

The impact of Anchor, a home visitation programme for maltreated children, on child developmental and behavioural outcomes

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ABSTRACT

Introduction: Adverse childhood experiences (ACEs) are associated with significant long-term impacts, yet few interventions specifically target ACE exposure, especially in Asian populations. Anchor, Singapore's first home visitation programme, addresses maltreatment among preschool children. This study evaluated Anchor's impact on children's developmental and behavioural outcomes.

Method: We conducted a prospective evaluation of children under 4 years assessed for maltreatment from November 2019 to July 2023. Developmental and behavioural progress was measured every 6 months using the Ages and Stages Questionnaires (ASQ-3) and ASQ:Social-Emotional (ASQ:SE-2), and annually using the Child Behaviour Checklist (CBCL).

Results: The results of 125 children (mean age 20.0 months, 48% female) were analysed. The mean length of stay in programme was 21.2 (7.3) months. At baseline, 92 (73.6%) children were at risk of developmental delay and 25 (31.7%) children aged ≥18 months had behavioural concerns. The programme was associated with significant improvements in gross motor ($P=0.002$) and fine motor ($P=0.001$) domains of the ASQ-3 and internalising problem scale ($P=0.001$) of the CBCL.

Conclusion: Anchor effectively enhances developmental and behavioural outcomes for children exposed to maltreatment. Targeted early intervention through such programmes can mitigate adverse impacts, optimising developmental trajectories and potentially reducing the long-term clinical and economic burdens associated with ACEs.

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Keywords: ACEs, adverse childhood experiences, behavioural difficulties, caregiver mental health, child

development, child maltreatment, community health visitor, developmental delay, externalising behaviour, home visit, home visitation programme, internalising behaviour, paediatrics

CLINICAL IMPACT

What is New

- Anchor is the first home visitation programme in Singapore designed to support preschool children who were exposed to maltreatment, and their families.
- Findings underscore the need for intervention in early childhood for these children to mitigate the long-term effects of adverse childhood experiences (ACEs).

Clinical Implications

- The study supports the need for a holistic programme to support maltreated young children and families.
- This finding can potentially influence policymaking and guide efforts to minimise the long-term clinical and economic burden caused by ACEs.

INTRODUCTION

Adverse childhood experiences (ACEs) can occur in the form of abuse (physical, emotional, sexual), neglect (physical, emotional) and household dysfunction. The first ACEs study published in

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1998 demonstrated the association between ACEs and multiple risk factors of mortality in adulthood.¹ The greater the number of ACEs exposure, the higher the odds of having negative psychosocial or behavioural outcomes in adulthood, such as tobacco use, alcohol problem, risky sexual behaviour and mental health problems.^{2,3} Early adverse experiences have been shown to cause changes to the developing brain, thereby adversely impacting long-term outcomes, such as cognitive development, academic performance, and physical and mental health in adulthood.⁴⁻⁶ Early relationships, particularly with primary caregivers, also play a crucial role in the emotional and social development of the child. Insecure attachment or disrupted relationships in early childhood can contribute to difficulties in emotion regulation and social interactions, which are linked to higher likelihood of mental health problems in adolescence and adulthood.⁷

The burden of ACEs has been widely studied over past decades. National surveys have reported prevalence of ≥ 1 ACE for adults to be 63.9% in the US,⁸ 46.4% in the UK⁹ and 80.9% in China,¹⁰ bearing in mind the difference in minimum age of recruited participants. The economic burden of ACEs was analysed across 28 European countries, which revealed the total ACE-attributable costs to range from USD0.1 billion (Montenegro) to USD129.4 billion (Germany) and these were equivalent to between 1.1% (Sweden and Turkey) and 6.0% (Ukraine) of nations' gross domestic products.¹¹ In Singapore, the reported lifetime prevalence of at least 1 ACE for adults was 63.9%.¹² Liu et al. described that individuals exposed to ≥ 3 ACEs utilised more direct medical care and experienced greater productivity losses than those without ACEs, resulting in substantial clinical and economic burden.¹³ The adjusted incremental costs of ACEs, compared to no ACE, were estimated to be SGD1.18 billion (≥ 1 ACE) and SGD680 million (≥ 3 ACEs) per year.¹³

At KK Women's and Children's Hospital (KKH), approximately 100 to 120 children under 4 years old are assessed for suspected maltreatment every year. While an assessment of the families was in place to determine the case disposition, there was a lack of structured developmental, behavioural and trauma assessments of the child and caregiver mental health assessment. Referrals for interventions were made if there were obvious developmental delays, but there was minimal opportunity to ensure that the referrals were being followed through and interventions were carried out in the home setting. Furthermore, there is a

paucity of evidence in the literature on targeted interventions to address ACEs, particularly in the Asian population.

Anchor, a home visitation programme, was established in KKH in 2019 with funding from Temasek Foundation, a philanthropic organisation. This programme was designed to serve maltreated young children (and their caregivers) to address exposure to ACEs. The aims of the programme were to optimise caregiver-child relationships, child development and caregiver mental wellness; break the cycles of abuse and harsh parenting; and improve the capability of the child protection community in child development and trauma management. Home visitation was the delivery model of choice for the programme because it provided trained home visitors with the opportunity to build trusting relationships with caregivers and to directly observe and understand the family dynamics, interactions and routines.¹⁴ This not only provided valuable insights, but also enabled intervention to be more relevant and helpful to the targeted family.

The primary objective of this study was to evaluate the impact of Anchor programme on the developmental and behavioural outcomes of children. The secondary objective was to identify factors associated with the lack of improvement in developmental outcomes in the children who were at significant risk of developmental delay at recruitment into the programme.

METHOD

This was a prospective single-arm interventional study of children exposed to maltreatment who were recruited into the programme between November 2019 and July 2023. The study was approved by the SingHealth Centralised Institutional Review Board (CIRB 2019/2683) and consent was obtained from primary caregivers. Only caregivers who consented to the study were included in the evaluation.

The Anchor programme recruited children under 4 years old, who were evaluated at KKH for suspected non-accidental injury or neglect. Siblings who were under 4 years old and living in the same household were also recruited due to their potential exposure to ACEs. Children who required foster care were recruited into Anchor programme after the foster parents took over as primary caregivers. Upon entry into the programme, these children and their caregivers received a holistic evaluation of their needs through various screening tools; comprehensive information about the family was also collected. The child's development and

behaviour were assessed using the Ages & Stages Questionnaires, Third Edition (ASQ-3),¹⁵ the Ages & Stages Questionnaires Social-Emotional, Second Edition (ASQ:SE-2)¹⁶ and the Child Behaviour Checklist for ages 1.5-5 (CBCL).¹⁷ The caregiver's mental health was screened using Generalised Anxiety Disorder scale (GAD-7),¹⁸ Patient Health Questionnaire (PHQ-9)¹⁹ and Parental Stress Scale (PSS).²⁰ Details regarding caregiver's mental health will be reported in a separate paper.

Following the evaluation, the children and their families were stratified based on an inhouse tiering system adapted from The Child and Adolescent Needs and Strengths.²¹ The tiering system involved assessment of the child (development, emotional-behaviour and health), primary caregiver (mental health and physical health) and social/family circumstances (Supplementary Table S1). Frequency of home visits was determined as follows: once every 2 months for Tier 1 (low risk), once a month for Tier 2 (moderate risk) and twice a month for Tier 3 (high risk). Tiering assessment was repeated annually and at the point of graduation from the programme. Home visits were helmed by Community Health Visitors (CHVs) and supported by other members of a multidisciplinary team consisting of psychologists, medical social workers and paediatricians. Children would graduate from the programme at 3 years old or after receiving interventions for at least 1 year (whichever occurred later). Families might be transited to a community agency, the preschool and/or hospital services depending on their needs for continued management.

Home visitation model in Anchor programme

The evidence-based interventions in Anchor programme focused on 4 main areas: early relational health; child's health, development and behaviour including managing trauma symptoms; caregiver mental health; and building community partnership to ensure ongoing support for the families. Interventions were both preventative as well as therapeutic to address any developmental or behavioural concerns. Caregivers of children with developmental delays were provided with targeted interventions during home visits while children with significant developmental delays were referred for additional therapy (hospital-based therapy or Early Intervention Programme for Infants and Children) in accordance with usual clinical practice. Children presenting with behaviours suggestive of trauma symptoms were supported by providing trauma informed care and supporting the relation and interactions between the caregiver and child. This included principles from Circle of Security Parenting and reflective parenting

approaches to promote safety and security needed to co-regulate and support behavioural change.²²

Training and supervision of the Anchor CHVs

The CHVs underwent an initial intensive training period of 4 weeks that included didactic lectures, direct teaching, observations, attachments to various departments such as child development department, and online training modules. The training covered topics related to childhood trauma and early adversities, relational health and attachment, caregiver mental health, child development and family engagement. They were also trained in Circle of Security Parenting, Infant Mental Health and received inhouse training on Abecedarian Approach.^{23,24}

A robust supervision framework was put in place to support the CHVs. This included weekly individual supervision with the psychologist, team level supervision through weekly Anchor multidisciplinary team meetings, and case consultations with speech therapists and occupational therapists. The psychologists were assigned as case supervisors and held weekly and ad hoc meetings with the CHVs to go through the progress of the children under their care. Furthermore, fidelity of the intervention was maintained through joint supervision visit by the CHV and a psychologist (who was not the case supervisor) every 6-monthly.

Outcome measures

Child development

Developmental assessment of each child was conducted by the CHVs using ASQ-3 and ASQ:SE-2 at 6-monthly interval. The ASQ-3 is a validated developmental screening tool for children which measures development in 5 domains: communication, gross motor, fine motor, problem-solving and personal-social. The results of ASQ-3 were recorded as categorical variables: black zone (>2 standard deviations [SD] below the mean), grey zone (1–2 SD below the mean) and white zone (equal to or above the mean).¹⁵ A child who scored in the grey or black zone was deemed to be at risk for developmental delay.

The ASQ:SE-2 is a validated developmental screening tool, which evaluates the socio-emotional capabilities in children with questions covering behavioural aspects such as self-regulation, compliance, social-communication and interaction with people. The results of ASQ:SE-2 were similarly recorded as categorical variables: black zone (>2 SD above the mean), grey zone (1–2 SD above the mean) and white zone (social-emotional development appears to be on schedule).¹⁶

Child behaviour

The behaviour of each child was assessed using a parent-reported screening tool, the CBCL, which was administered to children ≥ 18 months old at baseline and repeated at 12-monthly interval. The CBCL categorises behaviours into 7 syndrome scales and the score of each syndrome scale was calculated as summary scores for internalising or externalising problems. The internalising and externalising problem summary scores were then analysed as categorical variables using recommended cut-offs for normal (percentile score < 95 th percentile), borderline (percentile score between 95th and 98th percentile) and clinical (percentile score > 98 th percentile) ranges.¹⁷

Comparison of outcome measures

The developmental and behavioural outcome measures of each child were compared across 2 timepoints—at baseline and latest timepoint (at graduation or the latest evaluation) to demonstrate the trajectory. The trajectories were then categorised into 2 distinct groups (Table 1). A positive programme impact was reflected by an improvement or remaining within the normal range in developmental or behavioural domain at latest timepoint. In contrast, children who showed deterioration or continued to have developmental or behavioural concern at latest timepoint were

categorised under limited impact. Given the complex social background and ACEs exposure, it was important to note that children with age-appropriate developmental and behavioural milestones would still require significant interventions to help them maintain normal developmental trajectory and remain within age-appropriate range for emotions, behaviour and social functioning.

A subgroup analysis was performed on children with significant risk of developmental delay²⁵ at baseline, defined as > 2 SD below the mean (black zone), in the communication, gross motor or fine motor domains of the ASQ-3. These children required referrals for additional therapy during Anchor programme as they met the clinical threshold for intervention. The purpose of this subgroup analysis was to identify modifiable or non-modifiable factors that could have contributed to the lack of improvement while being in the programme. Children in this subgroup were considered to have improved if they had fewer developmental domains in the black zone at the latest timepoint compared to baseline.

Statistical analysis

All categorical and continuous variables were expressed as mean (SD) and frequency (percentages), respectively. The primary outcome, defined as changes in paired categorical data

Table 1. Categories of possible trajectories of developmental/behavioural outcomes.

Group category	Screening tools	Trajectory of developmental/behavioural outcomes	
		Baseline	Latest timepoint
Positive impact	ASQ-3, ASQ:SE-2	White zone	White zone
		Grey zone	White zone
		Black zone	Grey/white zones
	CBCL	Normal	Normal
		Borderline	Normal
		Clinical	Borderline/normal
Limited impact	ASQ-3, ASQ:SE-2	Black zone	Black zone
		Grey zone	Grey/black zones
		White zone	Grey/black zones
	CBCL	Clinical	Clinical
		Borderline	Borderline/clinical
		Normal	Borderline/clinical

ASQ-3: Ages & Stages Questionnaires, Third Edition; ASQ:SE-2: Ages & Stages Questionnaires Social-Emotional, Second Edition; CBCL: Child Behaviour Checklist

in ASQ-3, ASQ:SE-2 and CBCL domains, was assessed using McNemar's test. The odds ratio (OR) with 95% confidence interval (CI) derived from McNemar's test was calculated from the number of children who showed improvement compared to the number of children who showed deterioration in the developmental or behavioural domain at latest timepoint. In addition, clinical significance of primary outcome was assessed by means of the effect size, calculated using Cohen's g .²⁶ An effect size of 0.1 to <0.3, 0.3 to <0.5 and ≥ 0.5 indicates small, medium and large effect size, respectively.²⁶ The secondary outcome, defined as the lack of improvement among children with developmental delay, was treated as binary data with categories "worsened/remained same" or "improved". Univariate logistic regression model was fitted to identify factors associated with lack of improvement among children with developmental delay at baseline. Quantitative association from logistic regression was reported as OR with 95% CI. All tests were 2-sided, and P value below 0.05 was considered as statistically significant. All analyses were performed using Stata software version 14.2 (StataCorp, College Station, TX, US).

RESULTS

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A total of 157 children (and their caregivers) were recruited into the Anchor programme, where 19 families subsequently withdrew consent. Children without a second set of assessment ($n=13$) were excluded from the analysis as they were recruited <6 months at the time of reporting. There was no loss to follow-up. The baseline characteristics of the remaining 125 children (and their biological parents) are shown in Table 2. The mean age of the children at recruitment was 20.0 (13.4) months and there was equal distribution of both sex (60 [48.0%] female versus [vs] 65 [52.0%] male). There were 61 (48.8%) children who were Malays, 47 (37.6%) Chinese and 14 (11.2%) Indians. Fourteen (11.2%) children had a significant medical diagnosis that would have impacted their developmental progress. There were 63 (50.4%) children who had siblings enrolled into Anchor programme.

The mean age of biological mothers and fathers was 32.4 (6.4) and 37.0 (8.5) years, respectively. There were 42 (54.6%) mothers and 38 (54.3%) fathers who completed at least a post-secondary education. Fifty-six (64.4%) children were cared for in a 2-parent family, and 32 (38.6%) families were from low socioeconomic status with family per capita income $\leq$ SGD650.²⁷

The average length of stay in Anchor programme was 21.2 (7.3) months. Most (71.2%) children were

cared for primarily by their biological parents. Most of the primary caregivers remained unchanged throughout the programme. At enrolment into the programme, 45 (36.0%) children were under Tier 1, 70 (56.0%) under Tier 2 and 10 (8.0%) under Tier 3. The overall rate of compliance to home visits stipulated by the tiering was approximately 80%.

Primary outcome

At baseline, 92 (73.6%) children were at risk of developmental delay, with scores ≥ 1 SD below the mean score in at least 1 domain of the ASQ-3 screen (Table 2). Personal-social (55 [44.0%] children) and communication (53 [42.4%] children) were the most impacted domains. There were 30 (24.2%) children with social-emotional concerns on the ASQ:SE-2 screen. Twenty-five (31.7%) children had behavioural concerns at baseline; 18 (22.8%) children had internalising behavioural problems and 24 (30.4%) children had externalising behavioural problems.

Table 3 depicts the developmental and behavioural trajectory of children in each domain of the screening tools. In the gross motor domain of the ASQ-3 screen, the proportion of children who had age-appropriate gross motor skills at latest timepoint was significantly larger than the proportion of children who had age-appropriate gross motor skills at baseline (85.6% vs 72.0%). The odds of seeing an improvement in gross motor skills is 3.8 times (95% CI 1.5–11.5) the odds of seeing a deterioration ($P=0.002$; Cohen's $g=0.59$).

In the fine motor domain of ASQ-3 screen, the proportion of children who had age-appropriate fine motor skills at latest timepoint was significantly larger than the proportion at baseline (85.6% vs 71.2%). The odds of seeing an improvement in fine motor skills is 4.6 times (95% CI 1.7–15.5) the odds of seeing a deterioration ($P=0.001$; Cohen's $g=0.64$). The changes in developmental outcomes were not statistically significant for the communication, problem-solving and personal-social domains of ASQ-3 and social-emotional domain of ASQ:SE-2.

A total of 79 children had complete CBCL assessments over 2 timepoints. In the internalising problem scale on the CBCL, the proportion of children who had no internalising behavioural concern at latest timepoint was significantly larger than the proportion of children who had no internalising behavioural concern at baseline (92.4% vs 77.2%), and this change was statistically significant ($P=0.001$). In the externalising problem scale on the CBCL, the proportion of children who had no externalising behavioural concern at latest

Table 2. Baseline children, biological parents and programme characteristics.

CHARACTERISTICS	
Children	
Age at recruitment (months)	n=125
Mean (SD)	20.0 (13.4)
Sex, no. (%)	n=125
Female	60 (48.00)
Male	65 (52.00)
Race, no. (%)	n=125
Chinese	47 (37.60)
Indian	14 (11.20)
Malay	61 (48.80)
Others	3 (2.40)
Known medical condition, no. (%)	n=125
Autism spectrum disorder	7 (5.60)
Genetic syndrome	2 (1.60)
Abusive head trauma	4 (3.20)
Post-Group B Streptococcal, or GBS, meningitis/sepsis	1 (0.80)
Nil	111 (88.80)
Has a sibling in Anchor, no. (%)	n=125
Yes	63 (50.40)
No	62 (49.60)
At risk of developmental delay at baseline, no. (%) ^a	n=125
Nil	33 (26.40)
At least 1 domain (on ASQ-3)	92 (73.60)
2 or more domains (on ASQ-3)	59 (47.20)
Had behavioural concern at baseline, no. (%) ^b	n=79
Yes	25 (31.65)
No	54 (68.35)
Biological parent	
Biological mother's age at enrolment (years)	n=79
Mean (SD)	32.4 (6.4)
Biological mother's highest education, no. (%)	n=77
Primary	6 (7.79)
Secondary	28 (36.36)
Post-secondary and above	42 (54.55)
Others, e.g. special education school	1 (1.30)

Table 2. Baseline children, biological parents and programme characteristics. (Cont'd)

CHARACTERISTICS	
Biological parent	
Biological father's age at enrolment (years)	n=76
Mean (SD)	37.0 (8.5)
Biological father's highest education, no. (%)	n=70
Primary	6 (8.57)
Secondary	25 (35.71)
Post-secondary and above	38 (54.29)
Others, e.g. special education school	1 (1.43)
Family	
Family structure, no. (%)	n=87
Extended family living in same household	19 (21.84)
Single-parent family	12 (13.79)
2-parent family	56 (64.37)
Family per capita income, no. (%) ^c	n=83
≤SGD650	32 (38.55)
>SGD650	51 (61.45)
Anchor programme	
Length of stay in Anchor (months)	n=125
Mean (SD)	21.2 (7.3)
Primary caregiver during Anchor, no. (%)	n=125
Biological parent	89 (71.20)
Kinship carer	13 (10.40)
Foster parent	23 (18.40)
Tiering at enrolment, no. (%) ^d	n=125
Tier 1 (low risk)	45 (36.00)
Tier 2 (moderate risk)	70 (56.00)
Tier 3 (high risk)	10 (8.00)
Child referred for external therapy, no. (%)	n=42
Attended at least 1 external therapy session	23 (54.76)
Did not attend any external therapy session	19 (45.24)

CBCL: Child Behaviour Checklist; SD: standard deviation

^a Risk of developmental delay defined as ≥1 SD below the mean on ASQ-3^b Behavioural concern defined as borderline or clinical range on the CBCL^c Family per capital income of ≤SGD650 per month defined as low socioeconomic status based on the national benchmark (up till July 2023) when considering financial assistance and relief eligibility²⁷^d Inhouse tiering system adapted from The Child and Adolescent Needs and Strengths²¹

Table 3. Developmental and behavioural trajectory of individual children by domains of ASQ-3, ASQ:SE-2 and CBCL screening tools.

ASQ-3							
Domains	Total, no.	Baseline	Latest timepoint, n (% of total)		Odds ratio (95% CI)	Effect size ^b	P value ^c
			At risk ^a	Normal			
Communication	125	At risk ^a	32 (25.60%)	21 (16.80%)	1.05 (0.54–2.04)	0.02	0.88
		Normal	20 (16.00%)	52 (41.60%)			
Gross motor	125	At risk ^a	12 (9.60%)	23 (18.40%)	3.83 (1.52–11.51)	0.59	0.002
		Normal	6 (4.80%)	84 (67.20%)			
Fine motor	125	At risk ^a	13 (10.40%)	23 (18.40%)	4.60 (1.71–15.49)	0.64	0.001
		Normal	5 (4.00%)	84 (67.20%)			
Problem-solving	125	At risk ^a	20 (16.00%)	31 (24.80%)	1.72 (0.93–3.27)	0.27	0.06
		Normal	18 (14.40%)	56 (44.80%)			
Personal-social	125	At risk ^a	29 (23.20%)	26 (20.80%)	1.18 (0.64–2.19)	0.08	0.56
		Normal	22 (17.60%)	48 (38.40%)			
ASQ:SE-2							
Social-emotional	124	At risk ^a	14 (11.29%)	16 (12.90%)	1.33 (0.59–3.09)	0.14	0.45
		Normal	12 (9.68%)	82 (66.13%)			
CBCL							
Domains	Total, no.	Baseline	Latest timepoint, n (% of total)		Odds ratio (95% CI)	Effect size ^b	P value ^c
			Borderline/ clinical	Normal			
Internalising problem	79	Borderline/ clinical	6 (7.59%)	12 (15.19%)	NA	NA	0.001
		Normal	0 (0.00%)	61 (77.22%)			
Externalising problem	79	Borderline/ clinical	8 (10.13%)	16 (20.25%)	2.29 (0.89–6.57)	0.39	0.06
		Normal	7 (8.86%)	48 (60.76%)			

ASQ-3: Ages & Stages Questionnaires, Third Edition; ASQ:SE-2: Ages & Stages Questionnaires Social-Emotional, Second Edition;

CBCL: Child Behaviour Checklist; CI: confidence interval

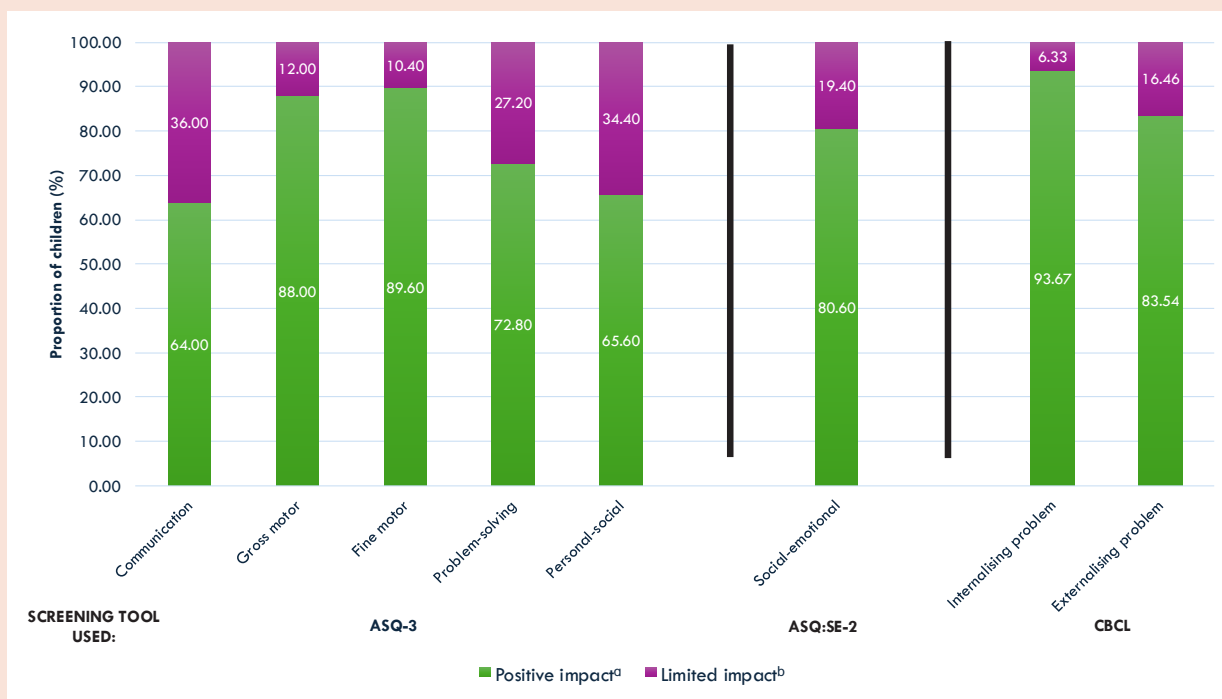
^a At risk of developmental delay defined as ≥ 1 SD below the mean on ASQ-3 and ≥ 1 SD above the mean on ASQ:SE-2 (i.e. grey and black zones)^b Effect size derived from Cohen's g ^c P value derived from McNemar's test

timepoint was larger than the proportion at baseline (81.0% vs 69.6%), but this did not reach statistical significance.

The primary outcome analysis was repeated to exclude 14 (11.2%) children with known medical conditions (Supplementary Table S2). The results were largely similar with statistically significant changes seen in gross and fine motor domains of the ASQ-3 screen and internalising and externalising problem scales on the CBCL.

Overall, most children (64.0%–93.7%) showed improvement or continued to meet age-appropriate milestones across all domains of the 3 screening tools at graduation or at latest evaluation (Fig. 1). Tiering assessment was repeated for 112 (89.6%) children. Among those children who were at Tier 2 or 3 at enrolment, 55 (73.3%) of them showed improvement in tiering at latest timepoint. A total of 92 (82.1%) children showed improvement in tiering or remained in Tier 1 at latest timepoint.

Fig. 1. Impact of Anchor programme on developmental and behavioural outcomes of children.



ASQ-3: Ages & Stages Questionnaires, Third Edition; ASQ:SE-2: Ages & Stages Questionnaires Social-Emotional, Second Edition; CBCL: Child Behaviour Checklist

^a Positive impact is defined as the group with children who had age-appropriate developmental outcomes or normal behavioural outcomes at latest timepoint and those who showed improvement at latest timepoint.

^b Limited impact is defined as the group with children who had developmental or behavioural concerns (i.e. grey or black zone on the ASQ-3 or ASQ:SE-2, or borderline or clinical range on the CBCL) at latest timepoint.

Secondary outcomes

Forty-two (33.6%) children in the study cohort were identified to be at significant risk of developmental delays at baseline. Sixteen (38.1%) children did not show improvement at latest timepoint. None of the child-related or parent/family-related factor was significantly associated with the lack of improvement in these children (Table 4). All 42 children were referred for additional external therapy, but only 23 (54.8%) attended at least 1 session. Among those who did not take up the external therapy referrals, 15 (78.9%) children still showed improvement in the developmental outcomes at the latest timepoint.

Discussion

Home visitation programmes such as Nurse-Family Partnership (United States), Child First (United States) and Early Start (New Zealand) are designed to serve at-risk populations such as low-income families and families with parental mental illness, substance abuse, incarceration, or domestic violence, with the intention of reducing the risk of adverse outcomes including child maltreatment.²⁸ In contrast, the evidence supporting the use of

home visitation programme as a secondary/tertiary prevention strategy to support children under the child welfare system is not as robust. Furthermore, to the authors' knowledge, there has not been any home visitation programme, targeted at serving children exposed to maltreatment, which reported child developmental and behavioural outcomes.

The Anchor programme is the first home visitation programme in Singapore designed to support young children (and caregivers) exposed to maltreatment. Almost three-quarters of children in this study cohort were at risk of developmental delay and one-third of cohort presented with behavioural difficulties. The children in Anchor programme came from families with complex backgrounds and challenges and were exposed to early childhood adversities. This can impact normal developmental trajectory,⁴ and trauma symptoms may manifest as problematic behaviours in these children.²⁹ Despite this, many of them showed improvement or continued to meet age-appropriate milestones across all domains of the 3 screening tools at graduation or at latest evaluation in Anchor programme. Majority of families improved from

Table 4. Univariate analysis on factors associated with the lack of improvement in children screened to have significant developmental delay at baseline.

Variables	Odds ratio (95% CI)	P value
Child-related factors		
Age at recruitment (months)	1.02 (0.97–1.07)	0.490
Stay in Anchor programme	0.99 (0.91–1.08)	0.851
Sex (male vs female)	1.04 (0.29–3.76)	0.950
Race (non-majority vs majority) ^a	0.68 (0.19–2.44)	0.555
Known medical condition (presence vs absence)	2.11 (0.57–7.86)	0.265
Parent/family-related factors		
Biological mother's age at enrolment (years)	0.89 (0.73–1.09)	0.264
Biological mother's highest education level (Post-secondary vs Others/Primary/Secondary)	0.75 (0.12–4.66)	0.758
Biological father's age at enrolment (years)	0.99 (0.87–1.13)	0.893
Biological father's highest education level (Post-secondary vs Others/Primary/Secondary)	0.23 (0.02–2.46)	0.223
Family per capita income (≤S\$650 vs >S\$650)	2.70 (0.64–11.47)	0.178

^a Majority race refers to Chinese. Non-majority races include Malay, Indian and others.

moderate-high risk group (Tier 2-3) to low-risk group (Tier 1) at latest timepoint.

There were statistically significant improvements with large effect sizes observed in gross motor and fine motor skills and internalising behaviours among children in this study cohort. The development of fundamental gross and fine motor skills during early childhood are essential for subsequent development of adaptive and cognitive skills.^{30,31} Internalising behaviours in childhood have been associated with early substance use, disruptive behaviour and mental health disorders such as anxiety and depression in adulthood,^{32,33} contributing to poor long-term economic and social outcomes such as lower annual income, higher incidence of welfare receipt and lower incidence of intimate partnership.³⁴ Therefore, it is imperative to implement evidence-based interventions that optimise developmental skills and address problem behaviours in early childhood to mitigate the long-term consequences.

Notably, the improvement in communication and personal-social domains of ASQ-3 screen was limited during the programme. This was comparable to another study on children from low-income families in Singapore, which showed poorer Bayley cognitive and language scores in children from moderate and high-risk families.³⁵ Language development is influenced by

multiple factors such as genetics, sex differences and family environment including socioeconomic status, parental education, and the level of engagement of parents with children.³⁶ Given the challenges faced by the families in this cohort, the impact on communication domain was understandably more apparent and might require longer period of observation to show improvement, as compared to the current programme duration (mean of 21 months).

The child's relationship with primary caregivers plays an essential role in the social and emotional development of the child and this could be impacted by caregivers' mental health issues. In our study, children with caregivers experiencing mental health issues were more likely to have heightened emotional and behavioural concerns.³⁷ Therefore, the programme also focused on the caregiver-child dyad relationship, by supporting responsive and sensitive caregiving practices, to help build secure attachments and increase moments of delight and positive childhood experiences. Interventions to address caregivers' mental health issues were also provided and the data collected will be analysed and reported in a separate study.

Among children with significant risk of developmental delay at baseline, no child-related or parent/family-related factor was significantly associated with lack of improvement in developmental

outcomes. This could be due to the small sample size. It was noteworthy that all 14 children with significant medical diagnosis such as autism spectrum disorder, genetic syndrome, abusive head trauma or post-GBS meningitis/sepsis were identified to have significant risk of developmental delays at baseline and these association were also reported in literature.³⁸⁻⁴² In addition, these children were referred for external therapy but only half attended at least 1 session. Many families in this cohort struggled to take up the referrals or attend external therapy sessions consistently due to other competing family needs and priorities.

It was encouraging to observe that most children who did not take up the referrals still demonstrated improvement in their developmental outcomes at the latest timepoint. This progress could be attributed to the CHVs' strategy of pacing with the family where they tailored interventions based on the child's needs and caregiver's capacity to implement them at home. This might involve frequently breaking interventions down into manageable steps, demonstrating them to the caregivers and embedding activities into daily routines.

There are limitations to this study. The nature of the study design, being a single-arm interventional study, limits the ability to conclude the definite impact of programme due to the absence of a control group. Furthermore, a diverse range of assessment tools for developmental and behavioural concerns was used across home visitation programmes that serve at-risk populations internationally, which limited the ability for direct comparison with other studies. While the small sample size could be a reason for the lack of statistical significance in the primary and secondary outcomes, statistically significant improvement was still demonstrated in 3 of the developmental and behavioural domains. Lastly, the duration in Anchor programme might be too short to demonstrate significant changes in all the developmental and behavioural outcomes in children, necessitating a longer-term study to observe the developmental and behavioural outcomes post-Anchor as well as to evaluate the cost-effectiveness of the programme.

CONCLUSION

Given the long-term deleterious consequences of ACEs, it is crucial that evidence-based interventions are put in place to optimise developmental skills and address problem behaviours in the childhood period. The study findings highlight the programme's potential to enhance the developmental and behavioural outcomes for children exposed to maltreatment. Through targeted early interventions,

the programme addressed the immediate impact of ACEs and helped to mitigate their detrimental effects. By doing so, it not only reduced the burden of adversities but also paved the way for an improved developmental trajectory, thereby ensuring these vulnerable children a better foundation for lifelong success. This programme can potentially be the standard of care for preschool children exposed to maltreatment and this may reduce the clinical and economic burden of ACEs in the long run.

Supplementary Materials

Table S1. Tiering system used in Anchor programme. Table S2. Developmental and behavioural trajectory of individual children by domains of ASQ®-3, ASQ®:SE-2 and CBCL screening tools, excluding 14 children with significant medical conditions.

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Ethics statement

Not applicable

Declaration

The authors declare there are no affiliations with or involvement in any organisation or entity with any financial interest in the subject matter or materials discussed in this manuscript.

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