 2016). Despite efforts to address inequities in SA, education systems remain highly dysfunctional, and much more needs to be done to improve the quality of early childhood development services in order to adequately prepare children

for school and address community poverty that adversely affects children's preparedness for school (Venter, 2022).

While there is recognition of the contested and multidimensional nature of school readiness in this country (Munnik et al., 2021), there is a history of controversy around its measurement, especially in relation to appropriate norms and how it was used historically in an exclusionary and inequitable manner (Amod & Heafield, 2013). Aside from these controversies, there is recognition that a significant portion of SA young children are not being adequately prepared for school, either academically or from a social and emotional perspective, particularly in low-income settings (Chikwanda et al., 2022). Earlier studies showed similarly concerning results regarding poor school readiness performance (Draper et al., 2012; Janse van Rensburg, 2015). Recent national data show that only 45% of 4–5-year-old SA children are on track for early learning (including early literacy, numeracy skills, and cognitive development), with 65% of SA children attending ECCE services facing barriers to thriving (Giese et al., 2022; Tredoux et al., 2023). These studies highlight social emotional development as positively associated with learning outcomes and with "positive deviance" – i.e. children performing well, despite challenging circumstances (Giese et al., 2022; Henry & Giese, 2023; Tredoux et al., 2023); however, recent research has identified numerous risks to the social emotional development of young and vulnerable SA children (Draper et al., 2024). In terms of motor skills, another domain of school readiness, a number of studies with children in low-income communities have found that children have adequate motor skills (Cook et al., 2019; Draper et al., 2012, 2020; Tomaz, Jones, et al., 2019; Tomaz, Prioreschi, et al., 2019; Van Heerden et al., 2017), which is a contrast to typical findings in many Minority World contexts (Barnett et al., 2016).

Adopting a social ecological perspective to understand factors influencing school readiness is highly relevant in SA, but research investigating broad social ecological factors influencing school readiness in SA children from low-income settings is limited. As isolated predictors from a single sphere of influence, there is some support for the school readiness of SA children being positively associated with EF (Cook et al., 2023), parental education, the child living with both parents, parents being married (du Toit et al., 2021), and the quality of the home learning environment (Dawes et al., 2020). In addition, caregivers' perceptions of social ecological factors influencing early childhood development have been qualitatively explored, in which caregivers spoke about their role developing, nurturing, providing, protecting, and disciplining their children. At the home level, risks to school readiness include low socioeconomic status, dysfunctional relationships, and caregiver mental health; resources related to early learning and social support (Draper et al., 2023). At the community level, risks include violence and crime; resources mentioned were social support, community programs, and infrastructure (Draper et al., 2023). Qualitatively, caregivers, ECCE educators, and health professionals point to school readiness being negatively impacted by unemployment, low socioeconomic status, violence, trauma, and substance abuse and that school readiness is positively influenced by parents as role models, child-rearing practices, parenting styles, and caregiver literacy (Munnik & Smith, 2019).

The Current Study

While concerns of school readiness in low-income SA settings are a highly pertinent issue that requires new and further evidence to redress, the literature on social ecological factors associated with school readiness in these settings remains limited. Therefore, this study aimed to identify the social ecological factors associated with school readiness in young children from low-income settings in Cape Town, SA. This study thus intended to answer the following exploratory research question: What social ecological factors, at the child, home, and community levels, predict school readiness as an overall construct, as well as specific domains of school readiness (literacy, numeracy, social emotional, and motor development)?

Methods

Study Design

The data reported in this paper derive from a larger short-term longitudinal study aimed at understanding the barriers and potential of early childhood education in four low-income SA settings, with a focus on executive function and early numeracy. Data collection (for data presented in this paper) took place at two timepoints: time 1, from August 2020 to April 2021, and time 2, approximately 7 months later, from May to November 2021. Other data from the longitudinal study have been published elsewhere (Cook et al., 2022; Draper et al., 2023; Merkley et al., 2023).

Participants and Recruitment

This study included 152 children aged 3- to 5-years (M_{age} = 57.92; 55% female) from the study sites and the primary adult caregiver of each child (n = 152, >18 years old; M_{age} = 37.80 years). Children who were not attending ECCE services at the first-time point were recruited, as they represent a particularly vulnerable group that remains understudied, and constitute a significant proportion (30%) of the population of 3–5-year olds in SA (Hall et al., 2019). Children not in ECCE services are likely at a higher risk for poor school readiness. We have not collected nor reported on the race/ethnicity of the participants in this study, given that reporting on race/ethnicity in South Africa is highly problematic. Due to the country's history of colonialism and apartheid, race/ethnicity and socioeconomic status remain highly conflated. Specifically, reporting on race/ethnicity in this context can be seen to imply that there is some underlying biological contribution of race/ethnicity to the outcomes reported in this paper.

Participants were recruited through a community-based organization (facilitated through the organization's home visitors, who implement a home-based stimulation program for children typically not attending ECCE services) from four low-income communities within the Cape Town Metropolitan area. Participants were recipients of this program. Two of the communities consist of mostly informal housing and with high levels of overcrowding (population density of 16,957.67 per km^2 and 10,120.31 per km^2) (Statistics South Africa, 2012). Other challenges include high rates of unemployment, food insecurity, alcohol abuse, crime, and HIV. The other two communities consist of both formal and informal housing, and the population density ranged between 4255.94 per km^2 and 16,553.99 per km^2. Gang activity and drug abuse are major challenges in these communities, in addition to high rates of unemployment, crime, and food insecurity (Statistics South Africa, 2012).

Statistical power for bivariate correlations and regression models was computed using G*power 3.1 (Faul et al., 2007). A priori analyses revealed that, for bivariate correlations, a sample exceeding 115 participants would be satisfactory for alpha = .05, and power = .95 to detect an effect size of .3. For multiple regressions, a sample exceeding 222 would be satisfactory, for alpha = .05, power = .95, and 20 potential predictor variables, to detect an effect size of .15. The sample was therefore initially intended to be at least 250 children, to be sufficiently powered to study the longitudinal relations between executive function and school readiness and account for potential attrition. From the initially recruited sample of 243, 60 dyads could not be included in the final analyses. Reasons for insufficient data capture for current analyses were as follows: 11% lost due to inability to reach the caregiver and child in person at time 1 (due to COVID-19 lockdowns, some of the caregiver interviews needed to be pursued telephonically, see Supplementary Figure 1) and a further 22% at time two. Reasons for this loss to follow up varied, including the change of phone number, losing their phone, or moving out of the community. Participants lost to follow up did not differ significantly in child age, caregiver age, caregiver education, household assets, exposure to violence, or the home learning environment.

Demographic data that was missing at Time 1 (including child age, child sex, and caregiver education) but available at Time 2 was inferred to maximize the available data. Missing data on other variables (school readiness, executive function, numeracy, exposure to violence; exposure to education; outlined below) were very low (<2%). Furthermore, due to the sensitivity of this data to

other factors (such as potential impacts of demographic variables, especially age, on developmental outcomes), it was decided that imputation of missing data was not a reasonable solution. Little's test (R. J. A. Little, 1988) refuted the assumption that the data were Missing at Random and because the missingness may depend on covariates, such as exposure to community violence, analysis of complete cases is a more conservative approach less prone to bias (R. J. Little et al., 2024).

The final sample of 152 included all child caregivers for whom complete datasets were available for variables of interest. A post hoc power analysis revealed that $N = 152$ and alpha .05, provided sufficient power (power = .98) to detect bivariate correlations of an effect size of .3. However, for alpha = .05, and 20 predictors, the power was less than satisfactory (power = .78) for multiple regression to detect an effect size of .15. We therefore opted to explore bivariate correlations between variables that were conceptually relevant to the socio-ecological model and then enter into multiple regression a reduced set of predictor variables. To convey precise estimates of effect size, we committed to reporting standardized beta coefficients for each of the predictor variables entered in the models.

Data Collection

All testing was conducted by trained research assistants who could speak the home language of the participants (isiXhosa, English, or Afrikaans). Testing was done in-person with children and caregivers, either at home or at a central community venue (necessary for safety reasons). Incentives for participation were provided (grocery voucher), as well as transport reimbursement where necessary. COVID-19 pandemic restrictions meant that some data collection from caregivers (and recruitment) needed to be telephonically (except direct child measures) until it was safe to meet in-person (see Supplementary Figure S1).

Measures

The International Development and Early Learning Assessment (IDELA, https://idela-network.org), a direct assessment intended for use with children three to six years of age, was used to assess school readiness at time 2 (Pisani et al., 2018). The IDELA has been shown to be a valid and reliable tool with good internal consistency (average Cronbach's alpha across 11 diverse sites between 0.75 and 0.91) for both the total and subscale scores (Pisani et al., 2018). It has been found to be feasible for use in a diverse range of low-income settings (Halpin et al., 2019; Pisani et al., 2018) and has shown to be predictive of later academic performance (Pisani et al., 2022). These characteristics make the IDELA an appropriate assessment of school readiness in low-income SA settings, although this is the first study to publish results of its use with SA children. The IDELA produces a total score and subscale scores for literacy, numeracy, social emotional, and motor (fine and gross) domains. The IDELA was translated into isiXhosa and Afrikaans with small adaptations to wording to ensure contextual relevance. The standard scoring procedures outlined by the developers were followed to calculate the percentage of correct items in each subscale. The IDELA includes an EF subscale, but this was not included in the current study as we were using a different tool to assess EF.

The executive function was assessed at times 1 and 2 using the Early Years Toolbox (EYT), which is a collection of iPad-based direct assessments for preschool-age children. It includes measures of inhibition (Go/No-Go), working memory (Mr Ant), and shifting (Card Sorting) (Howard & Melhuish, 2017). Previous research has provided validity and reliability evidence for EYT in South African data (Cook et al., 2019; Draper et al., 2020; Howard et al., 2020). All EYT tasks included integrated audio instructions translated into local languages for consistent sequencing and timing of tasks.

Early numeracy was assessed at times 1 and 2 using the Give-N task, which is used to reliably measure children's cardinality knowledge (Marchand et al., 2022; Wynn, 1990), and requires the tester to ask the child to give toy sets of different numbers of objects. For this study, soft toy dogs were used by testers, and children were asked to give up to eight sticks to the dog, and the number asked for was adjusted based on their response. The Give-N score is the highest N that they gave correctly, and

children were considered an N-knower if they correctly gave that number of items twice, and incorrectly gave the next highest number twice.

The caregiver questionnaire administered at times 1 and 2 included demographic, socioeconomic, and household details, as well as questions to assess the home learning environment, parent and family adjustment, and child exposure to community violence. Caregivers were asked to indicate their education level (number of years of school completed [used as a predictor variable in analyses], whether they completed high school). To assess socioeconomic status, items (number of household assets and income range) were used from the National Income Dynamics Survey (http://www.nids.uct.ac.za). Caregivers were asked to provide their child's age and sex and to indicate at time 2 if they were attending ECCE services. For this timepoint, this could have included their reception year (Grade R) at the school, which children attend in the year they turn six years old. Grade R is essentially part of pre-primary education in SA, even though many Grade R programs are offered in independently run preschools as well.

The Home Learning Environment (HLE) scale, reliable and adapted for use in SA (Dawes et al., 2020, 2021, 2023), was used to evaluate factors within the home environment associated with learning. This survey draws on the UNICEF Multiple Cluster Index Survey for children under 5 years (www.mics.unicef.org/tools) and the Home Learning Environment questionnaire (Melhuish et al., 2008) and was adapted to include resources that may be available in the home of SA children. The HLE scale includes frequency of home learning activities and books and toys in the home. For home learning activities (e.g. reading, playing, singing, telling the name of things, taking the child outside the home, counting things, drawing, or painting things), caregivers were asked to report whether in the past week they, or another household member, engaged in these activities with their children *never* (coded 0), *sometimes* (coded 1) or *many times* (coded 2). Scores for each activity were combined to form a total score, with a higher score indicating a higher frequency of home learning activities. Caregivers were also asked if children had books, homemade toys, toys from a shop, or used household objects (e.g. bowls, pots, or bottle tops) or objects found outside (such as sticks or leaves) as toys. Caregivers responded with either *yes* (coded 1) or *no* (coded 0). If caregivers responded *yes* to having books, they were asked to give the number of books they had in the home (*N* books). The *N* number of books was combined with the responses for having homemade toys, toys from a shop, and household objects to form a total score for resources in the home. Further details about the use of this scale in this study have been published elsewhere (Merkley et al., 2023).

The Parenting and Family Adjustment Scales (PAFAS; Sanders et al., 2014), a 30-item inventory, was used to assess parenting practice and family adjustment. It has previously been used in South Africa with a similar sample of child and caregiver pairs from low-income settings (Donald et al., 2018). Each item is rated on a 4-point scale from 0 (not true at all) to 3 (very much true), referring to the past four weeks. Scores are summed to yield a total score, as well as subscale scores for parental consistency, coercive parenting, positive encouragement, parent–child relationship, family adjustment, and parental adjustment; a higher score indicates higher levels of dysfunction. Of note, the overall scale and subscales varied widely in internal consistency, with only the parent-child relationship showing sufficient (>0.70) internal consistency with a Cronbach's alpha of 0.80. Therefore, only the parent–child relationship subscale was used in the later regression analyses.

The Child Exposure to Community Violence checklist (CECV; Martin et al., 2013) was used to assess the child's exposure to violence in the past year and was adapted from the "Things I have seen and heard scale" to be more contextually relevant in SA. This contains 29 questions about whether a child has witnessed or experienced general violent/criminal acts, family and non-family violence, and or had feelings/experiences of not being safe. Questions are answered on the following scale: never; once; twice; three to ten times; more than ten times. If caregivers indicated they did not know, this was scored as never. This yielded a total score whereby a higher number indicates higher exposure to community violence. The total CECV showed acceptable internal consistency with a Cronbach's alpha of 0.72. Subscales from the total score were also calculated and included the witnessing of general violent/criminal acts (CECV factor 1), directly experiencing

and witnessing family and non-family violence and threats of physical harm (CECV factor 2), and experiencing non-family sexual abuse and general feelings of unsafety (CECV factor 3). The internal consistency of the subscale CECV factor 1 was good with a Cronbach's alpha of 0.70. CECV factors 2 and 3 however showed poor internal consistency with Cronbach's alphas of 0.43 and 0.25, respectively. Due to the poor internal consistency, only the total CECV score was used in the analysis.

Data Analysis

Data were analyzed using Stata (StataCorp. 2021. *Stata Statistical Software: Release 17*. College Station, TX: StataCorp LLC). Exploration of the data indicated that assumptions of planned analyses (i.e., normality and collinearity) were met. Outliers were identified by calculating z-scores for each variable, with values greater than 3 standard deviations from the mean (both above and below) considered extreme outliers. It was decided that trimming outliers was not warranted for this study given the smaller sample size, as it would result in a loss of information, and biased parameter estimates. To assess the robustness of our findings to the influence of outliers, we performed sensitivity analyses by running regression models with and without outliers. The regression models with outliers did not significantly differ from those excluding outliers with coefficients and p-values of key variables remaining consistent across both models. Pearson correlation coefficients were calculated to inspect bivariate correlations and multicollinearity between variables and are included as supplementary material (Table S1).

Given the high number of potential independent variables, not all could be included in the regressions so as to avoid overfitting the model. To determine which variables from the child, household, and community levels were most relevant for inclusion in the regressions, individual regressions were first conducted for each independent variable with the dependent variable (IDELA scores). Following this, multicollinearity among the variables was assessed. Based on these results, the home learning environment variables and caregiver years of schooling were excluded (excluded variables are flagged visually in Table S1). Sensitivity analyses were conducted by running regressions both with and without the excluded variables. The results of these models were consistent, indicating that the exclusion of these variables did not significantly affect the findings.

These regressions were used to assess the prediction of the child-, home-, and community-level (specifically, community risk) factors at time 1 on the IDELA total and domain scores (i.e., literacy, numeracy, social emotional, and motor) at time 2. Regression models were estimated using ordinary least squares. This was done instead of using a fixed effects model as there were no significant changes in the key variables from time 1 to time 2. The final variables selected for model 1 (child factors) included age, sex, attending ECCE services, inhibition, cognitive flexibility, working memory, and early numeracy (Give-N) as predictors of IDELA total and subscale scores at time 2. Model 2 (child + home factors) included model 1 factors plus household assets and parent–child relationship (PAFAS subscale). Model 3 (child + home + community risk) included model 1 and 2 factors plus the CECV total score. In addition to the sequential regressions, simultaneous regressions were conducted for each IDELA subscale and total score to test whether the order of sequential models influenced the significance of the predictors or not.

Ethics Approval

This study adheres to the guidelines explained in the Declaration of Helsinki Ethical Principles for Medical Research Involving Human Subjects. This study was approved by the Human Research Ethics Committee (Medical) of the University of the Witwatersrand (reference: M200104). Written informed consent was provided by all participants (parent/caregiver consent for children).

Transparency and Openness

The study design and analysis were not pre-registered. We report how we determined our sample size (and the impact of the COVID-19 on achieving this sample size, see Supplementary Figure 1), all data exclusions (if any), all manipulations, and all measures in the study. We have followed the Journal Article Reporting Standards (Kazak, 2018). We do not have ethical approval to share data, but analysis code can be made available on request to the authors.

Results

Key descriptive characteristics of the sample ($n = 152$) are presented in Table 1; additional descriptive characteristics are provided in Table 2. Home languages of participants were English (33.1%), isiXhosa (48.7%), Afrikaans (43.6%), and others (0.7%); more than one language was indicated as being spoken at home for some participants. The simultaneous regressions revealed the same results as model 3 in the sequential regressions with the same predictors being significant. Simultaneous regression results are included as supplementary material (Tables S2–S6)

Sequential Linear Regression Results

Model 1 (child factors; Table 3) was significant ($p < .001$), explaining 55% of the variance in IDELA total scores. Model 2 (child + home factors) was also significant ($R^2 = .575$, $p < .001$) and accounted for an additional 2.4% of the variance. Similarly, model 3 (child + home + community) was significant ($R^2 = .584$, $p < .001$) and accounted for an additional 1% of the variance. In the final model (Model 3), the significant predictors were, in order of decreasing strength: attending ECCE services ($\beta = .349$, $p < .001$); child early numeracy ($\beta = .255$, $p < .001$); child age ($\beta = .178$, $p = .008$), and child cognitive flexibility ($\beta = .166$, $p = .007$). Parent–child relationship (with a higher score indicative of higher dysfunction) was only a significant predictor in model 2 ($\beta = -.114$, $p = .049$; i.e., higher dysfunction predicted a lower total score).

Results on the sequential linear regressions for the subscales are provided as supplementary material (Tables S7–S10). However, to summarize, model 1 significantly accounted for between 44% and 51% of the variance in literacy, numeracy, and motor subscales but only 21% of the variance for the social emotional subscale. Models 2 and 3 contributed to 5% or less additional variance for all subscales. At the child level, sex significantly predicted social emotional subscale scores, and cognitive flexibility and working memory significantly predicted literacy subscale scores. At the home level, the

Table 1. Descriptive characteristics of the sample.

Characteristics	Time 1	Time 2
Child age (m)	57.92 ± 6.44	65.03 ± 6.35
Child sex (female, n, %)	84 (55%)	84 (55%)
Child attending ECCE services (y, n, %)	–	89 (59%)
Caregiver age (y)	37.80 ± 11.09	39.09 ± 11.25
Caregiver relationship to child (n, %)		
Mother	108 (71.05%)	–
Grandmother	27 (17.76%)	
Father	8 (5.26%)	
Aunt	8 (5.26%)	
Other	1 (0.66%)	
IDELA (percentage scores)		
Overall score		49.68 ± 17.57
Literacy		37.69 ± 20.06
Numeracy		52.68 ± 19.23
Social emotional		48.06 ± 20.94
Motor		60.30 ± 25.93

ECCE = early childhood care and education. IDELA = International Development and Early Learning Assessment. Unless otherwise specified, data are presented as Mean ± standard deviation.

Table 2. Additional descriptive characteristics of the sample.

Child	Time 1	Time 2
Executive function		
Inhibition	0.61 ± 0.23	0.74 ± 0.21
Shifting	7.94 ± 2.12	8.32 ± 2.66
Working memory	1.62 ± 0.76	2.02 ± 0.8
Early numeracy		
Give N	3.75 ± 2.6	5.91 ± 2.52
Home and family		
Caregiver education		
Years of schooling	10.01 ± 1.82	9.96 ± 1.82
Completed high school (%)	26%	24%
Household composition		
Number of children	3.00 ± 1.51	3.02 ± 1.55
Number of adults	2.93 ± 1.54	2.89 ± 1.55
Total	5.93 ± 2.26	5.91 ± 2.26
Household assets	7.97 ± 3.00	7.89 ± 2.84
Household income (n, %)		
R750 or less	11 (7.24%)	10 (6.58%)
R750–R1500	42 (27.6%)	37 (24.34%)
R1500–R3000	55 (36.18%)	52 (34.21%)
R3000–R6000	33 (21.71%)	33 (21.71%)
R6000 or more	5 (3.29%)	5 (3.29%)
Did not answer	6 (3.95%)	15 (9.87%)
Home learning environment		
HLE frequency score (activities)	10.28 ± 2.98	12.57 ± 3.54
Books in the home (y)	100 (66%)	95 (63%)
Books and toys in the home (rating)	1.91 ± 7.77	2.00 ± 0.86
Parenting and Family Adjustment		
Parental consistency	6.26 ± 2.12	6.13 ± 2.03
Coercive parenting	5.60 ± 2.64	5.37 ± 2.39
Positive encouragement	2.76 ± 1.69	2.48 ± 1.64
Parent-child relationship	2.42 ± 2.33	2.15 ± 1.95
Family adjustment	3.65 ± 1.58	3.22 ± 2.48
Parental adjustment	5.76 ± 2.77	5.39 ± 2.51
Total score	26.46 ± 7.87	24.75 ± 6.6
Community		
Child Exposure to Community Violence		
Factor 1: General violence/criminal acts	7.97 ± 7.31	7.32 ± 7.19
Factor 2; Family and non-family violence	4.76 ± 4.48	4.07 ± 3.72
Factor 3: Feelings/experiences of unsafety	1.34 ± 2.19	1.19 ± 2.09
Total score	14.08 ± 11.12	12.58 ± 10.75

ECCE = early childhood care and education. IDELA = International Development and Early Learning Assessment. Unless otherwise specified, data are presented as Mean ± standard deviation. R1 ≈ US$ 0.0577.

household socioeconomic status significantly predicted social emotional subscale scores, and dysfunction within the parent–child (or caregiver–child) relationship predicted literacy subscale scores. At the community level, exposure to community violence significantly predicted literacy subscale scores (lower exposure associated with higher literacy), and social emotional and motor subscale scores (higher exposure was associated with higher social emotional and motor subscale scores).

Discussion

The aim of this study was to identify social ecological factors predicting school readiness in young children from low-income SA settings in order to address some of the gaps in the existing literature on factors influencing school readiness in these settings. A key finding of this study was that, in the selected settings, child level factors appear to be the stronger predictors of school readiness, whether they were modeled as a first set of predictors (in the hierarchical models) or whether they were simultaneously compared to factors at the home and community levels (in the simultaneous model). An important caveat is that this finding does not rule out the importance of home- and community-

Table 3. Sequential linear regression: IDELA total score (Percentage).

	Model 1: Child			Model 2: Child + home			Model 3: Child + home + community		
IDELA total score (percentage)	β	SE	*p*-value	β	SE	*p*-value	β	SE	*p*-value
Age in months	0.16	0.18	.015	0.18	0.18	.005	0.18	0.18	.009
Sex (boy – reference)	0.10	2.02	.093	0.09	1.98	.094	0.10	1.99	.088
Attending ECCE services (No – reference)	0.40	2.19	<.001	0.34	2.25	<.001	0.35	2.27	<.001
Executive function									
Inhibition	0.07	4.88	.262	0.09	4.89	.162	0.10	4.93	.139
Cognitive flexibility	0.15	0.5	.014	0.14	0.49	.016	0.15	0.49	.015
Working memory	0.12	1.53	.063	0.12	1.51	.067	0.12	1.51	.069
Early numeracy	0.25	0.42	<.001	0.26	0.41	<.001	0.25	0.42	<.001
	$R^2 = 0.552, p < .001$								
Household assets				0.10	0.33	.08	0.10	0.33	.070
Parent-child relationship *				−0.11	0.43	.05	−0.11	0.43	.058
				$R^2 = 0.575, p < .001, \Delta R^2 = 0.024$					
Child Exposure to Community Violence							0.044	0.09	.448
							$R^2 = 0.577, p < .001, \Delta R^2 = 0.002$		

ECCE = early childhood care and education. SE = Standard error. *Higher score = higher dysfunction.

level factors. This is because home- and community-level factors were also predictors of school readiness in this sample, and there were a small number of modest intercorrelations across levels. However, our results highlight the relative importance of child-level modifiable factors that have not always been considered in a low-income South African context.

At the child level, the strongest predictor was the child's attendance at ECCE services (at time 2), and supports existing evidence on the positive influence of exposure to ECCE services (Baker-Henningham, 2014; T. W. Brown et al., 2014; McCoy et al., 2017; Rao et al., 2017; Yoshikawa & Kabay, 2015), and the importance of ECCE services in low-income SA settings (Munnik & Smith, 2019). Although it is possible that there was an interaction between child age and ECCE attendance, the correlation coefficient between age and attending ECCE was only $r = .3$. However, further research would be helpful to explicate the interaction between age and ECCE attendance for this age group. The next strongest predictors were early numeracy and age.

Still at the child level, only cognitive flexibility predicted total IDELA scores (more precisely, cognitive flexibility and working memory were only significant predictors for literacy subscale scores). While EF has been shown to be strongly predictive of school readiness in other Minority and Majority World settings (Becker et al., 2014; Fitzpatrick et al., 2014; Nayfeld et al., 2013; Pellicano et al., 2017; Willoughby et al., 2019), it is possible that in these low-income SA settings, there are other factors fostering EF that are not being captured adequately with our current measures. This is supported by recent cross-cultural research (including South Africa) that has suggested that some children from Majority World countries, even from the lowest-SES groups in those contexts, perform comparably well on EF tasks to children in Minority World countries (Howard et al., 2020; Metaferia et al., 2021). In Majority World countries, there might be a range of EF-promoting factors in these contexts (e.g., need for vigilance, child responsibilities such as caring for siblings, and high expectation of compliance with adult instructions) that may contribute to stronger EFs that are not found in other settings that show an EF-school readiness link. In addition, EF measures have been construed as indexing potential (potential to learn, e.g., numeracy and potential to adapt to a school context), but it may be that specific exposure to content, and context, is needed in order for the potential to manifest into higher school readiness.

Some of these nuances need to be considered when assessing EF in cross-cultural contexts (Jukes et al., 2024). Another potential explanation for the limited predictive power of EF in this study is that in this sample, EF scores were largely within or above the normative range (Howard & Melhuish, 2017), as has been found in previous SA studies using this measure (Cook et al., 2019; Draper et al., 2020; Howard et al., 2020). Furthermore, while EF might be fostered naturally in these settings (Howard et al., 2020), the school readiness skills measured in the IDELA require specific instruction and input from caregivers, teachers, or

siblings. In other words, strong EF may show a child has the capacity to learn these skills successfully, but it does not mean they have learned them, as learning requires explicit exposure to content, as perhaps better captured by the numeracy index we assessed here (Give N). The measures of EF components used in the current study were decontextualized, and it is also possible that children need to be taught to leverage their relatively strong EF skills to achieve school-relevant goals. Indeed, Zelazo and colleagues argued that having strong EFs is important for learning EF-based life skills, which in turn impact outcomes such as school readiness and academic success in Minority World countries (Zelazo et al., 2024). Our findings highlight how the potential to learn (i.e., strong EF) alone may not be sufficient to influence school readiness, as exposure to relevant content, in context (e.g., via attendance of ECCE centers) is as (or more) important in our Majority World context.

Regarding the finding that child sex significantly predicted social emotional subscale scores, which is consistent with available evidence on gender differences in social emotional development (Chaplin & Aldao, 2013), largely from Minority World countries. This domain of development is increasingly being studied in Majority World countries (McCoy et al., 2019), and available evidence from Pakistan (Finch et al., 2018) is consistent with our findings. However, in a recent qualitative study in SA, neither sex nor gender emerged as salient in preschool teachers' perceptions of social emotional development (Goldschmidt & Pedro, 2020), highlighting the need for further research in SA low-income settings to better understand this developmental domain.

At the home level, our finding that the household socioeconomic status only predicted social emotional subscale scores is unexpected due to the preponderance of evidence on the negative impact of economic disadvantage on early childhood development (Black et al., 2017; Lu et al., 2020; McCoy et al., 2022; Wolf & McCoy, 2019). In addition, caregivers' perceptions of the influence of socioeconomic status on early childhood development (Draper, Cook, Howard, et al., 2023) and school readiness (Munnik & Smith, 2019) would seem to indicate that this factor would have been significant. In a study from Ghana, the involvement of caregivers in ECCE services was the primary mediating mechanism in the path from socioeconomic status to most school readiness outcomes (Wolf & McCoy, 2019), and it is possible that this could provide further insights into the seemingly limited association with socioeconomic status in this SA study.

Findings from this SA study on the more limited impact of the home learning environment on school readiness are somewhat consistent with the Ghanian study findings, where it was found that at-home stimulation was negatively associated with literacy, numeracy and motor components of the IDELA (Wolf & McCoy, 2019). There is evidence for the relationship between stimulation in the home and developmental outcomes in younger children (under 3 years old) in other African settings (Leighton et al., 2023; Okelo et al., 2024; Onyango et al., 2023; Russell et al., 2022); a meta-analysis of studies from a range of global settings showed this relationship was stronger with children over 18 months old (Yang et al., 2021). However, longitudinal data from five Majority World countries showed mixed findings regarding this relationship in our age group of interest (3–5 years) and suggested additional research is needed to better understand the diversity of stimulation in the home and how this influences child development outcomes across global contexts (Cuartas et al., 2023).

Also, at the home level, only dysfunction within the parent–child (or caregiver-child) relationship predicted the total IDELA score (and literacy subscale scores). Dysfunctional relationships were identified as a risk to early childhood development by caregivers in these SA settings (Draper, Cook, Howard, et al., 2023), and adverse experiences identified as factors negatively influencing school readiness in similar settings (Munnik & Smith, 2019) could contribute to this dysfunction. Caregiver education level did not reach significance as a predictor in this study, contrary to previous findings from SA (J. Brown & van der Merwe, 2021; du Toit et al., 2021; Munnik & Smith, 2019) and Ghana (Wolf & McCoy, 2019). Furthermore, none of the other PAFAS subscales reached the criterion as predictors of school readiness. The PAFAS coercive parenting subscale includes a question about spanking, and given the literature on the harms of physical punishment (Cuartas, 2021; Cuartas et al., 2019, 2021) and the protective role of supportive discipline (Lohndorf et al., 2021), it is surprising that this was not associated with any of the IDELA scores. It is possible that limited variation in the data and limitations in statistical power due to COVID-19 related attrition may contribute to these null associations.

At the community level, the association between exposure to community violence and literacy subscale scores was in the expected direction (i.e., lower exposure associated with higher literacy), which supports previous research regarding this risk (Falconer et al., 2021). However, the association between exposure to community violence and violence in the home with social emotional and motor subscale scores, respectively, was contrary to what would be expected (i.e. higher exposure was associated with higher social emotional and motor subscale scores). This does not align with the literature on the harmful effects of exposure to violence (Falconer et al., 2021; Jeong et al., 2020; Laurenzi et al., 2020). It is possible that in communities where violence is prevalent, there may be other stronger factors at the child, home, or community levels influencing these developmental domains, which potentially mitigate the risk that violence poses to young children's school readiness. Similarly, it is possible that limited variation in the data may contribute to unanticipated associations.

With regards to these and other unanticipated findings, it is reasonable to assume that there may be other risk and protective factors that were not measured or not adequately captured by the measures used in this study, even though contextually relevant measures were specifically selected. Other factors could include more granular measures of caregiver responsiveness (a key component of nurturing care (Britto et al., 2017)), social support, parenting styles, household chaos, community cohesion, and collectivist (versus individualistic) cultural norms that could be protective for school readiness. For example, it was observed anecdotally during this study that older children play "school" with younger children, doing activities such as counting, letter learning, and reading stories. This could be described as an extended caregiving and educational role that older children play in young children's lives. It is possible that this time spent with older children and the inclusion of younger children within the community may serve as protective factors to mitigate the impact of other risks, such as community violence.

In addition, this study did not include a specific measure of early literacy (at time 1), and future work could investigate the role of early literacy further, particularly across multi-lingual settings where it is challenging to find a contextually appropriate measurement tool. While this study aimed to apply a social ecological perspective, there are a great deal of potentially relevant factors at the child, home, community and broader societal levels that could be impacting school readiness that have not been assessed in this study. Assessing these factors from a purely quantitative perspective would likely overlook the nuances of the complex ways in which these factors operate differently across low-income settings in SA. While qualitative work has been incorporated into the larger study (Draper et al., 2023), there is scope for further work of this nature, including and perhaps especially ethnographic research, to better understand these complexities and identify the best strategies for intervention. Further limitations of this study are the limited number of settings (four communities) and sample size, which was smaller than intended due to the collection of data during the COVID-19 pandemic and the challenges of following up with caregivers, particularly if they were not in possession of a reliable mobile phone (or contact details) due to the economic challenges associated with the pandemic.

Given the complexity of the issue investigation in this study, future work with larger samples is required to more robustly investigate mechanisms and pathway effects using statistical methods such as structured equation modeling to identify predictors of school readiness in this context. Such studies could opt for a narrower approach with predictor variables to more reliably account for the mechanisms whereby features of the community and home environments (e.g. household assets) could impact school readiness outcomes. These limitations should prompt a conservative appraisal of our findings, specifically that null findings regarding home and community factors included in this study are not over-interpreted. The main strength of this study is the longitudinal (albeit short-term nature) study design that enables us to identify factors predicting school readiness in low-income SA settings more robustly.

Conclusion

The findings of this study build on the growing literature on school readiness in SA, as well as in the Majority World countries, and help to ensure that school readiness in the majority of the world's children is understood in contextually relevant ways. It should be noted that these findings may have

relevance for other vulnerable settings in SA and potentially other Majority World countries. Greater depth of understanding and insight can lead to more meaningful and effective mitigation of risks and amplification of protective factors so that early childhood development can be optimized in the Majority World. Furthermore, the application of a social ecological perspective can provide insight into the ways in which a range of factors can influence trajectories of development of competencies that equip children for school.

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The authors do not have permission to share data.

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