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Home environment, early reading, and math: A longitudinal study on the mediating role of family SES in transition from pre-primary to grade one☆

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ABSTRACT

This longitudinal study explored the role of home learning environments and family SES on children's early reading and math skills in Tanzania. Sample included 400 children – 182 boys and 218 girls, with an average age of 5.9 ranging from 62 to 73 months; and 400 parents – 314 mothers and 86 fathers from naturalised citizens/refugees and local majorities. Children's early reading (vocabulary) and math (number recognition) were assessed by the end of pre-primary and again by the end of grade one. Data were collected by MELE, Bracken's school readiness scale, and parents' questionnaire. Findings indicated that in a playbased pre-primary settings, family SES predicted children's early reading and math skills. Girls outperformed boys in math skills but not in early reading skills. However, home learning environments and family SES did not significantly predict the change in early reading or math skills from pre-primary to grade one. Further, family SES did not moderate the relationship between home learning environments and children's early reading and math skills. Parental involvements and children's mastery of the medium of instruction were vital for successful transition. Implications of these findings are discussed in a context of a developing sub-Saharan country.

1. Introduction and theoretical issues

Globally, early learning policymakers, researchers, parents, and practitioners have recently indicated specific concerns regarding the increasing learning achievement gap (OECD, 2015; SACMEQ, 2020; McCoy et al., 2017). The gap is said to exist across families of different socioeconomic statuses (Backe-Hansen, Walhovd, and Huang, 2014; Ip et al., 2016), gender (Ndijuye and Rao, 2019), and rural – urban contexts (Ndijuye & Tandika, 2022b). Although there is extensive empirical evidence on these issues in studies focusing on settings in the developed world, there are but few studies that have examined the roles of home environments on the transition of children from pre-primary to grade one in the sub-Saharan context, and Tanzania in particular. More importantly, findings from this study have implications for parents, teachers, practitioners, and policy-makers in low-and-middle-income countries in the sub-Saharan region. In this study, home environment is considered in light of both the aspect of home learning environments (HLE) and of the family socio-economic status (SES). This is because, in a context with widely undocumented homes and highly informal economies as is the case for most of sub-Saharan Africa, HLE and family SES are almost inseparable and extremely difficult to quantify (Bethel, 2016; Kafle et al., 2018).

This study was guided by cultural-historical wholeness theory (Hedegaard, 2012) which assumes that to understand the individual as being inseparably involved in diverse institutions such as the home, church, and school, one must understand that individuals are deeply anchored in the culture(s) and values of a society, and framed by the legal, economic, and political system of the state in which they happen to live. As such, individuals in their contexts can be understood on three planes: the formal societal, the general institutional, the specific level (Hedegaard, 2012). This theory establishes a dialectic relationship between culture(s) of a particular society, made up of its institutions – with their demands implied in activity settings, and persons who, when meeting specific demands, expectations, and activity settings, develop different motives, activities, and competencies (Fleer et al., 2012; Hedegaard, 2012).

Children's learning and development occurs in a specific society characterised by specific cultural practices, which then influences home

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and school learning experiences (Ndijuye, 2020). Despite the fact that Tanzania has, for example, a free and compulsory one to two years of pre-primary school education for children aged 4–6, there is a widening gap in the rate of enrolment, attrition, drop-outs and early pregnancies among school children across rural and urban areas, and family socio-economic status. For instance, in 2020 the enrolment rate was 105% in urban areas – 5% more than earlier anticipated, while it was only 87% in rural areas. In 2020, there were about 1218,603 children enrolled at pre-primary level, and 1383,817 at grade one level across the country (MoEST, 2021).

The Tanzania early childhood integrated policy focuses on holistic child development (MoEST, 2016). The custodian of pre-primary children includes various stakeholders ranging from parents, schools, social and security authorities to local communities. Pre-primary services are free, and each public primary school has a pre-primary class attached (URT, 2014). The pre-primary curriculum emphasises a play-based approach with specific focus on unstructured outdoor play with the aim of developing children's autonomy, creativity, and socio-emotional skills (MoEST, 2016). However, the grade one curriculum puts significant emphasis on the creation of highly structured learning environments to develop children's academic skills. It is important to note that pre-primary education is not an independent educational entity – each primary school in Tanzania *must* have a pre-primary class attached. The variations between these two educational experiences in the same setting may cause the home environment and family SES to thus influence children's academic skills in pre-primary and grade one in different ways.

The current 2014 Education and Training Policy in Tanzania does not discriminate by the children's gender, race, skin colour and their family's socio-economic status (United Republic of Tanzania [URT], 2014). The basic education that spans from pre-school to lower secondary school levels is free and compulsory. In 2021, there were 912,814 girls and 893,873 boys enrolled in various state pre-primary schools across Tanzania. In the same year, there were 1203,887 boys and 1238,924 girls enrolled at primary school level, and a further 1120,020 girls and 981,831 boys at lower secondary school level. There is a huge variation in teacher quality between schools located in urban and rural areas, as well as between state and private schools, with more skilled and quality teachers working in the urban private schools.

1.1. Trends on the role of family SES on early reading and maths skills

Existing empirical evidence in educational research have consistently documented the critical role of family SES and a supportive home environment when it comes to children's development and learning (Ip et al., 2016; Liu et al., 2022; Ndijuye and Tandika, 2022a). Among children from immigrant and disadvantaged groups in the sub-Saharan region, this has been found to be the most important factor in shaping children's early learning attainments (Dubeck et al., 2012; Ndijuye, 2020; Ndijuye and Tandika, 2022b). For instance, the higher level to which the parents are educated, the more complex and rich language they use with the child (Brushe et al., 2021; Lenes et al., 2022). Parents from higher SES households are reported to engage their children in more complex literacy and numeracy interactions and provide supportive feedback than those with lower levels of education (Dubeck et al., 2012; Lenes et al., 2022). These findings suggest that the noted parental behaviours have implications on child development (Bradley and Corwyn, 2003; Liu et al., 2022). As such, the home learning environment and family SES are indeed vital predictors of experiences and resources that can prepare and support children for successful formal schooling.

In Early Childhood Education and Care (ECEC) settings, studies have consistently indicated that children from a lower family SES are poorly transitioning to school than those from a higher family SES (Liu et al., 2022; Ndijuye and Tandika, 2022a; Zachrisson and Ribeiro, 2018). They have even been found to develop language skills at a much slower rate than those from a higher SES (McCoy et al., 2017). Even in the collectivist cultures such as Asia and sub-Saharan Africa, children belong to every member of the immediate community, and thus develop language much earlier due to increased interactions (Kjørholt et al., 2019; Liu et al., 2022). The findings therefore point out the vital role of family SES in children's language acquisition and development (McCoy et al., 2017; Ndijuye and Tandika, 2022a; Ren et al., 2021). In these regions, parents with a higher SES were more supportive and involved in their children's learning and development than their lower SES counterparts (Ndijuye, 2023; Ndijuye and Tandika, 2022b; Ren et al., 2021).

For over seventy-five years, there has been a debate on whether it is a school or home that makes a difference on children's learning (Coleman et al., 1966; Heyneman, 2015; Lee and. Borgonovi, 2022). While initial assumption was that determinants of students learning were the same across countries and contexts (Simmons and Alexander, 1978), later evidence from large-scale international assessment tests such as Programme for International Student Assessment (PISA), the International Association for the Evaluation of Educational Achievement's (IEA) or Third International Mathematics and Science Study (TIMSS) indicated that the level of impact could be similar across countries (Heyneman, 1976; Lee and Borgonovi, 2022). In high-income countries, variables associated with family SES such as parental education and family wealth has been consistently associated with children's learning attainments (Coleman et al., 1966; Sirin, 2005; Lee and Borgonovi, 2022). However, in low-and-middle-income countries, while family SES has implications on children's learning attainments, school-related factors such as availability of books and quality of teachers play a decisive role in learning attainments (Heyneman, 1976; Lee and Borgonovi, 2022; Ndijuye, 2023). For instance, Lee and Borgonovi (2022) examined the relationships between family SES and mathematics achievement across economically wealthy OECD and poor non-OECD countries using the 2012 PISA data set. Findings indicated that while family-related variables were strong predictors of math attainments in OECD countries, the variables were statistically insignificant among low-and-middle-income countries.

Yet, while studies have documented the implications of the differences HLE and SES can have on children's learning, it is not clearly known whether they decrease, increase, or persist by the time they start grade 1. This is because the contexts and focus of the early grades curriculum is different to that of those for pre-primary, and HLE and the child's family SES may change during the transition period (Lenes et al., 2022). There are some longitudinal studies which have reported the implications of HLE and family SES on early reading skills during pre-primary but found no relationship regarding when children were in the middle or final grades of primary school (Farkas and Beron, 2004; Niklas and Schneider, 2017). Even in high-income countries where the economy is generally stable and has relatively solid social mobility, various empirical studies have found that differences in HLE and family SES impacted the children's learning attainments during early childhood, the attainments were stable in early grades, and increased during primary school level (Passaretta and Skopek, 2018; Zachrisson and Ribeiro, 2018). Other studies indicate that these differences persist throughout the child's entire academic life (Schjølberg et al., 2008), and even later when it comes to their adulthood income (Heckman, Humphries, and Veramendi, 2018).

Poor school environments have been associated with poor learning achievements, limited socio-emotional skills, and poor job skills and performance (Cooper and Stewart, 2020; McCoy et al., 2017). However, studies have established that a supportive HLE can amend and compensate for the deficits of poor-quality schools (Coleman, 1968; Cooper and Stewart, 2020; Ndijuye, 2020; Niklas and Schneider, 2017). Such home learning activities as storytelling, parent-child book reading, singing, the parent supporting the child doing homework, and the naming of common items available in the Tanzanian local environments are all associated with improved children's skills when it comes to early reading and math (Ndijuye, 2020, 2022b).

Extensive research findings have established the relationship between HLEs and the development of the child's early numeracy and reading skills (Ndijuye and Tandika, 2022a). In a context characterised by the acute shortage of educational print materials and a scarcity of qualified early childhood teachers, as is the case in Tanzania, supportive HLEs has been singled out as one of the key factors in influencing the level of the child's early reading and math skills (Ndijuye and Rao, 2019; Niklas and Schneider, 2017). This is because parents spend more time engaged with the children in mentally-stimulating activities (McCoy et al., 2017; Ndijuye and Tandika, 2022b) and have potentially have more educational resources at their disposal (McCoy et al., 2017). Compared to the urban setting, a poor HLE for a rural child from a lower SES family in Tanzania is more challenging due to the absence of well-designed social security policies and the differences in rural-urban living standards (Kafle et al., 2018; Ndijuye, 2020; Ndijuye and Tandika, 2022b).

2. Educational context, system, and provision in Tanzania

Tanzania (URT) follows the 1(2)− 7–4–2–3 + formal educational model, in which compulsory basic education is one (or two) years of pre-primary school, seven years for primary school, four years for lower secondary school. The two years for high school and three extra tertiary levels are important levels for their further education, but are not compulsory (URT, 2014). The language of instruction in state schools from the pre-primary to the primary school levels is Kiswahili, while English is used from lower secondary school to the tertiary levels (MoEST, 2018; URT, 2014). Fig. 1,Fig. 2.

In addition to this, due to the liberalisation policies of the late 1980 s and early 1990 s in Africa, the period from 1995 to 2000 saw a decline in state school enrolment as a whole, because of the introduction of cost-sharing in education (Ndijuye, 2020). Due to the poor physical infrastructure and declining teacher quality in certain schools, most children, especially in rural areas, would go to school but not necessarily learn at their grade levels (RTI International, 2014, 2020; Uwezo, 2010, 2014, 2020). Various studies reported that most children were finishing their primary education cycle without having mastered basic reading and numeracy skills (Ndijuye and Rao, 2019; NECTA, 2020; RTI, 2014; UIS, 2020; Uwezo, 2015).

. The objective of the 2014 Education and Training Policy (URT, 2014) is to increase access to education without compromising the quality thereof, and to focus on issues related to inclusivity, class size, improved teacher training and the attrition rate (MoEST, 2021). Although children of naturalised citizens are entitled to access to compulsory and free basic education, their learning and developmental contexts are not well documented (Hovil and Lomo, 2015; Ndijuye and Rao, 2019; Ndijuye, 2020). Such educational data were not even included in the official government's Basic Education Statistics (BEST) until recently (MoEST, 2021).

3. Learning and developmental contexts of naturalised refugees/citizens in Tanzania

Tanzania hosts several millions refugees from neighbouring countries (Tanzania Ministry for Home Affairs, 2020), of which about 350,000 were naturalised as Tanzanian citizens in 2010 (MoHA, 2020). These naturalised citizens come from Burundi (82%), Somalia (8%), the Democratic Republic of Congo (4%), Rwanda (2%), Mozambique (1%), and other countries (3%) (MoHA, 2020). Until 2020, there were about 437,140 naturalised citizens of Burundian origin living in 'settlement areas' of Katumba, Mishamo and Ulyankulu, and a sizable population of them still live alongside the rural and local majority Tanzanian communities as 'self-settled refugees', specifically in villages in north-western Tanzania (Hovil and Lomo, 2015; MoHA, 2020). Until 2020, about 12,614 of the naturalised citizens of Burundian origin were children aged between 5 and 8 years old and were registered in various schools across the country (MoEST, 2021). In the same year, there were 56 qualified early grades teachers working in state-run primary schools in these settlement areas.

Recent findings have documented the learning achievement gaps between rural and urban children (Ndijuye, 2022), between genders (RTI International, 2020; Uwezo, 2020) and between marginal districts within the mainstream education system. Various national early reading and numeracy assessment tests (NECTA, 2020; RTI International, 2020; Uwezo, 2020) and empirical studies (Ndijuye and Rao, 2019) in Tanzania indicate that children of naturalised citizens early learning attainments are far better than their counterparts from majority groups. Their higher attainment has been presumed to be associated with parental beliefs and expectations (Ndijuye & Tandika; 2022a; Ndijuye and Rao, 2019) as well as with improved family living standards and a higher SES (Uwezo, 2020). However, it is not known to what extent family SES of naturalised citizens in the context of developing sub-Saharan country, mediates home environment and early reading and math.

More importantly, the complexities and debates around the roles of family SES and home learning environments on children's school readiness and their development of early numeracy and reading skills, calls for empirical findings to be collected from the context of low-and-middle-income countries. This study sheds light on these issues from Tanzania – a typical developing sub-Saharan context. The research focused on observing longitudinally development of early reading and mathematics skills among the children of naturalised citizens (self-settled and in-settlements) and urban and rural majority groups. Considering all this then, the following research questions were examined:

(1) How does the child's HLE and family SES predict early reading and mathematics skills by the end of their pre-school education and how does this change by the end of grade one?
(2) How does family SES moderate the relationship between HLE and early reading and mathematics skills by the end of preschool education and how does this change by the end of grade one?

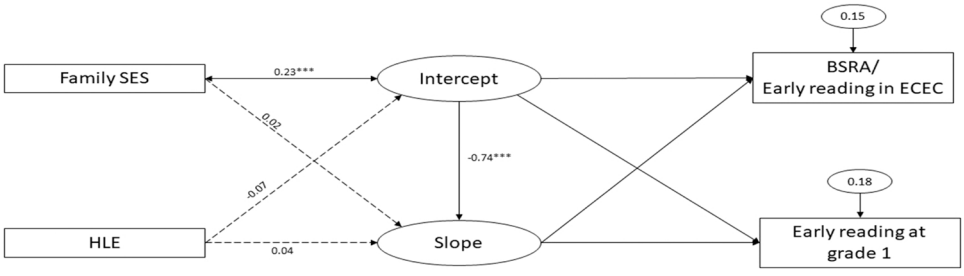

Fig. 1. Home learning environments and family SES predicting initial vocabulary and change from pre-primary to grade 1. The oval labelled intercept denotes the initial status (ECEC), and the oval labelled slope represents the difference score between pre-primary and grade 1 (measurement error was corrected). As such, predictors are allowed to correlate BSRA and EGRA tests. Dashed lines are nonsignificant, and the covariates are children's age and citizenship (immigrant) status. *$p < 0.005$, * **$p < 0.001$.

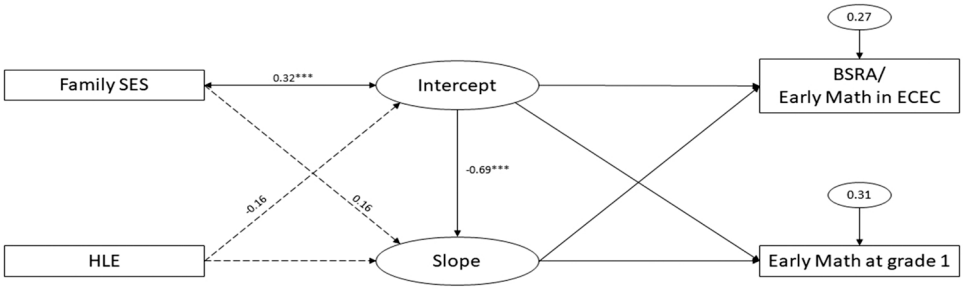

Fig. 2. Home learning environments and family SES predicting initial math skills and change from pre-primary to grade 1 on BSRA and EGMA Math tests. Dashed lines are nonsignificant, and covariates are children's age and citizenship (immigrant) status. *p < 0.05, * **p < 0.001.

4. Methodology

4.1. Study design and sampling issues

This study used a longitudinal research design to allow gaining of a broad and in-depth understanding of the contexts of children's HLEs and their family SES. Specifically, it collected both quantitative (children's tests) and qualitative (parents' interviews), whereby qualitative data clarified quantitative findings (Creswell and Creswell, 2018). Given the fact that Tanzania is such a large country, to establish differences between its various contexts, two regions were purposively selected with the following criteria: i) Holds the largest population of naturalised citizens of Burundian origin; ii) Has typical rural and urban centres inhabited by both naturalised citizens and local majorities. Based on the pre-determined selection criteria, the Kigoma and Katavi regions were selected. In the Kigoma region, we sampled the population groups of self-settled naturalised citizens and urban majority. In the Katavi region, we sampled the population groups of in-settlement naturalised citizens and the rural majority.

Because of the variations in the quality of services offered between the urban and rural contexts, three schools from each population group were instructed to administer Measuring Early Learning Environments (MELE) to control for influence of pre-school quality on children's early reading and mathematics skills. MELE is a tool used to measure the quality of pre-school services in low-and-middle income countries (UNICEF, 2017). MELE was administered in September 2020 to allow for the collection of data on children's early mathematics and reading skills by the end of pre-primary in December 2020. From each population group, one school was selected based on their MELE scores – four in total. In addition to this, 100 pre-school children and their parents were randomly selected from each school. The total sample size was 400 children and 400 parents – 204 from naturalized citizens and 196 local majority groups. The selected children were split between 182 boys and 218 girls, with an average age of 5.9 ranging from 62 to 73 months when phase one of the data collection was carried out. By the second phase of the data collection, two children had relocated to another town and thus did not participate in the study. Further, twenty parents (10 from local majority group, and 10 from naturalised citizens) were randomly selected and interviewed to gain a broad understanding of the home contexts.

5. Tools for data collection

The study adopted and used a contextualised parents' questionnaire to collect data on family SES and HLE (Rao et al., 2013). This questionnaire has been successfully used in other low-and-middle-income countries in the sub-Saharan Africa and Southeast Asian regions. While the original questionnaire consisted of five parts, this study adopted and used just three parts: the sections on demographic information, family SES, and HLE. Some irrelevant sections and/or questions were deleted or modified to meet the specific needs of this study, to reflect the Tanzania context, and to fit into the mental schema of typical sub-Saharan rural parents. For example, the questions about where children were born, immunisation, and the distance between home and school were omitted. Instead of asking whether children lived in urban or rural areas, we asked whether children were from local majorities or naturalized citizens. After contextualization of this tool, the calculated internal consistency (α) = 0.89.

Children's early mathematics and reading skills were measured by the contextualised Bracken's School Readiness Assessment (BSRA), third edition (Bracken, 2007). The BSRA is used to measure the foundational mathematics and reading skills of pre-primary school children during their preparation for formal schooling. Specifically for this study, given the aim was to measure early maths and reading skills, the items relating to certain skills were separately presented and counterbalanced. Furthermore, items relating to the development of expressive vocabulary were added. After contextualisation and the addition of said items, the calculated internal consistency came to (α) = 0.85. For this tool, the highest possible score was 40 – 20 points each for reading and math. To measure reading skills at grade one, the study used the Early Grades Reading Assessment (EGRA) which focuses on letter identification, reading common words, and comprehension (Duberk and Gove, 2015). The highest score possible was 40 points and the calculated internal consistency (α) = 0.86. To measure early math skills, the study used Early Grades Math Assessment (EGMA). The highest score possible was 40 points and the calculated internal consistency was (α) = 0.88. This study used the readily available Kiswahili version of EGRA and EGMA tools.

In early childhood education research, it is not uncommon to use tools that were developed for use in another contexts (Anderson and Sayre, 2016; Ndijuye, 2020). Indeed, BSRA has been successfully contextualised and used by other researchers in developing sub-Saharan countries (Liu, et al., 2022; Ndijuye and Rao, 2019; Ndijuye and Tandika, 2022b). However, the contextualisation of these tools has implications for the reliability of its findings. Furthermore, given that some of the items/sections were translated from English to Kiswahili, and the meaning of concepts may vary across contexts and cultures, in cross-cultural studies, the use of tools developed in other fields is justifiable (Ndijuye, 2020).

Follow-up interview with parents was conducted by the author to gain insights of home learning environments and family socio-economic status. The interviews were conducted at home after school hours following a pre-set home visit. The open-ended questions focused parent-child relationships, level of parents-schools' involvements and engagement, and how parents spent their income on children's education. Specifically with parents from the group of naturalised citizens, it was necessary to conduct interviews at home so that establish rapport and mutual trusts which is necessary in qualitative research (Creswell and Creswell, 2018). Each interview lasted between 20 and 30 min. It was necessary to conduct parents' interviews because while the medium of instruction at pre-primary and primary school levels in Tanzania is Kiswahili, available empirical evidence indicates that most of the

children – including those from naturalized groups, do not speak the language.

6. Research procedures

Since this was a longitudinal study, the author recruited two research assistants (Ras) for data collection and entering into the software for the analyses. The Ras were trained early childhood educators who hold bachelor's degrees and had some experience in early childhood education research. Practical training on the administration and interpretation of the MELE, BSRA, EGRA and EGMA was provided over five days and piloted for another five days. The pilot study was conducted to determine each item's level of difficulty and validity. Children were sampled in 2019, tested on BSRA in November 2020 when they had reached the end of their two-year pre-primary level schooling. They were administered the EGRA and EGMA tools in November 2021 when they were about to finish their grade one curriculum. The BSRA tool was jointly translated and back-translated by the author and a Kiswahili-English linguist. It was necessary that the author take part in the translation process as he is an ECEC research expert, and could thus aid in the cross-cultural aspect of the translation grounded in the ECEC and Tanzanian research context.

7. Ethical considerations

Ethical clearance was applied and obtained after submitting the project proposal to Tanzania's National Bureau of Statistics, and the research permit and introduction letters were sent by the Ministry for Local Government Authorities to the two study regions. Parents were asked to individually sign the written consent forms to allow their children to participate in the study and were also asked to verbally agree to take part in the study. Each participant was informed of their freedom to withdraw from participation in the study whenever they felt the need to do so. Each participant was assigned an identifying pseudonym for their safety, privacy, and confidentiality. At individual school level, written parental consent to administer the BSR child tests was obtained, and parents had to sign written voluntary participation consent forms. The collected data were entered and stored in a password-protected software.

8. Strategies for the data analyses

As indicated, descriptive and relational findings are reported in Table 1 and Table 2. The distribution of the data adheres to that as suggested by Kline (2016). However, given that some variables were somehow skewed, it was decided that the estimator used for the analyses would be MLR (robust maximum likelihood), in Mplus Version 7.3. Given these findings, a simple latent growth curve model (LGM), involving two variables measured the same way at two points, was applied (Duncan et al., 2006). To allow for estimation of the direction and difference in scores, two temporary separate observations were made. In this model, children's BSRA scores were regarded as intercepts, while later reading and math attainments in grade 1 were represented on the slope – change in score. For error variance, the model used time-specific measurement error using the composite Cronbach's alpha as a measure of reliability (Wang and Wang, 2012). Given that this was a longitudinal study, we did not use standardization across individuals within age groups and cohorts because it could have impeded observation of implications of age differences at given time points. Parents' follow-up interviews were conducted in Kiswahili – the widely-spoken language in Tanzania. The collected qualitative data were transcribed, translated from Kiswahili to English, coded, reduced, and described to develop themes and sub themes by observing procedures suggested by Onwuegbuzie and Leech (2021).

Table 1
Descriptive data.

			ALL	Boys	Girls		Boys (girls)
		N	M (SD)	M (SD)	M (SD)	CD	Skewness
BSRA (reading)	**S**	**400**	32 (3.66)	34 (3.54)	30 (3.72)	0.25	-0.35 (−0.49)
EGRA	**SS**	398	43 (2.52)	42 (2.88)	44 (3.10)	0.22	-0.67 (−0.52)
BSRA (math)	**S**	400	32 (3.35)	29 (3.27)	35 (3.74)	0.31	-0.36 (−0.43)
EGMA	**SS**	398	47 (3.66)	40 (3.82)	54 (3.63)	0.27	-1.17 (0.88)
Parental education			**Majority groups N(%)**			**N/citizens N(%)**	
No education			03(0.4)			17(2.2)	
Primary school			63(15.4)			122(31.5)	
Lower Sec. school			99(23.5)			32(08)	
Upper Sec school			20(05.3)			28(07)	
Diploma			072.5)			0(00)	
Bachelor's degree			06(1.5)			01(0.3)	
Postgraduate degree			02(0.5)			0(00)	
Family wealth (cumulative monthly family income and assets)							
			Mean (SD)			**Mean (SD)**	
			7.721(2.34)			6.846 (2.17)	
Home learning environments							
Presence of print materials			7.282 (2.13)			6.763 (2.09)	
Presence of electronic devices			7.461 (2.18)			6.531 (2.14)	
Level of parental involvements (in the past 30 days)							
In reading activities			6.822 (1.89)			8.31 (2.11)	
In maths activities			6.37 (2.08)			7.99 (1.88)	
In socioemotional activities			6.58 (1.97)			8.27 (2.01)	

Source: Field data, (2021).

9. Findings

9.1. Descriptive information

The BRSA mean scores were modelled as predictors of intercept factors, based on the HLEs and family SES. The slope factor was identified as the incremental changes that had occurred in the early reading and maths skills obtained by the end of the first grade. To calculate for the moderation effect, the study used a Chi-square difference test which employed the Satorra-Bentler correction method after applying the MLR estimator (See Satorra and Bentler, 2010). In all analyses, the control variables were made up of each child's initial level of academic skills which were calculated when the children were in pre-primary class, as well as the family SES and HLE – which were slope factors.

9.2. Differences in emergent reading and math (BSRA) and grade one reading and math skills

A one-way analysis of variance was conducted to determine the mean differences across groups and gender. The findings indicated that girls had significantly higher BRSA mean scores than boys during the year spent in pre-school ($F(1, 147) = 5.849$, $p = 0.001$, $d = 0.32$), and in grade one ($F(1, 136) = 4.005$, $p = 0.019$, $d = 0.20$). However, there was no significant differences between gender in EGRA mean scores ($F(1, 147) = 1.020$, $p = 0.074$, $d = 0.32$) or grade one ($F(1, 135) = 1.483$, $p = 0.121$, $d = 0.24$). For variables tested, HLE was associated with all of them and was notably correlated with mathematics skills in school ($r = 0.33$, $p < 0.001$). Furthermore, there was only a weak correlation to girls' early reading skills during their time in pre-school ($r = 0.21$, $p < 0.05$) – this is a large correlation size in the relationship between HLEs and the differences in the children between the genders. Family SES was strongly associated with children's reading skills, especially with boys during pre-school ($r = -0.46$, $p < 0.001$). Over time, high stability was found for early reading (boys, $r = 0.77$, $p < 0.001$ and girls, $r = 0.82$, $p < 0.001$) as well as their math skills (boys, $r = 0.71$,

Table 2
Correlations for all variables.

		1.	2.	3.	4.	5.	6.
1. Family SES	**S1**	–	-0.07	0.19 *	0.29 * *	0.33 * *	0.32 * *
2. HLE	**S1**	-0.17 *	–	-0.16 *	0.01	-0.33 * **	-0.12
3. Early reading (BSRA)	**S1**	0.29 * **	-0.49 * **	–	0.51 * **	0.77 * **	0.51 * **
4. Early Math (BSRA)	**S1**	0.33 * *	-0.07	0.41 * *	–	0.44 * **	0.56 * **
5. Early reading (EGRA)	**SS**	0.33 * *	-0.52 * **	0.77 * *	0.41 * *	–	0.52 * *
6. Earl math (EGMA)	**SS**	0.41 * **	-0.06	0.41 * *	0.59 * *	0.41 * *	–

Note: **S1** = pre-school, **SS** = grade 1. *p < 0.5, * *p < 0.01, * **p < 0.001

$p < 0.001$ and girls, $r = 0.68$, $p < 0.001$).

10. The effects of HLE and family SES on early reading and Math

The findings indicated that, as predictors of learning attainments during the pre-school year, HLE could significantly predict the level of the children's emerging literacy ($\beta = 0.26$, $p < 0.001$) and numeracy ($\beta = 0.38 < 0.001$) skills. Analysed according to family SES, HLE had a small but significant negative effect on Math during preschool year ($\beta = -0.18$, $p < 0.05$). However, there were no significant differences in the children's early reading skills during pre-school between the genders ($\beta = -0.069$, $p = 0.271$).

During the correction of measurement errors – which was carried out before the predictors were entered into the regression model – the variance of the literacy's slope factor was insignificant (var = 1.62, $p = 0.322$). However, it was significant for mathematics (var = 0.88, $p = 0.038$). Studies have recommended the inclusion of all predictors even if the slope factor variance is insignificant as they still have a significant influence on the variation of the slope as a function of the predictors (Lenes et al., 2022; Statmodel, 2002). The seemingly conflicting results are not uncommon in connection with a higher power of variability detection, due to the inclusion of predictors (Lenes et al., 2022). Further analyses showed that HLE did not significantly predict a change in the children's early reading skills ($\beta = 0.26$, $p = 0.311$) or in maths ($\beta = 0.22$, $p = 0.338$). Additionally, family SES was also not found to predict change in their early reading ($\beta = 0.0402$, $p = 0.819$) and maths skills ($\beta = -0.021$, $p = 0.785$) either.

10.1. The moderating role of family SES on the relationship between home environments and early reading and maths skills

We conducted separate analyses of the role or relationship between children's HLEs and family SES on their early reading and maths skills. Findings from the Chi-square difference test showed that across naturalised citizens and majority groups, there were no significant differences when it came to the role of the child's HLE on their early reading ($\Delta\chi^2$ (1) = 0.07, $p = 0.695$). There were also no significant differences of the effect of HLE between the genders either. Similarly, for their maths skills, the effect of HLE also did not differ significantly between boys and girls at pre-school ($\Delta\chi^2$ (1) = 0.24, $p = 0.826$). Given these findings – that HLE did not significantly predict the children's reading and mathematics skills, and the variance of the slope factors was also found insignificant – there was no reason to examine whether family SES mediated the association between HLE and any changes in their literacy and numeracy skills.

11. Follow-up interviews

The parents' follow-up interviews unfolded one broad theme of (un) availability of home support. This theme was further developed into two sub-themes of critical role of medium of instruction, and that of parental involvements in children's learning and development. Parents held the views that for successful transition from pre-primary to grade one, children needed to learn in a language they could understand – that is spoken at home. However, it was found that most of them spoke a non-medium of instruction at home. Parents seem to suggest that children's limited mastery of Kiswahili, which is the official medium of instruction in Tanzania, was linearly related to their limited early reading and numeracy attainments.

Similarly, parents reported about the vital role of their involvements in children's learning and development. Their views centred around involvements in school related activities such as meetings, preparation of children's meals, and regular communications with teachers on children's academic progress. None of them indicated interests to be involved in classroom activities or curriculum development. They revealed about special interest to be involved in helping children develop and master Kiswahili by developing a synergistic relationship with pre-primary schoolteachers. One of them said the following:

> "I know for sure that our pre-primary children are doing well even though they don't speak fluently, and I doubt whether most of them even understand the spoken (Kiswahili). I think we need to devise a special program (to help children) which will create a continuation of and link between what happens in school and home".

12. Discussion

12.1. The role of HLE and family SES on early reading and maths skills

The findings of this study concur with previous research findings conducted in both high income and low-and-middle-income countries, showing that HLE and family SES impact children's early maths and reading acquisition (Lenes et al., 2022; Ndijuye and Rao, 2019; Schjølberg et al., 2008). Some previous findings have documented the implications of family SES-related differences on language and literacy development, revealing that these have an impact even before the age of two, and that the margin is widened by the quality of pre-school services they go on to attend (Farkas and Beron, 2004; Zambrana et al., 2012). As such, the onset of the identified differences in SES when it came to the children's early reading skills may have started even before starting pre-school and during their early years. However, this is still a speculation and evidence for which requires more empirical studies and findings.

The current Education and Training Policy of Tanzania mandates that all pre-school aged children should attend at least one year at an ECEC centre in a nearby primary school (MoEST, 2014). However, this study found significant differences in HLEs and family SES for school-aged children, in regard to their early reading and mathematics skills, even though findings from other contexts indicated that pre-school attendance minimises these differences (Lenes et al., 2022; Ndijuye, 2022). Empirical findings from other low-and-middle-income countries in the sub-Saharan region has consistently indicated that the effect of moderate SES differences in children's school readiness and mathematics skills starts to diminish when children begin grade one (McCoy et al., 2017; Ndijuye and Rao, 2019). This suggests that Tanzania and other countries with similar learning contexts can do more to lessen family SES gaps in pre-school.

There were no significant effects of HLE and family SES on the change in children's school math and early reading skills from pre-school to grade one. In other words, the differences in family SES

found during pre-school years persisted into grade one. This finding aligns with previous research showing that SES differences are stable or slightly increase after school entry (Lenes et al., 2022; Passaretta and Skopek, 2018). The possible explanations for this could be that, regardless of family SES backgrounds, during grade one all children were exposed to early reading instructions which enhanced their skills. Furthermore, it could also be due to the high stability in early math and reading skills from preschool to grade one – we found the estimated variance of the slope factor to be insignificant for math and statistically very small for early reading. This could be interpreted to mean that there were no variations around the mean slopes that could, in practice, indicate that there was no variance left to be explained by other factors. While these findings are uncommon – the disparities in learning attainments across rural and urban areas due to the acute shortage of teaching and learning resources, similarly, for years research from high-income countries has consistently found such rank order between children aged four to eight years (Brandlistuen et al., 2021; Lenes et al., 2022; Passaretta and Skopek, 2018).

13. The role of family SES on children's early maths and reading skills

Though findings from previous studies that focused on gender differences in early reading skills are mixed (Brandlistuen et al., 2021; McCoy et al., 2017; McTigue et al., 2021; Ndijuye and Tandika, 2022b) the results from this study did partly align with our earlier held assumption that girls showed some advantages in early reading by the end of pre-school. Researchers around the world have claimed that gender differences in early literacy skills could be because of the assessment tools used (Lenes et al., 2022), educational settings (Brandlistuen et al., 2021), the children's age (Ndijuye & Tandika, 2022b), differences in cognitive and brain structure between boys and girls (Weiland and Yoshikawa, 2013), and cultural and parental beliefs (Ndijuye & Tandika, 2022a). Nevertheless, these mixed findings and speculations call for more systematic, wider, cross-sectional, and longitudinal studies in order to further investigate this phenomenon.

The available evidence shows that boys are typically slower when it comes to language production and comprehension, though the differences are said to drastically decrease starting from the age of three (Weiland and Yoshikawa, 2013; Zambrana et al., 2012). Some studies have suggested that the boys start to catch-up as early as 30 months (Bouchard et al., 2009). The findings of this study concur with studies that have established that boys do catch up at a certain point between pre-school and early grades (Lenes et al., 2022; McTigue et al., 2021). Compared to boys, girls scored slightly higher in maths by the end of pre-school. This suggests that maths skills require more intentional focus than language, which is developed in everyday life. Existing evidence indicates that girls actively participate in more adult-initiated activities, including maths, than boys (Lenes et al., 2022; Stangeland et al., 2018). In a context where the curriculum is play-based and there is high degree of children's autonomy – as it is in Tanzania – girls may simply choose to engage in activities that enhance their maths skills. However, since the gender differences in mathematics was relatively small in magnitude, and considering the socio-cultural contexts of teaching and learning in Tanzania, these results should be cautiously interpreted.

Generally, the findings indicated that there were no significant differences resulting from differences in family SES. This is contrary to long-standing assumption linking social inequality and educational achievements (Korous et al., 2022; Stangeland et al., 2018; Toivainen et al., 2017; McTigue et al., 2021). This study did not fully embrace this materialistic hypothesis, rather supported embraced the fact that even though family SES at birth is linked to later income, there is no direct pathways from economic resources to later learning attainments. Among children from naturalized citizens, family beliefs and expectations towards education play an important role in learning attainment. However, these findings do not disregard other vital factors such as quality of preschool, childhood cognitive abilities and communities around children.

These findings concur with other studies conducted in low-and-middle income countries in the sub-Saharan region (Heyneman, 1976; Heyneman and Loxley, 1983; Ndijuye and Tandika, 2022). In Uganda, Heyneman (1976) and Zumbach (2010) found that regardless of family SES, children aspired to excel in school and maintain social cohesion rather than divisions resulting from social hierarchy. However, in the sub-Saharan region, the influence of socio-cultural reasons on children's development and learning is understudied. Even among over-researched developed countries, the influence of family SES on predicting learning attainments is highly variable (Heyneman, 2015; Lee and. Borgonovi, 2022).

Conclusion and recommendations

The documented differences in family SES and HLE are said to have implications on children's school readiness and early reading and maths skills, which then persist throughout their educational career and beyond. To achieve the current policy target of the provision of quality pre-school experiences for all children across the country (MoEST, 2014), all children should have access to quality services that will allow them to experience developmentally stimulating environments and that reduce the effects of the gaps in the children's HLE and family SES. To achieve that, there is a need to invest and improve the professional development programmes for early grades teachers – both in-service and pre-service teachers. Some reports indicate that much of the ECE policy decisions in Tanzania are not particularly informed by the existing empirical evidence (Ndijuye and Rao, 2019). This necessitates more research-based policy decisions, and more importantly, evidence-based ECE teacher education programmes to help bridge the gap between policy, research, and practice. And what is equally important is that, given the reportedly poor-quality schools in Tanzania, (UIS, 2020), there is a need to carefully and empirically study, understand, and support the home learning environments which potentially augment the deficits caused by limited school-related resources.

There is thus a need for further studies to consider other mechanisms and indicators behind family SES and HLEs, such as the quality and quantity of parental-child interactions. Findings have indicated that HLE predicted the trajectory of children's school readiness and early reading skills by the end of pre-school. However, no changes to the level of these skills were recorded by the end of grade one. Compared to boys, girls had a marginal advantage in maths by the end of pre-school. However, there were no significant differences in the change in early reading and maths skill between the genders by the end of grade one. Across the investigated groups, the role of HLE and family SES on children's learning attainment did not differ across gender. These findings generally suggest that more efforts and investments are required to increase the quality of early childhood education in a context with limited educational resources and a lot of learning and developmental disparities.

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Conflict of Interest

To our best knowledge, there is no conflict of interest that exists worth reporting.

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