

Mitigating adverse social determinants of health in the vulnerable population: Insights from a home visitation programme

Kevin Wei Hao Liang^{1,2,3} MMed, Keith Wei Han Liang^{1,3} MMed, Qing Rong Chan² BA, Winnie Hwee Suat Goh^{2,3,4} FAMS

ABSTRACT

Introduction: Low-income families are exposed to adverse childhood experiences and psychosocial risks that impact child development. At the KK Women's and Children's Hospital in Singapore, Kids Integrated Development Service (KIDS0-3) is a home visitation programme that aims to optimise the development of children from low-income families.

Method: Data comprising family demographics, maternal psychosocial risks and outcomes of child development were collated through a chart review of 469 mother-child dyads enrolled from June 2014 to October 2022.

Results: Based on the Family and Adult Support Tool, 312 families (67%) were identified as moderate or high-risk. Children from moderate and high-risk families had poorer Bayley cognitive (mean 95.88 [SD 8.25] versus [vs] 98.44 [SD 8.72], $P=0.014$) and language scores (mean 87.38 [SD 10.35] vs 90.43 [SD 9.61], $P=0.016$) at 24 months of age, compared to the low-risk group. Children of teenage mothers had lower Bayley cognitive scores (mean 95.16 [SD 8.42] vs 97.76 [SD 8.55], $P=0.037$), and children of mothers who experienced sexual abuse had lower Bayley cognitive scores (mean 93.1 [SD 5.68] vs 99.7 [SD 8.17], $P=0.013$) and language scores (mean 82.3 [SD 12.87] vs 91.3 [SD 10.86], $P=0.021$). Antenatal enrolment yielded better child language (mean 90.1 [SD 9.37] vs 87.13 [SD 10.79], $P=0.04$) and motor outcomes (mean 99.62 [SD 9.45] vs 94.72 [SD 9.51], $P=0.001$) than postnatal enrolment.

Conclusion: Psychosocial risks impact the development of children from low-income families in Singapore. Findings underscore the importance of early, integrated intervention for vulnerable families.

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Keywords: adverse childhood experiences, child development outcomes, low-income families, maternal psychosocial risks, toxic stress

CLINICAL IMPACT

What is New

- This is a Singapore study describing the psychosocial risks of mothers from low-income families and its impact on child development.
- Findings underscore the importance of upstream intervention in vulnerable families.

Clinical Implications

- Findings highlight the need for early, tailored support for vulnerable families, in particular, teenage mothers and mothers with history of sexual abuse.
- Upskilling of home visitors in infant mental health and trauma-informed care is crucial to support the needs of vulnerable families.

INTRODUCTION

Strong evidence consistently links low income to Adverse Childhood Experiences (ACEs) and children's long-term health, developmental, educational and social outcomes.^{1,2}

Poverty increases parenting stress, and this is especially important in early childhood when the home environment and parent-child bond are the main contributing factors in shaping children's biological and psychosocial pathways.³ Furthermore, research has linked early poverty to changes in brain structures critical for emotional regulation and cognitive function.⁴

Despite the growing economy, poverty remains evident in Singapore. A substantial 12% of households in Singapore do not have adequate income to meet basic consumption needs; the relative poverty rate indicates that 24% of households in Singapore do not earn enough to keep up

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¹ Department of Paediatrics, KK Women's and Children's Hospital, Singapore

² KKH KIDS0-3, Division of Medicine, KK Women's and Children's Hospital, Singapore

³ Duke-NUS Medical School, Singapore

⁴ Department of Child Development, KK Women's and Children's Hospital, Singapore

Correspondence: Dr Kevin Wei Hao Liang, Department of Paediatric Medicine, KK Women's and Children's Hospital, 100 Bukit Timah Road, Singapore 229899.

Email: kevin.liang.w.h@singhealth.com.sg

with the rest of society.⁵ A study conducted by the Singapore Children's Society showed that 62% of children from low-income families experienced at least 3 ACEs.⁶

To achieve health equity and mitigate downstream effects of poverty, it is pertinent to commence early integrated interventions from conception and early childhood, especially during the first 1000 days of life.^{7–10} Interventions designed to optimise child development should aim at strengthening the capability and capacity of their caregivers.¹¹ These efforts can shift the odds towards more favourable developmental outcomes, especially for children at risk.¹²

The Kids Integrated Development Service (KIDS0-3) began in 2014 at KK Women's and Children's Hospital (KKH), the largest public hospital providing tertiary healthcare services for women and children in Singapore. Using an integrated health and social approach, this programme aims to mitigate adverse social determinants of health and optimise the developmental potential of children from low-income

families. To date, there have been limited local data pertaining to maternal psychosocial risk factors and its association with child development outcomes in the vulnerable population.

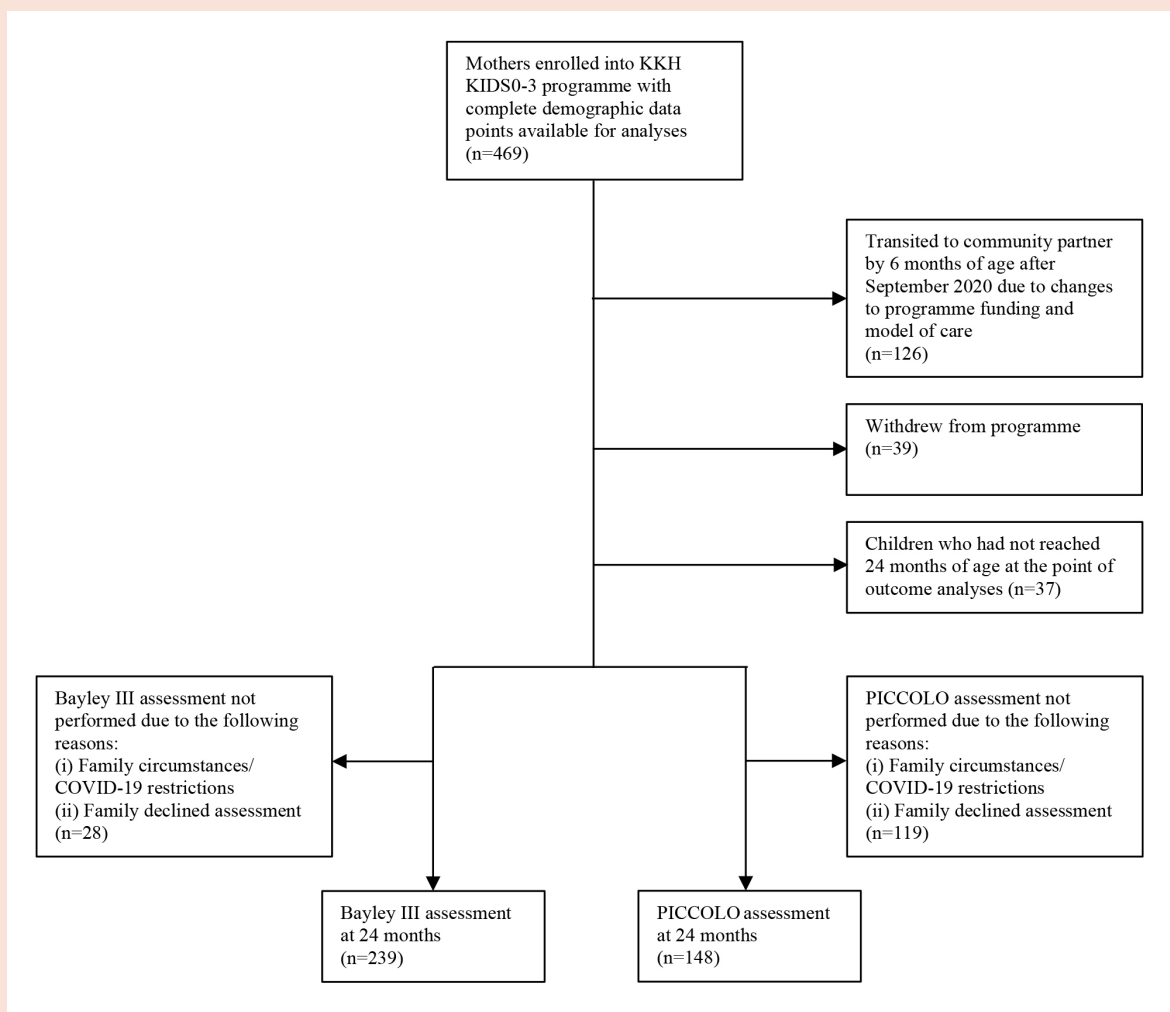
This paper aims to describe the demographics and psychosocial risk factors of mothers from low-income families enrolled into the programme at pregnancy or within 1 week postpartum, as well as to study the associations between psychosocial risk factors and child development outcomes.

METHOD

Study design

This is a descriptive retrospective study of a single-centre home visitation programme targeting low-income families in Singapore. Information was collated through a chart review of 469 mother-child dyads enrolled in the KIDS0-3 programme from June 2014 to October 2022 (Fig. 1). Three hundred and sixty mothers (77%) were enrolled prenatally, and 109 (23%) were enrolled postnatally.

Fig. 1. Number of families enrolled and assessment of demographic data and outcomes.



This programme included pregnant women whose children would be born Singapore citizens at KKH or infants that are Singapore citizens, from less than 7 days old and with per capita family income $\leq$ SGD650 or gross household income $\leq$ SGD2500. This targets to support the bottom 20th percentile by household income in the population.¹³

By virtue of the fact that specialised services would better meet their needs, babies with the following problems were excluded from the programme: malignancy; congenital cyanotic cardiac disease; severe birth defects detected antenatally; genetic conditions associated with significant developmental delay and/or associated with other organ involvement; chronic conditions with neuromuscular or musculoskeletal involvement that would impede their ability to perform developmental activities; conditions with high nursing needs (e.g. long-term nasogastric tube feeding, stoma, tracheostomy); and any other conditions with specific programmes in the hospital or community that can cater to their needs (e.g. home care, very low birth weight baby <1.5 kg, early intervention programme for infants and children).

The programme is transdisciplinary, where frontline team members, known as key workers, are the single point of contact for the family.¹⁴ They consist of nurses who support families during the antenatal and early postnatal period up to 12 weeks post-delivery, and health visitors who provide support from 12 weeks onwards. They are supported by the team of doctors, social workers and allied health professionals through peer learning, coaching and reflective supervision.

Enrolled mothers receive regular home visits starting from pregnancy until their child reaches the age of 3. During pregnancy, nurses conduct a home visit in each trimester, and advise mothers on maternal nutrition, mental wellness, exercise, and smoking and alcohol cessation. The importance of key antenatal investigations and appointments is reinforced to improve understanding and compliance. Pre-delivery, mothers are advised on birth preparedness, home readiness, breastfeeding and parent craft. They are guided using principles of infant mental health, to promote early stimulation of their newborn through daily caregiving practices. From 12 weeks onwards, the health visitors conduct home visits every fortnight till 6 months of age and monthly visits thereafter. They focus on promoting healthy nutrition, growth and child development practices. Key workers apply the Abecedarian approach, a set of evidence-based strategies implemented through individualised adult-child interactions.^{15,16} It comprises 4 interconnected elements that facilitate adult-child interaction and

stimulate children's development: language priority, enriched caregiving, conversational reading and learning games. Every key worker is trained in the Abecedarian approach, and fidelity checks are conducted for quality assurance. The programme also adopts a developmental parenting approach to home visitation, which comprises evidence-based strategies to engage parents in supporting children's development.¹⁷ In this regard, the Home Visit Rating Scales have been applied to guide observations in home visit quality and improve home visitation practices and family engagement.¹⁸

Through a transdisciplinary and family-centred approach, the key workers aim to build strong rapport with families and develop self-sufficient families who can navigate societal challenges. This is augmented by collaborative partnerships established with community agencies and preschools.

Study variables

Demographic data comprising age, ethnicity, education level, employment status and housing type were obtained at enrolment. Psychosocial risks were assessed using the Family and Adult Support Tool (FAST),¹⁹ which is adapted from Child and Adolescent Needs and Strengths, or CANS — a family of planning and outcome management tools developed by the John Praed Foundation.²⁰ It is a multipurpose communicative tool for understanding family needs and strengths in order to prioritise intervention, and this has been standardised for use among family service centres in Singapore which provide community-based social services. It measures the domains of safety concerns, risk behaviours, individual functioning, family functioning and family strengths. Each domain is scored on a level of 0 to 3, where 3 indicates the highest risk. Families in the programme were rated as "low risk" if risk factors were scored at 0 or 1 only, "moderate risk" if at least one level-2 risk was identified, and "high risk" if at least one level-3 risk was identified. ACEs were recorded through a questionnaire adapted from the Centers for Disease Control and Prevention's ACEs study in the US.²¹ Data collection for ACEs commenced mid-way during the study; hence, only 340 cases were recorded.

Outcome measures included child development and parent-child interaction at 24 months of age. Due to changes in the government's funding model from September 2020 onwards, children assessed to be of low-to-moderate risk were transited to the community partner by 6 months of age for continued follow-up through home visits. Children assessed to be of high risk continued to receive

support from the programme till 3 years of age. In addition, due to home-visiting restrictions during the COVID-19 pandemic and family circumstances, the above assessments could not be completed for every family. In particular, assessment of parent-child interaction involved a process of video recording and hence, there was a substantial number of mothers who declined. In view of these reasons, data at 24 months for development and parent-child interaction were only available for 51% and 32% of the sample, respectively (Fig. 1).

The Bayley-III tool was administered to children at 24 months of age to assess developmental outcomes.²² Bayley-III is a standardised neurocognitive assessment tool used to assess the development of infants and young children aged between 1 and 42 months across 5 domains (cognitive, language, motor, adaptive and social-emotional) using a series of play tasks and parent report questionnaires. Scoring is dichotomous (1, 0) and the composite score for Bayley-III is calculated for the cognitive, language and motor scales.

Parenting Interactions with Children: Checklist of Observations Linked to Outcomes (PICCOLO) was used to assess parent-child interaction at 24 months of age. It is a validated tool for children ages 10 to 47 months, that predicts child outcomes in cognitive development, vocabulary and behaviour using observational measures of parenting interactions.²³ It measures 4 domains of developmental parenting (affection, responsiveness, encouragement and teaching), where the observation of items is scored from 0 to 2 (0=absent, 1=barely, 2=clearly). A scoring grid is used, and the individual domains are rated as below average, average or above average.

Statistical analysis

Baseline demographics, psychosocial risk based on FAST and maternal ACEs were summarised as frequencies and percentages. Continuous variables were compared using independent-samples t-test. Independent-samples t-test was used to compare mean scores for Bayley-III among families belonging to different risk groups based on FAST (moderate/high and low); it was also performed to compare Bayley-III mean scores of children among mothers who were enrolled antenatally versus postnatally. Chi-squared test was used to compare the scores of various domains of PICCOLO among families in the moderate/high- and low-risk groups. All data analyses for this report were performed using SPSS Statistics version 28 (IBM Corp, Armonk, NY, US). A *P* value <0.05 was considered statistically significant.

RESULTS

Population demographics and psychosocial risk profile

In our cohort, 118 (25%) were young mothers below the age of 21 years. Two hundred and sixty-nine were Malay (57%), and the rest comprised 101 (22%) Chinese, 60 (13%) Indian, 2 (0.1%) Eurasian, and 37 (7.9%) from other ethnic groups. Two hundred and fifty-three (54%) mothers were unemployed and 267 (57%) lived in 1- or 2-room public rental flats. Three hundred and seven (65%) mothers received education of secondary school level or below. Three hundred and sixty (77%) mothers in the programme were recruited antenatally, with 50 (11%) mothers recruited in the first trimester of pregnancy (Table 1).

Based on the FAST, 272 (58%) families had significant financial needs, 112 (24%) had significant mental health issues, and 117 (25%) had criminal involvement (Table 1); 312 (67%) families were identified to have moderate-to-high risks at enrolment. One hundred and seventy mothers (50%, *n*=340) had experienced ≥3 ACEs (Table 2).

Child development outcomes

The Bayley-III tool was administered to 239 (51%) children at 24 months of age. Out of 239 children, 234 (98%), 196 (82%) and 232 (97%) had normal cognitive, language and motor ability respectively.

Children of teenage mothers had lower Bayley cognitive scores (teenage mothers: mean 95.16, SD 8.42; non-teenage mothers: mean 97.76, SD 8.55), and children of mothers who reported an experience of sexual abuse scored lower in Bayley cognitive (mean 93.1, SD 5.68) and language scores (mean 82.3, SD 12.87), compared with those whose mothers did not (cognitive: mean 99.7, SD 8.17; language: mean 91.3, SD 10.86).

Children from families in the moderate/high-risk group based on FAST had poorer Bayley cognitive (mean 95.88, SD 8.25) and language scores (mean 87.38, SD 10.35) at 24 months of age, compared with those in the low-risk group (cognitive: mean 98.44, SD 8.72; language: mean 90.43, SD 9.61) (Table 3). In addition, there were more families in the moderate/high-risk group scoring below average PICCOLO scores in Encouragement (χ^2 [2,171]=7.12, *P*=0.028) and Teaching (χ^2 [2,171]=9.56, *P*=0.008) when compared with those in the low-risk group.

Table 1. Sample demographics, FAST items, frequency and percentages (n=469).

Demographic categories		Number of families	Percentage (%)
Maternal age	Below 21 years of age	118	25
	21–25 years of age	125	27
	26–30 years of age	116	25
	Above 30 years of age	110	23
Maternal ethnicity	Chinese	101	22
	Malay	269	57
	Indian	60	13
	Eurasian	2	0.1
	Other ethnic groups	37	7.9
Maternal education level	Special needs school	6	1
	Up to primary school level	43	9
	Up to secondary school level	264	56
	Vocational school	103	22
	Diploma	33	7
	Degree and higher	20	5
Maternal employment status	Working full-time	47	10
	Working part-time/adhoc	37	8
	Homemaker	120	26
	Others	12	2
	Unemployed	253	54
Housing type	1- & 2-room public rental flat	267	57
	3-, 4-, 5-room public purchased flat	184	39
	Executive apartment or condominium	3	1
	Others	15	3
Recruitment period	First trimester	50	11
	Second trimester	140	30
	Third trimester	170	36
	Postnatal	109	23
FAST rating at point of intake	Low needs	157	33
	Moderate needs	204	44
	High needs	108	23
Moderate/high needs for the following FAST domains			
Safety concerns	Child abuse	13	3
	Intimate partner violence	17	4
	Home environment safety	20	4

Table 1. Sample demographics, FAST items, frequency and percentages (n=469). (Cont'd)

Demographic categories		Number of families	Percentage (%)
Risk behaviours	Suicide risk	10	2
	Self-harm risk	7	1
Individual functioning	Physical/medical	98	21
	Employment	51	11
	Educational	14	3
	Mental health	112	24
Family functioning	Family conflict issues	40	12
	Family communication issues	56	16
	Financial	272	58
	Social support	70	15
	Criminal involvement	117	25
Caregiving	Involvement in care	3	0.5
	Supervision/discipline	7	1
	Caregiver knowledge	9	2
	Caregiver stress	8	2
	Caregiver organisational skills	3	0.5
Family strength	Relationship	15	3
	Resiliency	4	1
	Resourcefulness	1	0.2
	Motivation to change	1	0.2

FAST: Family and Adult Support Tool

Language (mean 90.10, SD 9.37) and motor (mean 99.62, SD 9.45) development scores for children whose mothers were enrolled antenatally were higher than children whose mothers participated postnatally (language: mean 87.13, SD 10.79; motor: mean 94.72, SD 9.51) (Table 4).

DISCUSSION

This study gives insight into the psychosocial risk factors of vulnerable families, their impact on child development outcomes, and provides a better understanding of the role of a home visitation programme in mitigating adverse social determinants in Singapore.

Compared to the Singapore adult population, mothers from our cohort had a considerably higher proportion of ACEs, especially for divorce/separation, incarceration, violence, substance abuse and sexual abuse.²⁴

A quarter of mothers in our cohort were less than 21 years of age. Children born to teenage mothers in our cohort had lower Bayley cognitive scores at 24 months of age. The effect of younger maternal age on cognitive outcomes in children is likely to be associated with the sociodemographic circumstances that the children are born into. Morinis et al.²⁵ also showed a strong association between young maternal age and poor cognitive outcomes at 5 years, but after adjustment for confounders, this effect was mostly explained by marked inequalities in sociodemographic circumstances and perinatal risks. A more tailored intervention for young adolescent mothers is important. Key areas include maternal nutrition, mental wellness and the avoidance of smoking, alcohol use and substance abuse. Key workers also emphasised contraception, family planning and role of parents. The programme has strengthened

Table 2. Maternal Adverse Childhood Experiences (ACEs; n=340).

	Number of mothers ^a (KIDS 0-3)	KIDS 0-3 ^a (%)	Singapore ^b (%)
Types of ACEs			
Divorce/Separation	178	53	22
Incarceration	109	33	5
Mental illness	51	15	6
Substance abuse	85	25	5
Violence	102	30	8
Economic hardship	133	39	-
Emotional neglect	145	43	46
Physical neglect	46	14	6
Physical abuse	75	22	5
Emotional abuse	85	25	8
Sexual abuse	45	13	5
Number of ACEs			
0 ACEs	56	16	
1 ACE	51	15	
2 ACEs	63	19	
3 ACEs	39	11	
4 or more ACEs	131	39	

^a KIDS ACEs data collection commenced mid-way of study. Hence, there were only 340 cases with ACEs recorded.

^b Data for Singapore adult population from Subramaniam M, Abidin E, Seow E, et al. Prevalence, socio-demographic correlates and associations of adverse childhood experiences with mental illnesses: Results from the Singapore Mental Health Study. Child Abuse Negl 2020;103:104447.

Table 3. Bayley-III and FAST risk: means, standard deviations and *P* values (n=239).

Bayley-III domains	FAST risk mean (SD)		t-test statistic (<i>P</i> -value) ^a
	Low	Moderate/high	
Cognitive	98.44 (8.72)	95.88 (8.25)	2.474 (0.014)
Language	90.43 (9.61)	87.38 (10.35)	2.435 (0.016)
Motor	98.15 (9.89)	98.20 (9.55)	-0.040 (0.968)

^a Comparing means of Bayley scores between children from families in the low versus moderate/high groups based on FAST risk. FAST: Family and Adult Support Tool; SD: standard deviation

collaborative efforts with the hospital's teenage pregnancy clinic to enrol pregnant adolescents. The team also works closely with community partners to facilitate early infant care placement as mothers seek education or employment opportunities. Where needed, the programme works with voluntary welfare organisations that can provide baby necessities, counselling services or a temporary shelter during family crises.

Importantly, the key workers journey closely with adolescent mothers to monitor their mental health, develop their parenting confidence and empower them to make responsible life decisions.

In our study, 13% of mothers reported an experience of sexual abuse. Children of these mothers scored significantly lower in Bayley cognitive scores and language scores. Mothers' early adversity has been known to affect their

Table 4. Recruitment period and Bayley-III: means, standard deviations and *P* values for variables (n=239).

Bayley-III domains	Recruitment period mean ^a (SD)		t-test statistic (<i>P</i> -value) ^b
	Antenatal	Postnatal	
Cognitive	97.75 (8.67)	96.87 (7.68)	0.733 (0.464)
Language	90.10 (9.37)	87.13 (10.79)	2.06 (0.040)
Motor	99.62 (9.45)	94.72 (9.51)	3.55 (0.000)

^a Composite scores were compared with the standardised composite scoring provided by the developers: 69 and below: extremely low; 70–79: borderline; 80–89: low average; 90–109: average; 110–119: high average; 120–129: superior; and 130 and above: very superior.

^b Comparing means of Bayley scores between children whose mothers were enrolled into the programme antenatally versus postnatally

children's development, largely through effects on maternal mental health and parenting confidence.²⁶ In particular, childhood sexual abuse results in increased risks for mothers and their children due to the intergenerational nature of this trauma and the disruption it causes in the mother-child relationship.^{27,28} Consequently, disruption to maternal attachment can have a lasting impact on neurological, emotional and social development.²⁹ With the higher prevalence of ACEs in vulnerable families, in particular, sexual abuse, there is a pressing need to upskill the team in infant mental health and trauma-informed practice. The key workers have undergone certificate courses conducted by the University of Minnesota, Center for Early Education and Development, that provide a crucial foundation in infant mental health and intervention with infants, toddlers, and their parents. The programme has also embarked on training sessions facilitated by mental health experts to equip the team on evidence-based principles of trauma-informed practice.³⁰ This allows key workers to support the families more effectively, identify mental health concerns, and facilitate early referral to the Mental Wellness Service or Psychosocial Trauma Support Service where warranted. A greater emphasis is also being placed on reflective supervision, where key workers share their feelings about working with vulnerable families; this aids to decrease burnout and improve satisfaction and morale.³¹

Families in the moderate/high-risk groups based on FAST were also associated with poorer Bayley cognitive and language scores as well as poorer PICCOLO encouragement and teaching scores, compared to those who belonged to the low-risk group. Poverty increases young children's exposure to biological and psychosocial risks that affect development through changes in brain structure and function.³² Such children are often exposed to multiple and cumulative risks, and their development is increasingly compromised with the accumulation of such risks.³³ In addition, a lack of positive parenting behaviours negatively

affects child development, and this is apparent as early as 6 months of age.³⁴ Though the findings of lower Bayley scores among children of mothers with moderate/high risk were statistically significant, we recognise that the clinical outcomes may vary. This is in part due to the intervention from key workers and government assistance from social service agencies, which may have helped to buffer the impact of the adverse environment for children belonging to the moderate/high-risk groups. When supporting families with higher psychosocial risk, the programme focuses on promoting positive parenting behaviours. One approach is through video-feedback intervention, where key workers share with parents the strengths observed in their parent-child interaction, and potential areas of improvement in each domain. In high-risk families where mothers are unable to function as the primary caregiver, the programme works with the family and government agencies to find an alternative caregiver, who can build a safe, stable and nurturing relationship with the child, thereby buffering the impact of toxic stress.

Positive developmental outcomes were seen in children whose mothers were enrolled antenatally into the programme. The findings build on existing literature showing that investment in the vulnerable population should commence before birth because intervention during pregnancy can mould the future trajectory of health and abilities.³⁵ During antenatal home visits, mothers are provided with anticipatory guidance that promotes mental wellness and healthy pregnancies. Mothers are taught early developmental stimulation practices in preparation for their newborns, and this is reinforced postnatally. This has been key in helping mothers to support their child's development through daily caregiving routines and practices. Although 77% of mothers were enrolled antenatally, only 11% were enrolled in the first trimester. It is hence crucial to streamline processes and improve community networking to allow early referrals of pregnant women at risk.

CONCLUSION

It is the responsibility of every child health worker to advocate for and achieve health equity in the vulnerable population. As Singapore's attention shifts from "survive to thrive", and from "healthcare to health", it is pertinent that these families are not left behind.³⁶ Altering the developmental trajectory of a young child growing up in an adverse environment requires much perseverance.¹² A holistic population health approach with inter-professional collaboration within the community is crucial. We must emphasise positive parenting and strengthen the capacity of parents to fulfil their roles effectively³⁷—this will give children a better start in life.

The findings highlight the psychosocial risk profile of the low-income families in Singapore and its impact on child development outcomes. Early targeted interventions such as home visitation are important to reach families who may have difficulties accessing healthcare services due to psychosocial constraints.

Further development to tailor intervention and support is pertinent, as this home visitation programme expands to benefit more families. This can be achieved with continual refining of our service delivery through data feedback, regular upskilling of team members, and strengthening of collaboration with our partners in the ecosystem.

Conflict of interest

None to declare.

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