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ARTICLE

Exploring the Impact of Socioeconomic Status and Physical Play on Early Childhood Development among Macau Young Children

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ABSTRACT

This research investigates the intricate relationships between socioeconomic status (SES) and physical play in early childhood development within the unique context of Macau. Our study reveals that parental education levels are associated with conducive home environments for child development, characterized by larger play spaces, diverse toys, and increased participation in physical activities and extracurriculars. This study found a significant correlation between media screen activity and involvement in extracurriculars or physical activity programs, highlighting the need to explore the multifaceted influences on children's media consumption. This study emphasizes the importance of parental education in creating nurturing environments for child development and the crucial need for an in-depth understanding of media screen activity's role in early childhood. Our findings bear implications for academia and policymakers, educators, and parents, underscoring the importance of supportive environments that facilitate physical play, promote parental education, and encourage healthy media usage habits for optimal child development outcomes. However, a larger and more diverse sample size in future research could enhance these findings' external validity.

1. Introduction

1.1 Background Information on Early Childhood Development

Recognized as the cornerstone of an individual's developmental journey, early childhood encapsulates the critical first five years of life (Valla, Slinning, Kalleson, Wentzel-Larsen, & Riiser, 2020). During this period, children are exceptionally open to environmental stimuli, rapidly acquiring essential motor, cognitive, and communicative skills that set the stage for future growth and learning. In contemporary society, the weight placed on educational success from an early age is substantial, with parents often stressing the significant role that formal schooling plays in their child's developmental trajectory. Yet, it is crucial to acknowledge that influences on a child's development transcend the confines of a school curriculum. As the primary social construct, the family is instrumental in molding a child's experiences, opportunities, and overall developmental outcomes (Bradley & Corwyn, 2002; Lee & McLanahan, 2015). A growing body of research underscores the home environment's vital role the home environment plays in shaping a child's developmental path (Yang, Yang, Zheng, Song, & Yi, 2021). Salient factors, such as socioeconomic status, the parents' roles, and the

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provision of stimulating experiences, significantly steer a child's cognitive, social, and emotional development (Ginsburg, Communications, Child, & Health, 2007); September, Rich, & Roman, 2016); Slemming, Norris, Kagura, Saloojee, & Richter, 2022).

1.2 The Potential Influence of Socioeconomic Status on Child Development

Socioeconomic status (SES) is an influential factor encompassing various dimensions, including income, education, and occupation. Previous studies have demonstrated that SES is associated with a wide range of developmental outcomes in children, including health, cognitive, and socioemotional outcomes (Bradley & Corwyn, 2002; Letourneau, Duffett-Leger, Levac, Watson, & Young-Morris, 2013), which can impact a child's access to resources such as quality education and healthcare (Sheridan & McLaughlin, 2016). Empirical studies suggest that higher parental education and household income positively correlate with superior child development outcomes (Akhlaghipour & Assari, 2020). Parents with elevated incomes, often associated with higher educational attainment, command an enhanced understanding of effective parenting practices and enjoy more substantial social capital, thereby positively fostering their children's development (Wimer & Wolf, 2020). For instance, a recent study from China discovered a significant association between family income and parental education with preschool children's cognitive school readiness (Xia, 2022). In contrast, financial constraints can impair parents' capacity to offer warm, sensitive parenting, adversely influencing children's development (Zhang, 2012).

1.3 The Role of Physical Play in Child Development

Physical play is a critical component of early childhood development, as identified in recent studies (Sincovich, Gregory, Harman-Smith, & Brinkman, 2020; Suzuki, 2020; Prins, van der Wilt, van Santen, van der Veen, & Hovinga, 2022). Such play-based activities equip children with indispensable motor, cognitive, and socioemotional skills, serving as the bedrock for their holistic growth and development (Undiyaundeye, 2013). The advantages of physical play in fostering children's development are well-delineated in scholarly literature, underscoring its profound impact on children's comprehensive well-being. Children explore the world and their identities through play, cultivating the necessary skills for academics, work, and interpersonal relationships (Ginsburg, Communications, Child, & Health, 2007). According to Milteer and colleagues, physical play promotes resilience to cooperate, overcome challenges, and negotiate with others (Milteer, Ginsburg, Communications, Child, Health, Ameenuddin, Christakis, Cross, & Hill, 2012). Participating in play activities equips children with the capacity to navigate varied situations, fostering adaptability in the face of change (Thomas & Harding, 2011).

1.4 The Impact of Availability of Learning Resources in the Physical Home Environment, Media Screen Activity, and Extracurriculars

1.4.1. Availability of Learning Resources in the Home Environment

Exposure to various stimulating experiences and diverse learning opportunities within a child's home environment can profoundly influence their intellectual and socio-emotional development. The availability of resources within this environment, including books, educational toys, and other intellectually stimulating materials, plays a crucial role in a child's cognitive evolution (Zoghi, Gabbard, Shojaei, & Shahshahani, 2019). Children from families with higher educational attainment often have more access to these resources, fostering intellectual curiosity, enhancing language development, and promoting critical thinking skills. A study stated that the greater the availability of resources in a child's familial environment and the higher the family's economic status, the better the child performs on cognitive development tests (Pereira, Guedes, Morais, Nobre, & Santos, 2021). Understanding the variations in the availability and utilization of such resources across different educational backgrounds can illuminate potential disparities in learning opportunities. This understanding, in turn, can guide strategies to ensure equitable access to educational resources for all children, thereby promoting a more balanced educational landscape.

1.4.2. Extracurriculars and Media Screen Activity

There is significant emphasis on the potential detrimental effects of excessive use of electronic devices on child development (Domingues-Montanari, 2017; Al & Al, 2020). Nevertheless, research must clarify the possible correlation between electronic device usage and children's extracurricular engagement, particularly concerning SES. One might hypothesize that families with a higher SES may have a more acute understanding of the potential negative outcomes of excessive screen time. As a result, they could encourage their children to participate in extracurriculars as a substitute or supplement to screen-based activities. This approach could be a conscious attempt by these parents to provide a balanced developmental experience for their children, facilitating participation in tech-

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nologically driven activities and rich educational experiences. This underscores the need for additional research on the complex interplay between digital media usage, extracurriculars, and SES influencing child development.

To explore these interrelated factors, this study investigated the correlation between SES and physical play, specifically focusing on parental educational attainment, income, physical home environment, parent involvement, and media screen activity. By examining these aspects, we aimed to understand how these factors influence early childhood development, thereby informing the development of effective interventions and policies that promote positive outcomes for children from diverse backgrounds.

2. Materials and Methods

2.1 Participants

The participants in this study were caregivers, primarily parents of children aged 18 to 60 months in Macau. The participants were selected using a simple random sampling method, ensuring a representative sample from the target population. The inclusion criteria for this study were as follows: the caregiver had at least one child between 18 months and 60 months, regardless of sex, and the child did not have significant illnesses, injuries, or major medical treatments. Additionally, parents with more than one child within the age range of 18 months to 60 months were instructed to answer the questionnaire based on one child of their choice. Ultimately, 359 children between 18 and 60 months were included in the present study. They were categorized into age groups: 18-24 months, 24-36 months, 36-48 months, and 48-60 months. The ethics board of the University of Macau approved the research protocols. Written informed consent was obtained from all participants after they were fully briefed about the study procedures and implications.

2.2 Procedures

The research questionnaire was designed based on the research objectives and informed by relevant empirical studies (September, Rich & Roman, 2016; Zoghi, Gabbard, Shojaei & Shahshahani, 2019). The questionnaire encompassed the Developmental Screening Scale for Young Children (DSSYC) (Huang, 2000), Affordances in the Home Environment for Motor Development-Self Report (AHEMD-SR) (Gabbard & Rodrigues, 2008), Media Screen Activity, and Parents' Involvement. The recruitment poster was created and disseminated through various emails, mobile text messages, and social media platforms (including WeChat and Facebook). Flyers were circulated in nurseries across Macau to invite the primary caregivers of children to participate. Data collection took place in the fall of 2020.

2.3 Measure

2.3.1. Young Children's Development

For the assessment of the development of early childhood, the DSSYC developed by Huang was used. This scale consists of five dimensions, which are language and communication development (31 items), social-personal development (34 items), gross motor skills development (36 items), fine motor skills development (31 items), and perceptual-cognitive development (35 items). The scale provides three response options: "able=3," "don't know=2," and "unable=1." The "don't know" response option may indicate that the caregiver has not observed the child's behavior or is uncertain about how to respond due to unclear item wording. The data are considered invalid if the respondent selects "don't know" for more than sixteen items. Scoring involves identifying the basal level and the ceiling level. The interpretation categories include normal development (i.e., basal level falls within the age-appropriate item group), suspected developmental delay (i.e., basal level below the age-appropriate item group, ceiling level below or within the age-appropriate item group), and follow-up (i.e., basal level below the age-appropriate item group, ceiling level exceeds the age-appropriate item group). Furthermore, the scale allows for the assessment of developmental range. A "wide" field is considered when the child's age is less than four years and the difference between the ceiling and basal levels exceeds six months. On the other hand, an "imbalanced" range is observed when the child's age is over four years and the difference between the ceiling and basal levels exceeds 12 months. This scale provides a comprehensive observation of overall child development and is widely applied in research related to early childhood development (Lei, 2017; Tsai, 2011). The reliability estimates for the DSSYC were established with high consistency, with Cronbach's α ranging from 0.962 to 0.967 (Zhao & Lei, 2018).

2.3.2. Physical Home Environment

The assessment of the physical home environment utilized the Chinese version of the AHEMD-SR (Gabbard & Rodrigues, 2008), which is a validated and reliable questionnaire consisting of three types of questions: Simple dichotomic choice, 4-point Likert-type scale, and description-based queries; representing 20 variables and 67 items. This self-administered questionnaire consists of five aspects: outside and inside space, variety of stimulation, gross motor toys (sliding, creeping, climbing, and rolling),

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and fine motor toys (such as puzzles and shape sorters). A total AHEMD-SR score was calculated by summing the scores of each subscale. A short family demographic survey was included, capturing variables such as the number of adults and children in the house, number of rooms (excluding the bathroom), the duration the child has lived at home, parents' education, annual family income, and childcare attendance. Internal consistency reliability was assessed using Cronbach's α coefficient, ranging from 0.80 to 0.91, indicating high reliability (Gabbard & Rodrigues, 2008).

2.3.4. Media Screen Activity and Parents Involvement

Participants were asked to provide information about media screen activity and parental involvement. The variables examined included the number of electronic devices in the household, the age of the child's first contact with screens in months, the child's daily screen time categorized into different intervals (i.e., less than 30 minutes, 30-60 minutes, 60-120 minutes, more than 120 minutes), reason of using the devices (i.e., pacification, entertainment, learning, rewarding good behavior, improving family interaction, and others), and parental views on their child's media screen activity. Participants were also asked to rate their involvement with their children. This included indicating whether the child attended any extracurriculars or participated in physical activity programs, the amount of time spent daily with the child, and outdoor activities over the past six months.

2.4 Analytical Plan

After the data collection of the questionnaires, a coding process was implemented to ensure data organization. The collected data were then subjected to statistical analysis using SPSS 26.0 and Excel 2021 for Windows. Independent sample t-test and Spearman correlation coefficient were used for statistical tests. The educational attainment of parents was categorized into three levels: Primary and middle school (PS&MS), secondary school (SS) and college and above (COLL). The pairwise comparison was significant. Performance was compared across groups using one-way ANOVA and chi-square. The analysis assessed the significance of these differences and calculated p-values to determine their statistical value.

3. Results

3.1 Descriptive Statistics

As shown in Table 1, descriptive statistics were used to summarize the child and family characteristics in the study sample. These statistics highlight the diversity in parental involvement, media screen activity, family structure, educational attainment, and income levels.

The study's cohort consisted of 359 children, fairly split between males (51%) and females (49%). The most represented age group was 24-36 months, followed by the 18-24 months group. A considerable majority of participants were from Macau (90.5%).

Regarding parental involvement, most children (78%) did not engage in extracurricular activities, and a significant majority (85%) did not participate in physical activity programs. Parent-child interaction was typically between 3-5 hours daily, while the duration of outdoor activities for most children ranged from 30-60 minutes.

In family demographics, mothers were the primary caregivers. Most families had two or three rooms in their homes, excluding bathrooms. Families typically had children with two or more siblings or just one child. Fathers and mothers predominantly completed college-level or higher education, and most families reported an annual income exceeding MOP 400,000. More than half of the fathers and about one-fifth of the mothers earned a monthly salary exceeding MOP 25,000.

Regarding media use, most children (84.7%) used electronic devices, often for entertainment (36.1%).

3.2 The Differences in Physical Home Environment and Child Development Between Extracurriculars and PA Programs

As shown in Table 2, the differences in child development and home environment between children who joined extracurriculars or PA programs and those who did not join were examined. Specifically, 79 (22.0%) children attended the extracurriculars and 280 (78.0%) did not. Regarding whether children participate in PA programs, 54 (15.0%) children participated, and more than four-fifth (85.0%) did not. T-tests were conducted to compare the means of the variables, and p-values were calculated to determine the significance of the differences.

Physical Home Environment. Children who joined extracurriculars had a significantly higher mean score for gross motor toys (M = 19.30) and fine motor toys *(*M = 51.14*)* compared to those who did not join (M = 15.75 and 41.79, respectively). Similarly, children who participated in PA programs had a significantly higher mean score for gross motor toys *(*M = 19.46) than those who did not participate (M = 16.02).

Parents Involvement. Children who joined extracurriculars showed a marginally higher mean score for physical activities (M = 4.56) than those who did not. However, no significant difference was found in play involvement or children's usage of electronic devices between the two

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Table 1. Descriptive Statistics of Child and Family Characteristic

Variable	Unit	Frequency(n)	Percentage(%)
Children Information			
Gender	Male	183	51.0
	Female	176	49.0
Age group	18-24 months	109	30.4
	24-36 months	123	34.3
	36-48 months	76	21.2
	48-60 months	51	14.2
Birthplace	China mainland	12	3.3
	Macau	325	90.5
	Hong Kong	11	3.1
	Others	11	3.1
Parents Involvement			
Extracurriculars	Not attend	280	78.0
	Attend	79	22.0
PA programs	Not participate	305	85.0
	Participate	54	15.0
Parent company time (indoor + outdoor)	≤ 3 hours	38	10.6
	3-5hours	165	46.0
	5-8hours	105	29.2
	≥ 8 hours	51	14.2
Outdoor activities	≤ 30 minutes	57	15.9
	30-60minutes	199	55.4
	60-120minutes	61	17.0
	≥ 120minutes	42	11.7
Media Screen Activity			
Devices	Never used	55	15.3
	Have used	304	84.7
Reason of using	Pacify	84	23.4
	Entertainment	129	36.1
	Learning	46	12.7
	Reward	66	18.3
	Interaction	30	8.3
	Others	4	1.2
Main caregiver	Father	59	16.5
	Mother	165	45.9
	Paternal grandfather	21	5.9
	Paternal grandmother	48	13.3
	Maternal grandfather	9	2.7
	Maternal grandmother	27	7.4
	Others	30	8.3
Number of siblings	One	148	41.2
	≥Two	211	58.8
Number of rooms	One room	6	1.7
	Two rooms	179	49.9
	Three rooms	156	43.5
	Four rooms	17	4.7
	≥Five rooms	1	0.3
Father educational attainment	Primary and Middle	43	12.0
	Secondary	94	26.2
	College and above	222	61.8
Mother educational attainment	Primary and Middle	29	8.1
	Secondary	104	29.0
	College and above	226	62.9
Annual income (MOP)	≤ 400,000	100	27.9
	> 400,000	259	72.1
Father's salary	≤ 25,000	169	47.1
	≥ 25,001	190	52.9
Mother's salary	≤ 25,000	282	78.6
	≥ 25,001	77	21.4

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Table 2. Differences in Family and Home Environment between Extracurriculars and PA Programs

Variable	Total	Extracurriculars			PA programs		
	Mean±SD	Join (n=79)	Not Join (n=280)	T-test	Join (n=54)	Not Join (n=305)	T-test
		Mean±SD	Mean±SD		Mean±SD	Mean±SD	
Physical Home Environment							
Outside space	0.97±1.939	1.28±2.259	0.89±1.834	0.002	1.37±2.284	0.90±1.866	0.007
Inside space	11.61±2.379	11.65±2.521	11.60±2.342	0.180	11.66±2.691	11.60±2.324	0.054
Variety of stimulation	26.36±3.211	26.84±2.933	26.23±3.278	0.291	27.07±2.906	26.24±3.250	0.414
Gross motor toys	16.53±9.351	19.30±10.565	15.75±8.844	0.019**	19.46±11.657	16.02±8.803	0.005*
Fine motor toys	43.84±15.175	51.14±15.380	41.79±14.492	0.575***	52.59±15.947	42.3±14.520	0.294***
Parents Involvement							
Move activities	4.43±0.587	4.56±0.496	4.39±0.606	0.065*	4.57±0.492	4.40±0.600	0.073
Play involvement	2.71±0.401	2.77±0.347	2.70±0.414	0.040	2.77±0.349	2.70±0.409	0.041
Electronic use	1.84±0.766	1.95±0.221	1.82±0.387	0.000***	1.96±0.191	1.83±0.380	0.000***
Media Screen Activity							
First contact	13.72±7.900	15.62±9.777	13.19±7.214	0.000*	15.93±10.112	13.33±7.393	0.000
Favorable views	0.26±0.180	3.63±0.678	3.44±0.785	0.294*	3.61±0.763	3.46±0.766	0.983
Child Development							
Language and Communication Development							
Basal level	38.78±16.614	47.42±17.383	36.34±15.575	0.485***	48.26±15.244	37.1±16.301	0.099***
Ceiling level	47.78±16.497	57.19±14.709	45.13±16.018	0.755***	58.35±14.051	45.91±16.208	0.282***
Mean	43.51±15.990	52.49±15.184	40.97±15.307	0.756***	41.74±15.734	58.35±14.051	0.154***
Social and Personality Development							
Basal level	36.33±16.368	43.29±16.294	34.37±15.874	0.463***	43.17±16.907	35.12±15.997	0.751**
Ceiling level	46.90±11.722	52.54±9.493	45.31±11.813	0.087***	53.87±8.806	45.67±11.753	0.005***
Mean	41.79±12.867	48.03±11.506	40.03±12.700	0.206***	48.63±11.26	40.57±12.791	0.065***
Gross Motor Development							
Basal level	36.53±13.727	41.51±12.216	35.13±13.823	0.000***	41.54±13.538	35.64±13.591	0.194***
Ceiling level	42.78±10.153	47.16±7.203	41.55±10.526	0.000***	48.41±6.074	41.79±10.409	0.995***
Mean	39.79±11.108	44.46±8.813	38.48±11.346	0.000***	45.09±8.448	38.85±11.269	0.345***
Fine Motor Development							
Basal level	37.96±17.352	46.06±19.819	35.67±15.895	0.019***	47.52±19.302	36.26±16.446	0.194***
Ceiling level	47.57±15.504	56.76±15.517	44.98±14.508	0.046***	57.87±14.711	45.75±14.939	0.995***
Mean	42.97±15.519	51.62±16.718	40.53±14.273	0.008***	52.93±15.613	41.20±14.846	0.345***
Perception and Cognition Development							
Basal level	39.52±19.508	48.85±21.056	36.89±18.242	0.092***	49.72±20.880	37.71±18.718	0.463***
Ceiling level	48.88±16.180	58.05±14.291	46.29±15.757	0.029***	60.61±12.755	46.80±15.848	0.003***
Mean	44.46±16.913	53.70±16.601	41.86±16.094	0.650***	55.37±15.508	42.53±16.433	0.384***

Note: *p < 0.05, **p < 0.01, ***p < 0.001

groups. Similarly, there were no significant differences in parental involvement measures between children who participated in PA programs and those who did not.

Media Screen Activity. Children who joined extracurriculars had a higher mean number of devices at home (M = 7.49) than those who did not (M = 8.94), with a significant difference. However, the two groups had no significant difference in the child's age of first contact with electronic devices. Moreover, children who joined extracurriculars had significantly higher mean scores for

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favorable views of electronic devices of parents (M = 3.36) compared to those who did not join. No significant differences were found in media screen activity variables among children who participated in PA programs compared to those whose parents did not participate.

Child development. Specifically, children who participated in these activities demonstrated higher mean scores for basal- and ceiling-level language and communication growth, social and personality development, gross motor development, fine motor development, and perception and cognition development.

Regarding language and communication development, children who joined extracurriculars and PA programs exhibited significantly higher mean scores for both basal levels (M = 47.42 and 48.26 and ceiling levels (M = 57.19 and 58.35) than their counterparts who did not participate. Similarly, significant differences were observed in both basal level (M = 43.29 and 43.17) and ceiling level (M = 52.54 and 53.87) of social and personality development among children who participated in extracurriculars and PA programs. In motor development, both gross and fine motor skills showed significant differences between children who joined extracurriculars and PA programs and those who did not participate. Children who participated in these activities had significantly higher mean scores for both basal level (M = 41.51 and 41.54) and ceiling level (M = 47.16 and 48.41) of gross motor development compared to their non-participating counterparts. The same pattern was observed for fine motor development, with children who joined extracurriculars and PA programs exhibiting significantly higher mean scores for basal levels (M = 46.06 and 47.52) and ceiling levels (M = 56.76 and 57.87). Children who joined extracurriculars and PA programs demonstrated significantly higher mean scores for both basal level (M = 48.85 and 49.72) and ceiling level (M = 58.05 and 60.61) of perception and cognition development than those who did not participate.

3.3 The Differences in Home Environment and Child Development Based on Parental Education Attainment

As shown in Table 3, an analysis was conducted to examine the differences in parents' educational attainment and its association with various variables related to family information, parents' involvement, physical home environment, media screen activity, and child development.

Family information. Both the father's and mother's educational attainment is significantly associated with family SES (as reflected by salaries and annual income) and family size (number of siblings) ($p < 0.05$).

The father's educational attainment level showed significant differences in the mother's salary when comparing PS & MS to COLL (M = 1.09 and 1.29) and SS to COLL (M = 1.09 and 1.29). However, no significant difference was observed when comparing PS & MS to SS (M = 1.09). The mother's educational attainment level showed substantial differences in her salary across PS & MS compared to COLL (M = 1.03 and 1.29) and SS compared to COLL (M = 1.11).

The father's educational attainment level showed sig-

Table 3. Differences in Involvement and Home Environment between Parents' Educational Attainment (One-way ANOVA)

	Father Educational Attainment			Mother Educational Attainment		
Variables	**Level**	**Level**	**Sig.**	**Level**	**Level**	**Sig.**
Parents Involvement						
Play involvement	PS &MS	SS	0.629	PS &MS	SS	0.050**
	PS &MS	COLL	0.443	PS &MS	COLL	0.909
	SS	COLL	1.000	SS	COLL	0.001**
Physical Home Environment						
Inside Space	PS &MS	SS	0.264*	PS &MS	SS	0.978*
	PS &MS	COLL	0.008**	PS &MS	COLL	0.173
	SS	COLL	0.053	SS	COLL	0.021*
Fine-motor toys	PS &MS	SS	0.568*	PS &MS	SS	0.842***
	PS &MS	COLL	0.047*	PS &MS	COLL	0.024*
	SS	COLL	0.066	SS	COLL	0.000***
Gross-motor toys	PS &MS	SS	0.905*	PS &MS	SS	0.214**
	PS &MS	COLL	0.037*	PS &MS	COLL	0.403
	SS	COLL	0.008**	SS	COLL	0.000***

Note: p values refer to group differences. *p < 0.05, **p < 0.01, ***p < 0.001

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nificant differences in the father's salary when comparing PS & MS to COLL (*M* = 1.42 and 1.62) and SS to COLL (*M* = 1.37 and 1.62). The PS & MS to SS comparison did not yield a significant difference (*M* = 1.34, 1.41 and 1.61). Significant differences were observed in the mother's educational attainment level across the comparisons of PS & MS to COLL (*M* = 1.34 and 1.61) and SS to COLL (*M* = 1.41 and 1.61).

The father's education level showed significant differences in the annual income when comparing PS & MS to COLL (*M* = 5.49 and 5.78) and SS to COLL (*M* = 5.57 and 5.78). Similarly, there were significant differences across all comparisons in the mother's educational attainment level: PS & MS compared to SS (*M* = 5.24 and 5.65) and PS & MS compared to COLL (*M* = 5.24 and 5.77).

The father's education level showed significant differences in the number of siblings when comparing PS & MS to COLL (*M* = 1.74 and 1.53) and SS to COLL (*M* = 1.66 and 1.53), but not when comparing PS & MS to SS (*M* = 1.74 and 1.66). The mother's educational attainment level showed significant differences in PS & MS compared to COLL (*M* = 1.83 and 1.65) and SS compared to COLL (*M* = 1.65 and 1.53).

Parents Involvement. The mother's educational attainment was more associated with variations in parental play involvement, enrollment in extracurriculars, and participation in PA programs, particularly when comparing SS to COLL. The father's educational attainment showed a different level of influence.

The father's educational attainment level showed no statistically significant differences in play involvement, whether the father's academic level was PS&MS compared to SS (*M* = 2.77 and 2.71) or PS&MS compared to COLL level (*M* = 2.77 and 2.70). SS to COLL level comparison was not statistically significant (*M* = 2.71 and 2.70). In contrast, the mother's educational attainment level did indicate statistically significant differences in play involvement when comparing PS & MS to SS levels (*M* = 2.77 and 2.60), while no significant difference was observed when comparing PS & MS to COLL (*M* = 2.77 and 2.76). A significant difference was noted when comparing SS to COLL (*M* = 2.60 and 2.76).

There were no statistically significant differences for the father's education attainment in terms of enrollment in extracurriculars, whether comparing PS & MS to SS (*M* = 1.16 and 1.17), PS & MS to COLL *(M* = 1.16 and 1.25), or SS to COLL (*M* = 1.17 and 1.25). However, for mother's education attainment, significant differences were observed when comparing PS & MS to SS (*M* = 1.21 and 1.12) and SS to COLL (*M* = 1.12 and 1.27), but not when comparing PS & MS to COLL (*M* = 1.21 and 1.27).

The father's educational attainment didn't show significant differences in participation in a PA program when comparing PS & MS to SS (*M* = 1.09 and 1.13), PS & MS to COLL (*M* = 1.09 and 1.17), or SS to COLL (*M* = 1.09 and 1.19). However, for mother's education attainment, there were significant differences when comparing PS & MS to SS (*M* = 1.10 and 1.09) and SS to COLL (*M* = 1.09 and 1.19), while no significant difference was observed when comparing PS & MS to COLL (*M* = 1.10 and 1.19).

Physical Home Environment. The parental educational attainment, particularly of the mother, is significantly associated with variations in the physical home environment, especially regarding available inside space and the presence of fine-motor and gross-motor toys.

The father's educational attainment level showed significant differences in inside space when comparing PS & MS to COLL (*M* = 10.83 and 11.88). The mother's educational attainment level showed substantial differences in the inside area when comparing SS to COLL (*M* = 11.20 and 11.85).

The father's educational attainment level showed significant differences in the availability of fine motor toys when comparing PS & MS to COLL (*M* = 40.33 and 45.34). Significant differences were observed in the mother's educational attainment level when comparing PS & MS to COLL (*M* = 39.86 and 46.47) and SS to COLL (*M* = 39.24 and 46.47).

The father's education attainment level showed significant differences in the availability of gross-motor toys when comparing PS & MS to COLL (*M* = 14.49 and 17.71) and SS to COLL (*M* = 14.69 and 17.71). Or the mother's educational attainment level, there were significant differences when comparing SS to COLL (*M* = 13.87 and 17.80).

Media Screen Activity. The educational attainment of parents, particularly fathers, is associated with the media screen activity of their children, including the number of devices available, the age at first contact, the reasons for using devices, and views on electronic usage. However, the mother's education has less influence, with significant differences only observed for the number of devices and daily screen time.

The father's education attainment level showed significant differences in the number of devices when comparing PS&MS to COLL (*M* = 6.98 and 8.32) and SS to COLL (*M* = 6.96 and 8.32). No significant difference was observed when comparing PS & MS to SS (*M* = 6.98 and 6.96). The mother's educational attainment level showed substantial differences in the number of devices when comparing SS to COLL (*M* = 6.80 and 8.28).

The father's educational attainment level showed sig-

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nificant differences in the age at first contact with media devices when comparing SS to COLL (M = 15.61 and 12.84). No significant differences were observed across any comparisons for the mother's educational attainment level.

The father's educational attainment level showed no significant differences in daily screen time across any comparisons. For the mother's educational attainment level, there were significant differences observed when comparing SS to COLL (M = 1.76 and 1.58). The comparison between PS & MS and COLL (M = 1.86 and 1.58) was marginally significant.

The father's educational attainment level showed significant differences in the reason for using devices when comparing SS to COLL (M = 3.41 and 3.32). For the mother's educational attainment level, there were significant differences when comparing PS & MS to COLL (M = 3.32 and 3.57) and SS compared to COLL (M = 3.39 and 3.57).

The father's educational attainment level showed significant differences in favorable views on screen time when comparing SS to COLL (M = 0.31 and 0.24). No significant differences were observed across any comparisons for the mother's educational attainment level.

Child Development. The father's educational attainment is associated with differences in basal perception and cognitive development in children, with higher educational attainment related to advanced development. However, the mother's educational attainment does not significantly influence perception and cognitive development.

The father's educational attainment level significantly differed in basal perception and cognitive development when comparing PS & MS to COLL (M = 45.12 and 37.70). The mother's educational attainment level did not show any significant differences in the basal level of perception and cognitive development across any comparisons: PS & MS compared to SS (M = 39.14 and 41.18), PS & MS compared to COLL (M = 39.14 and 38.81), and SS compared to COLL (M = 41.18 and 38.81).

4. Discussion

This study contributes valuable insights to the body of research examining the impact of the SES (parental educational attainment and income) and physical play (physical home environment, parent's involvement, media screen activity) on early child development, with particular emphasis on the five dimensions of the DSSYC, namely language and communication development, social-personal development, gross motor skills development, fine motor skills development, and perceptual-cognitive development. The results lend empirical support to the influence of these factors and highlight the importance of parental educational attainment and physical play in providing an environment conducive to the child's development.

Impact of Physical Play and Home Environment

Physical Play: Previous research showed moderate evidence for a positive association of physical activity with motor and cognitive development (Veldman, Santos, Sousa-Sá, & Okely, 2019). Our findings indicate a positive association between participation in these activities and various dimensions of child development. Involvement in extracurriculars and Physical Activity (PA) programs is positively associated with all five sizes of DSSYC. Children involved in these programs demonstrated enhanced language and communication skills, social-personal development, gross and fine motor skills development, and perceptual-cognitive development.

Enriched Home Environment: Children participating in extracurriculars and PA programs had access to more gross and fine motor toys, indicative of enriched home environments. This availability of toys and a stimulating environment played a vital role in their development of gross and fine motor skills and fostered social interactions essential for social-personal development.

Impact of Socioeconomic Status

Parental Educational Attainment: A parent's educational attainment is crucial in multiple facets of child development. Higher parental education levels have been associated with favorable outcomes in various domains. The study underscores the impact of parental educational attainment on children's cognitive development. Higher-educated parents often possess a more comprehensive understanding of early childhood education and are more committed to their child's learning and development. This, in turn, positively affects children's cognitive abilities and linguistic proficiency. On the other hand, mothers with higher educational attainment show a greater inclination to enroll their children in extracurriculars, engage in physical activities, and provide play opportunities. This indicates that mothers' educational background influences their understanding of child development and their proactive involvement in fostering children's developmental prospects.

Home Environment and Access to Toys: One notable finding is that parents with higher educational attainment tend to have higher family incomes and larger indoor and outdoor activity spaces. These factors contribute to a more enriched physical home environment, providing children

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greater opportunities for exploration, play, and motor development. Furthermore, a greater abundance of toys and the involvement of multiple children in the family foster social interactions and cognitive development. Previous research indicated that more sources of play materials, including toys, predict better cognitive development (Wang, Luo, Yue, Tang, & Shi, 2022). According to Duncan, Magnuson, & Votruba-Drzal (2017), a traditional association exists between higher parental educational attainment and increased opportunities for higher-paying employment. This, in turn, results in higher income and access to additional resources, enabling parents to acquire a wider range of materials and resources conducive to supporting their children's learning and development.

Access to Extracurriculars and PA Programs: Children with parents having higher educational attainment were more likely to participate in extracurriculars and PA programs, which have been established as beneficial for all dimensions of DSSYC. This indicates a disparity in access to these programs based on SES and underlines the importance of equitable distribution of opportunities for child development. On the other hand, mothers with higher educational attainment are more inclined to enroll their children in extracurriculars, engage in physical activities, and provide play opportunities. This indicates that mothers' educational background influences their understanding of child development and their proactive involvement in fostering children's developmental prospects.

Impact of Media Screen Usage and Parents Involvement

Previous research indicated that most parents express that digital technology could positively impact children's cognitive and social development (Genc, 2014). Regarding media screen activity, the study highlights the differential influence of fathers and mothers based on their educational attainment. Fathers with higher education levels demonstrate a more favorable view towards electronic device usage, likely influenced by their greater exposure to such devices in professional settings. This finding suggests that fathers play a significant role in shaping children's screen media behavior.

5. Conclusions

This research significantly enhances the comprehension of the interconnections among parental education levels, physical play, media screen use, and early child development, thereby contributing substantially to the academic discourse in this field. By exploring these elements, we have enriched our comprehension of the intricate factors influencing children's developmental trajectories.

Our research emphasizes the crucial role of parental education in shaping the home environment and fostering parental involvement. We observed that higher parental education levels corresponded to more conducive conditions for child development, as evident in larger play spaces, a greater variety of toys, and enhanced participation in extracurriculars and physical activity programs. This underscores the necessity of parental education in cultivating an environment that nurtures and stimulates child development.

In addition, our research illuminates the role of media screen activity during early childhood. Although no significant relationship was found between participation in extracurriculars or physical activity programs and media screen activity, this underscores the need for an in-depth understanding of the factors influencing children's media consumption. Future research should further investigate the complex interplay between home environment facets, parental attitudes, and societal influences to gain a broader understanding of the impact of media screen activity on child development.

The limitations of our study need to be recognized. The relatively small sample size may limit the broad applicability of our findings. Future studies should strive to include larger and more diverse samples to enhance the results' external validity. Moreover, the geographical context of Macau may have swayed the results, especially regarding children's real activity spaces. The research tools and assessment scales used in this study were mainly derived from mainland China and foreign countries, potentially needing to capture Macau-specific characteristics and environmental factors fully. Future research should consider tailoring assessment tools to mirror the local context better and accurately evaluate children's experiences in Macau.

The implications of this research are not confined to academia. Policymakers, educators, and parents alike can leverage the insights gleaned from this study. Creating supportive environments that emphasize parental education, facilitate physical play, and encourage healthy media usage habits should be a priority to optimize child development outcomes.

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Appendix

Appendix 1: *Mean and standard deviation of parents' educational attainment*

Variable	Father Educational Attainment				Mother Educational Attainment		
	Mean±SD				Mean±SD		
	Total	PS &MS	SS	COLL	PS &MS	SS	COLL
Family Information							
Mother's salary	1.21±0.411	1.09±0.294	1.09±0.281	1.29±0.456	1.03±0.186	1.11±0.309	1.29±0.454
Father's salary	1.53±0.500	1.42±0.499	1.37±0.486	1.62±0.487	1.34±0.484	1.41±0.495	1.61±0.490
Annual income	5.69±0.778	5.49±0.856	5.57±0.769	5.78±0.756	5.24±0.988	5.65±0.665	5.77±0.779
Siblings	1.59±0.493	1.74±0.441	1.66±0.476	1.53±0.500	1.83±0.384	1.65±0.478	1.53±0.500
Parents Involvement							
Play involvement	2.71±0.401	2.77±0.309	2.71±0.434	2.70±0.403	2.77±0.298	2.60±0.480	2.76±0.362
Extracurriculars	1.22±0.415	1.16±0.374	1.17±0.378	1.25±0.435	1.21±0.412	1.12±0.321	1.27±0.445
PA program	1.15±0.358	1.09±0.294	1.13±0.335	1.17±0.378	1.10±0.310	1.09±0.283	1.19±0.390
Physical Home Environment							
Inside place	11.61±2.379	10.83±2.419	11.32±2.375	11.88±2.335	11.21±2.484	11.20±2.472	11.85±2.298
Fine-motor toys	43.84±15.157	40.33±16.163	41.91±13.912	45.34±15.357	39.86±14.114	39.24±13.540	46.47±15.456
Gross-motor toys	16.53±9.351	14.49±9.753	14.69±6.903	17.71±9.994	16.28±10.697	13.87±7.351	17.80±9.760
Media Screen Activity							
Devices	7.81±3.202	6.98±3.203	6.96±3.213	8.32±3.099	7.72±2.999	6.80±2.854	8.28±3.282
First contact (month)	13.72±7.900	14.19±9.132	15.61±9.225	12.84±6.863	14.07±7.250	14.04±8.910	13.54±7.504
Daily screen time	1.65±0.772	1.72±0.701	1.79±0.788	1.58±0.773	1.86±0.743	1.76±0.794	1.58±0.758
Reason of using	3.50±0.601	3.37±0.525	3.41±0.588	3.56±0.613	3.32±0.531	3.39±0.634	3.57±0.583
Favorable views	0.26±0.180	0.28±0.165	0.31±0.184	0.24±178	0.27±0.160	0.28±0.181	0.26±0.182
Child Development							
Perception and cognition development							
Basal level	39.52±19.508	45.12±22.675	41.27±18.636	37.70±19.023	39.14±18.23	41.18±19.153	38.81±19.860

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Appendix 2: *Correlation between SES and physical play*

Variable	Language	Social	Gross Motor	Fine Motor	Cognition
Physical Home Environment					
Outside space	0.077	0.070	0.077	0.087	0.066
Inside space	-0.024	0.016	0.005	-0.007	-0.032
Variety of stimulation	.226**	.233**	.268**	.262**	.233**
Gross motor toys	.215**	.175**	.186**	.197**	.187**
Fine motor toys	0.059	0.007	0.050	0.044	0.019
Parents Involvement					
Move activities	0.083	0.041	0.083	0.061	0.038
Play involvement	0.039	-0.027	-0.043	0.022	0.027
Electronic use	-0.039	-0.059	-0.059	-0.047	-0.065
Media Screen Activity					
Devices	-0.015	-0.012	0.000	0.012	-0.024
First contact	.228**	.183**	.188**	.223**	.230**
Family Information					
Father educational attainment	-0.052	-.109*	-0.090	-0.093	-0.091
Mother educational attainment	-0.025	-0.078	-0.061	-0.072	-0.014
Father's salary	0.092	0.045	0.092	0.072	0.057
Mother's salary	-0.005	-0.049	-0.062	-0.029	-0.021
Parents Involvement					
Extracurriculars	.292**	.264**	.211**	.275**	.284**
PA program	.264**	.228**	.192**	.257**	.268**
Parent company time (indoor + outdoor)	.146**	0.084	0.085	.108*	0.093
Outdoor activities	.219**	.189**	.218**	.186**	.218**

Note：*p < 0.05, **p < 0.01, ***p < 0.001

Language=Language and communication development

Social= Social and personality development

Gross Motor= Gross motor development

Fine Motor= Fine motor development

Cognition= Perception and cognition development

Appendix 3: *Differences of variable between parents' educational attainment (Chi-Square)*

Variable	Unit	Father educational attainment				Mother educational attainment			
		PS&MS (%)	SS (%)	COLL (%)	χ^2	PS&MS (%)	SS (%)	COLL (%)	χ^2
Family Information									
Mother's salary	≤ 25,000	39(10.9)	86(24.0)	157(43.7)	21.184***	28(7.7)	93(25.9)	161(44.9)	20.046***
	≥ 25,001	4(1.1)	8(2.2)	65(18.1)		1(0.3)	11(3.1)	65(18.1)	
	Total	43(12.0)	94(26.2)	222(61.8)		29(8.0)	104(29.0)	226(63.0)	
Father's salary	≤ 25,000	25(7.0)	59(16.4)	85(23.7)	18.282***	19(5.3)	61(17.0)	89(24.8)	14.926***
	≥ 25,001	18(5.0)	35(9.8)	137(38.2)		10(2.7)	43(12.0)	137(38.2)	
	Total	43(12.0)	94(26.2)	222(61.8)		29(8.0)	104(29.0)	226(63.0)	
Annual income	≤ 400,000	14(3.9)	27(7.5)	29(8.1)	15.626***	13(3.5)	27(7.5)	30(8.4)	20.198***
	> 400,000	29(8.1)	67(18.7)	193(53.7)		16(4.5)	77(21.5)	196(54.6)	
	Total	43(12.0)	94(26.2)	222(61.8)		29(8.0)	104(29.0)	226(63.0)	
Siblings	One	11(3.1)	32(8.9)	105(29.2)	9.723 **	5(1.4)	36(10.1)	107(29.8)	12.253**
	≥Two	32(8.9)	62(17.3)	117(32.6)		24(6.6)	68(18.9)	119(33.2)	
	Total	43(12.0)	94(26.2)	222(61.8)		29(8.0)	104(29.0)	226(63.0)	

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Appendix 3 continued

Variable	Unit	Father educational attainment				Mother educational attainment			
		PS&MS (%)	SS (%)	COLL (%)	χ^2	PS&MS (%)	SS (%)	COLL (%)	χ^2
Number of rooms	1 1	1(0.3)	1(0.3)	4(1.1)	16.012*	1(0.3)	2(0.6)	3(0.8)	7.139
	2 2	23(6.4)	55(15.3)	101(28.1)		17(4.7)	58(16.2)	104(29.0)	
	3 3	17(4.7)	37(10.3)	102(28.4)		10(2.7)	42(11.6)	104(29.0)	
	4 4	1(0.3)	1(0.3)	15(4.2)		1(0.3)	2(0.6)	14(3.9)	
	≥5	1(0.3)	0	0		0	0	1(0.3)	
	Total	43(12.0)	94(26.2)	222(61.8)		29(8.0)	1.4(29.0)	226(63.0)	
Parents Involvement									
Extracurriculars	Not Join	36(10.1)	78(21.7)	166(46.2)	3.523	23(6.4)	92(25.6)	165(46.0)	9.941 **
	Join	7(1.9)	16(4.5)	56(15.6)		6(1.7)	12(3.3)	61(170)	
	Total	43(12.0)	94(26.2)	222(61.8)		29(8.1)	104(28.9)	226(63.0)	
PA program	Not Join	39(10.9)	82(22.9)	184(51.3)	2.238	26(7.2)	95(26.5)	184(51.3)	6.041*
	Join	4(1.1)	12(3.3)	38(10.5)		3(0.8)	9(2.5)	42(11.7)	
	Total	43(12.0)	94(26.2)	222(61.8)		29(8.0)	104(29.0)	226(63.0)	
Parent company time (indoor + outdoor)	≤ 3 hours	2(0.6)	6(1.7)	30(8.4)	10.648	1(0.3)	11(3.1)	26(7.2)	3.741
	3-5hours	16(4.5)	46(12.8)	103(28.6)		15(4.2)	52(14.5)	98(27.4)	
	5-8hours	19(5.2)	30(8.4)	56(15.6)		10(2.7)	28(7.8)	67(18.7)	
	≥ 8 hours	6(1.7)	12(3.3)	33(9.2)		3(0.8)	13(3.6)	35(9.7)	
	Total	43(12.0)	94(26.2)	222(61.8)		29(8.0)	104(29.0)	226(63.0)	
Outdoor activities	≤ 30 minutes	8(2.2)	14(3.9)	35(9.7)	5.566	2(0.6)	21(5.8)	34(9.5)	5.092
	30-60minutes	20(5.7)	48(13.4)	131(36.6)		19(5.2)	52(14.5)	128(35.7)	
	60-120minutes	7(1.9)	19(5.3)	35(9.7)		5(1.4)	16(4.5)	40(11.1)	
	≥ 120minutes	8(2.2)	13(3.6)	21(5.8)		3(0.8)	15(4.2)	24(6.7)	
	Total	43(12.0)	94(26.2)	222(61.8)		29(8.0)	104(29.0)	226(63.0)	
Media Screen Activity									
Devices	Never used	4(1.1)	10(2.8)	41(11.4)	4.485	3(0.8)	14(3.9)	38(10.6)	1.219
	Have used	39(10.9)	84(23.4)	181(50.4)		26(7.2)	90(25.1)	188(52.4)	
	Total	43(12.0)	94(26.2)	222(61.8)		29(8.0)	104(29.0)	226(63.0)	
Daily screen time	≤1h	18(5.0)	38(10.6)	127(35.4)	11.001	10(2.8)	45(12.5)	128(35.7)	10.536
	1-2h	19(5.3)	41(11.4)	66(18.3)		13(3.6)	42(11.7)	71(19.8)	
	>2h	6(1.7)	15(4.2)	29(8.1)		6(1.7)	17(4.7)	27(7.5)	
	Total	43(12.0)	94(26.2)	222(61.8)		29(8.1)	104(28.9)	226(63.0)	
Children Information									
Gender	Male	25(7.0)	54(15.1)	104(29.0)	3.973	18(5.0)	56(15.6)	109(30.4)	2.453
	Female	18(5.0)	40(11.1)	118(32.8)		11(3.0)	48(13.4)	117(32.6)	
	Total	43(12.0)	94(26.2)	222(61.8)		29(8.0)	104(29.0)	226(63.0)	
Age group	18-24 months	11(3.1)	24(6.7)	74(20.6)	14.642*	5(1.4)	23(6.4)	81(22.6)	9.686
	24-36 months	10(2.8)	30(8.4)	83(23.1)		13(3.5)	41(11.4)	69(19.3)	
	36-48 months	10(2.8)	27(7.5)	39(10.9)		6(1.7)	25(7.0)	45(12.5)	
	48-60 months	12(3.3)	13(3.6)	26(7.2)		5(1.4)	15(4.2)	31(8.6)	
	Total	43(12.0)	94(26.2)	222(61.8)		29(8.0)	104(29.0)	226(63.0)	
Birthplace	China mainland	1(0.3)	6(1.7)	5(1.4)	5.371	2(0.6)	5(1.4)	5(1.4)	10.239
	Macau	41(11.4)	82(22.9)	202(56.3)		27(7.4)	95(26.5)	203(56.6)	
	Hong Kong	1(0.3)	3(0.8)	7(1.9)		0	4(1.1)	7(1.9)	
	Others	0	3(0.8)	8(2.2)		0	0	11(3.1)	
	Total	43(12.0)	94(26.2)	222(61.8)		29(8.0)	104(29.0)	226(63.0)	

Note: *p < 0.05, **p < 0.01, ***p < 0.001

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