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Association of parental social network diversity with behaviour problems and resilience of offspring in a large population-based study of Japanese children

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ABSTRACT

Objectives The current study aimed to elucidate the impact of parental social network diversity on the behaviour problems and resilience of offspring.

Design We used cross-sectional data from the Kochi Child Health Impact of Living Difficulty study in 2016.

Setting and participants Participants were first, fifth and eighth grade children living in Kochi prefecture, Japan (N=9653). We calculated parental social network diversity by counting the number of people with whom parents connected on a daily basis (ie, structural social network diversity) and by assessing perceived psychosocial support (ie, functional social network diversity).

Primary outcome measures Child behaviour problems and resilience were respectively assessed using the Strengths and Difficulties Questionnaire (SDQ) and the Child's Resilient Coping Scale (CRCS), as rated by caregivers.

Results Diversity in parental structural and functional social networks showed an inverse association with SDQ total difficulties score (B=−0.16 (95% CI −0.25 to −0.07) and −0.20 (95% CI −0.27 to −0.13), respectively), and a positive association with prosocial behaviour score (B=0.11 (95% CI 0.08 to 0.15) and 0.09 (95% CI 0.06 to 0.12), respectively) and CRCS score (B=0.75 (95% CI 0.46 to 1.05) and 1.12 (95% CI 0.88 to 1.35), respectively) in the adjusted model. Parental mental health accounted for 36% and 43% of the total effects of structural and functional social network diversity respectively on the total difficulties score. For prosocial behaviour score, parental involvement accounted for 31% of the effects of functional social network diversity.

Conclusion The results shed light on new strategies to enhance child mental health that do not directly involve children but rather focus on parental social networking.

Strengths and limitations of this study

► We assessed parental social network diversity, which has received less attention than other social network metrics but is potentially advantageous from an intervention perspective.

► Although both social network diversity and child mental health were evaluated by caregivers, our focus on structural aspects mitigated the disadvantage due to common method bias by providing information about externally explicit social connection.

► This is a cross-sectional study from which it is difficult to infer causality.

with mental health problems has increased over recent decades.[2] Child mental health impacts everyday life in the areas of well-being, health, and education[3 4]; beyond this, it also has long-lasting and wide-ranging effects on a child's life course, although most cases are neither detected nor treated.[5] Recent trends have paid much attention to preventive intervention,[6] which encourages identification of risk factors and ways to address those factors as quickly as possible.

To address child mental health problems, we need to focus not only on their risk factors, but also on factors promoting positive aspects of child mental development—that is, prosocial behaviour and resilience.[7] Prosocial behaviour is a known predictor of a reduction in future behaviour problem,[8] and is also positively associated with mental well-being[9] and longevity.[10] Resilience is the ability to overcome emotional, developmental, economic and environmental adversities,[11] and is known to reduce the risk of negative outcomes in the face of adverse experiences.[12] Thus, by enhancing such properties, we can simultaneously improve mental health and prevent mental illness.

INTRODUCTION

Mental health is one of the most challenging issues in child health. Approximately 10%–20% of children and adolescents around the world experience mental disorders,[1] which include emotional and behavioural problems, and the number of children living

Social determinants of child mental health include socioeconomic status (SES), parental psychological illness, parenting style, interactions with peers or other adults, and social discrimination or violence.[13] Additionally, social capital cultivated in interactions between family and community may play a critical role in both preventing mental health problems and enhancing mental well-being.[14 15] Previous studies showed the critical role of social capital, suggesting, for example, that children in families or communities with rich social capital showed fewer behaviour problems.[16] Also, some previous studies revealed that children with higher social capital environments developed more positive mental states, particularly in the form of enhanced prosocial behaviour[17] and resilience.[18] Social capital is fundamentally captured as embedded resources in social networks[19]; thus, it is important to elucidate the role of social networks. It is also critical to determine whether the relationship between parental social networks or social capital and child mental health may have any implications for health policy.

Social networks are defined as the web of social relationships surrounding an individual and the characteristics of those ties, or the structure of one or more networks of relations within a system of actors.[20] Several studies have reported on the association between parental social support and aspects of child mental health such as behaviour problems, psychosocial development and mental well-being[21–24]; however, to the best of our knowledge, the association between parental social network 'diversity' (which reflects not only the number of people in one's social network but also the number of different channels of connection)[25] and child mental health has yet to be investigated. Social network diversity may be a sensitive indicator of child mental health because heterogenous social networks, or bridging social capital, have shown stronger impacts on health than homogenous social networks.[26] Considering that generalisable social support intervention has yet to be successfully uncovered,[27] it would be beneficial to discover network diversity, which is more explicitly obvious metrics of social connections, as a promotor of child mental well-being. In addition, unlike social support, which acts beneficially as a stress buffer when there is a trouble, network diversity would promote mental well-being regardless of the presence of their difficulties by integrating individuals into society.[27] Thus, we hypothesised that parental social network diversity may be associated with child mental health in terms of both prevention of mental illness (including behaviour problems) and promoting the positive side of mental health, including prosocial behaviour and resilience.

Social networks include both structural and functional aspects.[28] A previous study showed no difference in the effects of functional and structural social networks on mental health,[29] although it focused only on adults, and age might act as a modifier of the impacts of various aspects of social networks on mental health.[30] According to the social network model of child development, parental social networks influence child development through (1) increasing the child's social network diversity by providing access to either members of the parental social network or the skills necessary for children to build their own social networks (direct path) and (2) enhancement of parent–child interaction through improvement of parental mental health (indirect path).[31] Since functional networks play stress-buffering roles for the parent,[27] they may affect child mental health more indirectly while structural networks may affect it more directly. Based on this hypothesis, the current study aimed to elucidate the association between the diversity of parental structural and functional social networks and child mental health, considering both negative and positive outcomes (ie, behaviour problems, prosocial behaviour and resilience).

METHODS

The 2016 Kochi Child Health Impact of Living Difficulty study is a cross-sectional study that examines the living environment and health of 1st, 5th, 8th and 11th grade children and their caregivers in Kochi prefecture, Japan. The targets were any children attending any school in Kochi prefecture, except for correspondence course high schools and one special needs school. Self-reported questionnaires were distributed to 23 750 children and their caregivers. In Kochi city, 3517 questionnaires were returned via mail while 11 022 questionnaires were returned via schools outside of Kochi city. In total, we received 14 323 valid responses (response rate 60.3%). We adjusted the differences in response rates among cities by weighting them with the inverse response rates. Questionnaires completed by 11th graders, whose questionnaire did not include the Child's Resilient Coping
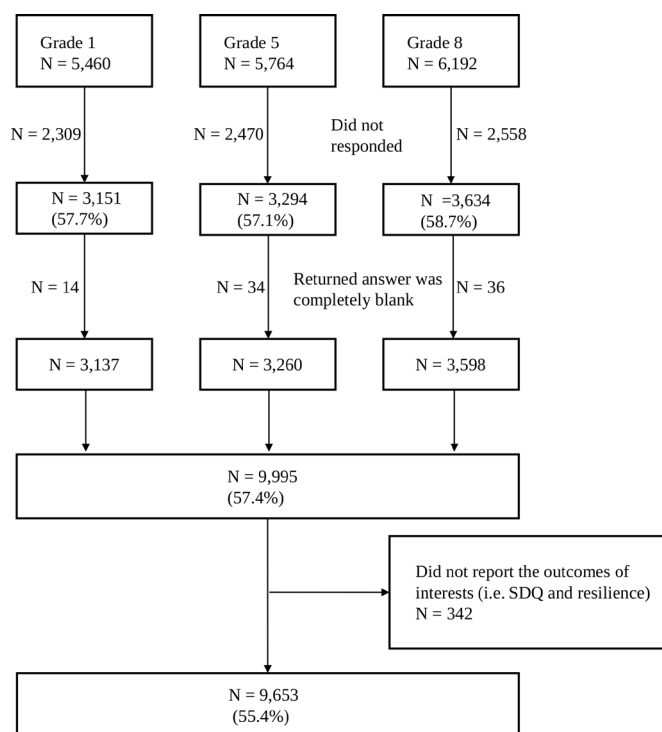

Figure 1 Sampling flow chart. SDQ, Strengths and Difficulties Questionnaire.

Table 1 Characteristics of samples

		Total (N=9653)		Grade 1 (N=3038)		Grade 5 (N=3124)		Grade 8 (N=3491)		
		N or mean	% or SD	N or mean	% or SD	N or mean	% or SD	N or mean	% or SD	P value
Child's sex	Boy	4556	47.2	1523	50.1	1437	46.0	1596	45.7	
	Girl	4905	50.8	1499	49.3	1654	52.9	1752	50.2	
	Missing	192	2.0	16	0.5	33	1.1	143	4.1	<0.001
Respondents	Mother	8556	88.6	2753	90.6	2767	88.6	3036	87.0	
	Father	896	9.3	236	7.8	288	9.2	372	10.7	
	Others	201	2.1	49	1.6	69	2.2	83	2.4	<0.001
Marital status	Married	8111	84.0	2653	87.3	2624	84.0	2834	81.2	
	Divorced	1269	13.2	317	10.4	402	12.9	550	15.8	
	Bereaved	92	1.0	12	0.4	31	1.0	49	1.4	
	Unmarried	98	1.0	37	1.2	35	1.1	26	0.7	
	Missing	83	0.9	19	0.6	32	1.0	32	0.9	<0.001
Maternal age		41.26	5.2	38.31	4.8	41.38	4.7	43.71	4.6	<0.001
Difference in parental ages		2.02	4.6	2.31	4.8	2.06	4.7	1.73	4.3	<0.001
Maternal educational attainment	Junior school	142	1.5	36	1.2	41	1.3	65	1.9	
	High school/junior collage	7221	74.8	2216	72.9	2350	75.2	2655	76.1	
	University/graduate university	1797	18.6	686	22.6	556	17.8	555	15.9	
	Unknown	3	0.0	0	0.0	1	0.0	2	0.1	
	Missing	490	5.1	100	3.3	176	5.6	214	6.1	<0.001
Highest parental occupation	Full-time/regular staff	7108	73.6	2268	74.7	2283	73.1	2557	73.3	
	Part-time/non-fulltime employee	2154	22.3	671	22.1	701	22.4	782	22.4	
	Not working	86	0.9	23	0.8	30	1.0	33	1.0	
	Searching for a job	48	0.5	12	0.4	18	0.6	18	0.5	
	Missing	257	2.7	64	2.1	92	2.9	101	2.9	0.449
Caregiver's self-rated health	1 (not good)	66	0.7	12	0.4	23	0.7	31	0.9	
	2 (not very good)	687	7.1	167	5.5	210	6.7	310	8.9	
	3 (normal)	2380	24.7	674	22.2	796	25.5	910	26.1	
	4 (somewhat good)	3058	31.7	1000	32.9	980	31.4	1078	30.9	
	5 (good)	3065	31.8	1118	36.8	1013	32.4	934	26.8	
	Missing	397	4.1	67	2.2	102	3.3	228	6.5	<0.001
K6 score		3.37	4.4	3.28	4.2	3.40	4.4	3.43	4.4	0.330
Total difficulties score (0–40)		8.72	5.4	9.55	5.5	8.64	5.4	8.07	5.3	0.093
Prosocial behaviour (0–10)		6.61	2.1	6.69	2.1	6.80	2.0	6.36	2.1	0.007
Resilience (0–100)		64.03	17.5	62.69	16.86	66.01	16.8	63.44	18.60	<0.001

Scale (CRCS), and questionnaires without responses to the outcomes of interest (ie, Strengths and Difficulties Questionnaire (SDQ) and CRCS) were excluded. Our analytic sample contained a total of 9653 responses (response rate 55.4%) (figure 1).

Measurements

Diversity of parental structural and functional social networks

We calculated social network diversity to measure the number of social roles that respondents contacted regularly in their social networks, according to the Social Network Index created by Cohen et al.[25] To better reflect

the Japanese context, we identified the following nine social roles: spouse, parent, child, close relative, close friend, student, employee, neighbour and other group member. Using all social roles except for child (since the target of this study is parental social network diversity), structural dimension was assessed by asking daily connections to these roles. Relationship with a spouse was assessed by marital status and dichotomised as either '1=yes including currently married or living with someone in a marital-like relationship' or '0=never married, separated, divorced or widowed'. Cohabitation status was assessed

by asking respondents if they lived together with parents or parents-in-law and close relatives. As for employment status, if respondents answered that they had an occupation, they were assumed to have a social relationship with employees. If they answered that they were students, they were assumed to have a social relationship with students. Relationships with friends, neighbours and group members were assessed by questions that asked about relationships with people in their neighbourhood, their frequency of sharing food (eg, giving garden-grown vegetables to neighbours), and their memberships in other social groups, respectively. Also, functional dimension (ie, networks providing psychosocial support) was assessed by asking respondents to choose which of the following people they would ask for help when experiencing problems: their spouse or partner, parents, parents-in-law, relatives, neighbours, friends, employees or employers, and others. The responses were dichotomised as either 'yes' or 'no' for each category to indicate whether or not they have a relationship with each role. The total number of connections was defined as the structural and functional dimensions of social network diversity. Further assessment details are available in online supplemental method 1 and table 1.

Child mental health outcomes
Child behaviour problems were assessed with the Japanese version of the SDQ,[32] which includes subscales such as emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems and prosocial behaviour. Each subscale score ranged from 0 to 10. The total difficulties score was the sum of these sub-scaled scores with the exception of prosocial behaviour, and ranged from 0 to 40. The Cronbach's alpha values of our sample for the total difficulties and prosocial behaviour scores were 0.81 and 0.72, respectively, which showed reliable internal consistency. Child resilience was assessed with the CRCS, with eight items developed for suitability to a Japanese context regarding resilience and coping.[33] The total score ranged from 0 to 100, and the Cronbach's alpha of our sample was 0.86, indicating high reliability. As for validity, Pearson's correlation between the CRCS score and the SDQ total difficulties score was −0.60 (p value (p)<0.001) and that between the CRCS and SDQ prosocial behaviour scores was 0.50 (p<0.001). Higher total difficulties scores in SDQ indicated more behaviour problems (problematic) and higher prosocial behaviour scores in SDQ and CRCS scores indicated more prosocial behaviours and more resilient attitude (favourable).

Covariates
To adjust for potential confounders, we assessed the characteristics and household status of children and parents, including the child's grade, child's sex, respondents of the questionnaires, marital status, maternal age, parental age difference, maternal educational attainment, occupation of the mother or father, whichever has the higher level of expertise, and caregiver's self-rated health. Also,

parental mental health was assessed with the Kessler 6 scale[34] and a parental involvement score was calculated as the arithmetic sum of the answer (from '1=rarely' to '5=everyday') for the following nine interactions: parental tutoring, playing sports, playing computer games, playing cards, talking about school, talking about socio-political issues, talking about recent TV programmes, preparing meals and going out.[35] The Cronbach's alpha value for the parental involvement score was 0.65. Further details on the assessment of parental involvement are available in online supplemental method 2.

Analysis
First, we analysed the relationships between structural and functional social network diversity and child mental health with a multiple linear regression model. Model 1 adjusted for the child's grade, child's sex, respondents of the questionnaires, marital status, maternal age, parental age difference, maternal educational attainment, highest parental occupation and caregiver's self-rated health. Missing data were coded as dummy variables. We further adjusted for the parental mental health and parental involvement scores to examine mediating effects. Since there were some differences in the characteristics among different grades, we further investigated interaction between social network diversity and the child's grade in the sensitivity analysis. Second, we conducted mediation analysis to determine if those mediators could explain the total effects following the four-step algorithm: first, we fitted the model for the variables; second, we simulated the model parameters; third, we simulated potential values of the mediators and outcomes and calculated the quantities of interest; fourth, we computed the point estimate and CIs, which are described more deeply elsewhere[36 37] and in online supplemental method 3. We also conducted sensitivity analysis to check the robustness of our estimates by checking the degree of violation of our sequential ignorability assumption. All analysis was conducted with STATA V.15.

Patient and public involvement
There was no patient and public involvement to be mentioned.

RESULTS
Table 1 shows participants' characteristics. Approximately 90% of respondents were mothers for all grades. Divorced parents made up 10.4%, 12.9% and 15.8% of 1st, 5th and 8th grade participants, respectively. Maternal educational attainment of university or higher was 22.6%, 17.8% and 15.9% across the grades, respectively. 73.6% of parents in total sample were employed full time, which did not significantly differ across grades. The percentage of boys was 50.1%, 46.0% and 45.7%, respectively, suggesting that caregivers of boys in older grades were less likely to respond to the questionnaire.

Table 2 Distribution of parental social network index

	Total		Grade 1		Grade 5		Grade 8		
	N or mean	% or SD	N or mean	% or SD	N or mean	% or SD	N or mean	% or SD	P value
Structural social network									
Spouse	8111	84.0	2653	87.3	2624	84.0	2834	81.2	<0.001
Parents	1852	19.2	525	17.3	622	19.9	705	20.2	0.005
Close relatives	268	2.8	91	3.0	99	3.2	78	2.2	0.047
Close friends	7613	78.9	2441	80.4	2480	79.4	2692	77.1	0.004
Students	33	0.3	16	0.5	7	0.2	10	0.3	0.099
Employees	8009	83.0	2453	80.7	2600	83.2	2956	84.7	<0.001
Neighbours	3447	35.7	1071	35.3	1172	37.5	1204	34.5	0.030
Group members	2542	26.3	758	25.0	889	28.5	895	25.6	0.004
Total (0–8)	4.30	1.2	4.29	1.2	4.36	1.2	4.26	1.2	0.002
Functional social network									
Spouse	4116	42.6	1343	44.2	1302	41.7	1471	42.1	0.101
Parents	1456	41.8	1315	43.3	1264	40.5	1456	41.7	0.079
Close relatives	2280	23.6	714	23.5	707	22.6	859	24.6	0.165
Close friends	1596	16.5	523	17.2	475	15.2	598	17.1	0.052
Employees	1385	14.4	385	12.7	440	14.1	560	16.0	<0.001
Neighbours	2239	23.2	665	21.9	718	23.0	856	24.5	0.040
Other	110	1.1	31	1.0	30	1.0	49	1.4	0.180
Total (0–7)	2.37	1.4	2.52	1.4	2.34	1.4	2.26	1.4	<0.001

Table 2 shows the distribution of diversity in parental structural and functional social networks. The average numbers of social roles in structural social network were 4.29, 4.36 and 4.26; and that in functional social network were 2.52, 2.34 and 2.26 for parents of 1st, 5th and 8th grade children, respectively. In the structural network, parents with connections to a spouse (p<0.001), close relatives (p=0.047), close friends (p=0.004) and neighbours (p=0.030) gradually decreased as children's grades increased, while parents with connections to the parents (p=0.005) increased. In the functional social network, parents with connections to employees (p<0.001) and neighbours (p=0.040) increased as children's grades increased.

Table 3 shows the coefficients (B) of the multiple linear regression model, which analysed the relationships between parental structural and functional social network diversity and child mental health. We found a dose–response relationship; the SDQ total difficulties score was lower for children, whose structural social network was more diverse (B=−0.16, 95% CI −0.25 to −0.07), while prosocial behaviour and resilience were higher for those whose parents had higher structural social network diversity (B=0.11, 95% CI 0.08 to 0.15; B=0.75, 95% CI 0.46 to 1.05, respectively) in the fully adjusted model. Similarly, a dose–response relationship existed between functional social network diversity and child mental health even after full adjustment: an inverse association with total

difficulties scores (B=−0.20, 95% CI −0.27 to −0.13) and positive associations with prosocial behaviour and resilience were observed (B=0.09, 95% CI 0.06 to 0.12, and B=1.12, 95% CI 0.88 to 1.35, respectively). Further analysis with an interaction term between social network diversity and child's grade showed that significant interaction effects on prosocial behaviour and resilience were found between structural social network and child's grade only. The detailed results are available in online supplemental table 2.

Table 4 shows the results of mediation analysis. For the total difficulties score, parental mental health explained 36% (95% CI 0.29 to 0.48) and 43% (95% CI 0.38 to 0.50) of the total effects of structural and functional social network diversity, respectively. On the other hand, parental involvement explained a lower percentage, that is, 11% (95% CI 0.09 to 0.15) and 9% (95% CI 0.08 to 0.11). Parental involvement accounted for 31% (95% CI 0.26 to 0.38) of the total effect of functional social network diversity on prosocial behaviour. The mediating effect of both parental mental health and parental involvement on the association of structural and functional social network diversity with resilience was less than 30%.

DISCUSSION
We found that both structural and functional parental social network diversity were inversely associated with

Table 3 Association of structural and functional parental social network indices with child mental health

	Crude		Model 1		Model 2		Model 3		Model 4	
	B	95% CI	B	95% CI	B	95% CI	B	95% CI	B	95% CI
Structural social network										
Total difficulties score (0–40)	−0.46	−0.55 to −0.37	−0.23	−0.32 to −0.13	−0.19	−0.28 to −0.10	−0.20	−0.29 to −0.11	−0.16	−0.25 to −0.07
Prosocial behaviour (0–10)	0.15	0.12 to 0.19	0.14	0.11 to 0.18	0.14	0.11 to 0.18	0.12	0.08 to 0.15	0.11	0.08 to 0.15
Resilience (0–100)	1.60	1.30 to 1.89	1.10	0.79 to 1.41	1.03	0.73 to 1.34	0.81	0.52 to 1.11	0.75	0.46 to 1.05
Functional social network										
Total difficulties score (0–40)	−0.52	−0.59 to −0.44	−0.36	−0.44 to −0.29	−0.24	−0.31 to −0.17	−0.32	−0.40 to −0.25	−0.20	−0.27 to −0.13
Prosocial behaviour (0–10)	0.16	0.13 to 0.19	0.14	0.11 to 0.17	0.13	0.10 to 0.16	0.1	0.07 to 0.13	0.09	0.06 to 0.12
Resilience (0–100)	2.11	1.86 to 2.35	1.70	1.45 to 1.94	1.50	1.26 to 1.75	1.31	1.07 to 1.55	1.12	0.88 to 1.35

Model 1 adjusted for child's grade, child's sex, respondents of questionnaires, marital status, maternal age, parental age difference, maternal educational attainment, highest parental occupation and caregiver's self-rated health; Model 2 adjusted model 1+parent's K6 score; Model 3 adjusted model 1+parental involvement score; Model 4 adjusted model 1+parent's K6 score and parental involvement score.

child behaviour problems and positively associated with prosocial behaviour and resilience among children, which remained after further adjusted for child characteristics, household characteristics including parental socioeconomic status and parents' self-rated health. Further mediation analysis indicated that parental mental health and parental involvement accounted for at most less than 50% of the association between parental social network diversity and child mental health, although these findings should be interpreted with caution considering the cross-sectional nature of the data and especially the potential bidirectional association of parental social networks and mental health. In addition to the importance of parental social networks, connections, or ties for child mental health that was shown by previous studies,[22–24] our study also revealed that the diversity of structural and functional aspects of parental social networks is an important direct and indirect factor affecting child mental health, which is consistent with the previous studies showing that both structural and functional social networks exhibit similar positive relationships with child mental health.[29 38]

Additionally, our findings highlighted the importance of diversity in parental social networks for the positive side of mental health, that is, prosocial behaviour and resilience. Such diversity may promote these positive traits and serve as a reference point for children on how to behave socially and cultivate friendships. The direct effects of parental network diversity on child mental health can be derived from social learning theory—that is, how children learn social skills from parental behaviour.[24 39] Our results for the interaction between social network diversity and age (which are available in online supplemental table 2) showed that parental structural social network diversity had a strong impact on the prosocial behaviours and resilience of older children. This may be because older children could observe and learn how their parents communicated on a daily basis and then imitate their parental behaviour in their own social networks, while younger children could not model parental behaviour. Another potential underlying mechanism by which children may gain values from parental social network diversity would be the experience of co-parenting and of having adult friends or family members to play with,[23] leading to a reduction in overall mental problems. Even though the direct associations survived after adjusting for parental mental health, the potential unmeasured confounders and reverse causation (ie, parents whose children showed less behaviour problems have more time to create diverse social networks) should be accounted in the interpretation. To clarify the association and its mechanisms, we need to further explore how the social networks of parents affect those of children.

Theoretically, parental social network diversity can improve child mental health via parental mental health and parental involvement.[21 40 41] Parental social network is a known protective factor against parental mental stress[42] and negative parenting,[43 44] which can be explained by the stress-buffering effect and various pieces of information

Table 4 Mediating effects of parental mental health and parental involvement on association of structural and functional parental social network diversity with child mental health

| Independent variables | Dependent variables | | Mediators | | | |
| | | | Parental mental health | | Parental involvement | |
			B	95% CI	B	95% CI
Structural social network	Total difficulties score	ACME	–0.14	–0.17 to –0.11	–0.04	–0.05 to –0.03
		DE	–0.24	–0.33 to –0.15	–0.34	–0.43 to –0.24
		TE	–0.38	–0.47 to –0.28	–0.38	–0.47 to –0.28
		% mediated	0.36	0.29 to 0.48	0.11	0.09 to 0.15
	Prosocial behaviour	ACME	0.01	0.01 to 0.01	0.04	0.03 to 0.05
		DE	0.15	0.12 to 0.19	0.13	0.09 to 0.16
		TE	0.16	0.13 to 0.20	0.16	0.13 to 0.20
		% mediated	0.06	0.05 to 0.08	0.23	0.18 to 0.29
	Resilience	ACME	0.28	0.21 to 0.34	0.36	0.27 to 0.46
		DE	1.22	0.92 to 1.52	1.13	0.84 to 1.42
		TE	1.50	1.20 to 1.79	1.49	1.20 to 1.81
		% mediated	0.18	0.15 to 0.23	0.24	0.20 to 0.30
Functional social network	Total difficulties score	ACME	–0.22	–0.25 to –0.20	–0.05	–0.06 to –0.04
		DE	–0.30	–0.37 to –0.22	–0.47	–0.54 to –0.40
		TE	–0.52	–0.59 to –0.45	–0.52	–0.59 to –0.44
		% mediated	0.43	0.38 to 0.50	0.09	0.08 to 0.11
	Prosocial behaviour	ACME	0.01	0.01 to 0.02	0.05	0.04 to 0.06
		DE	0.14	0.11 to 0.17	0.10	0.08 to 0.13
		TE	0.15	0.12 to 0.18	0.15	0.12 to 0.18
		% mediated	0.09	0.07 to 0.11	0.31	0.26 to 0.38
	Resilience	ACME	0.42	0.35 to 0.48	0.45	0.38 to 0.53
		DE	1.69	1.45 to 1.94	1.66	1.43 to 1.89
		TE	2.11	1.87 to 2.34	2.11	1.87 to 2.36
		% mediated	0.20	0.18 to 0.22	0.21	0.19 to 0.24

Model adjusted for child's grade, child's sex, respondents of questionnaires, marital status, maternal age, parental age difference, maternal educational attainment, highest parental occupation and caregiver's self-rated health.
ACME, average causal mediation effect; DE, direct effect; TE, total effect.

on parenting from social networks. In addition, peer pressure[45] to behave properly as 'a parent', which arises during social interactions, might work to guide parents to favourable parental involvement. Parental ill mental health and parenting stress are risk factors for child mental health,[46] while parental involvement affects child positively.[47] Although longitudinal studies are warranted, our results added a preliminary empirical evidence to these theoretical explanations.

Our findings, which come on top of the research on the high social costs of maternal isolation,[48] may act as a driver for policy makers to intervene more actively in child mental health problems by reducing social isolation among caregivers. In addition to conventional interventions to provide parents with more opportunities to engage in social networks, and attempts to mitigate parental mental health problems and to improve parental involvement would be partially effective in addressing child behaviour problems due to parental isolation. Social network diversity could be increased, for example, by creating systematic linkages to mentors, facilitating mutual aid groups, and making the best of natural helpers within society in collaboration with health sectors, the welfare system and even social network systems.[49]

This study has several limitations. First, sampling bias may have occurred because of the different methods used to collect questionnaires from cities within and outside of Kochi, as well as the low response rate. Second, social network diversity was assessed by the caregivers themselves, and the responses, especially for functional social network diversity, might be biassed because parents themselves may relate to their own level of perceived social support.[24] However, this limitation might be partially overcome since structural social networks mostly assessed the 'structural' connection that was explicit to others. Third, social network diversity was assessed by

considering features specific to Japanese culture—for example, excluding church attendance, but adding food sharing with neighbours, which may limit generalisability. However, since positive associations between social networks and several health outcomes have been replicated in diverse cultures,[50 51] our findings may be applicable to countries other than Japan. Fourth, child mental health was assessed not by children, but by their parents, which might induce a common method bias. However, evidence shows that parent-reported SDQ is useful for predicting child psychological disorders.[52] Fifth, considering the two-way relationship of the social network (ie, a bidirectional relationship between child behaviour and parental involvement[53]), our cross-sectional study had a critical disadvantage in the design for inferring causality. Future longitudinal studies are warranted to confirm the current findings.

Despite these limitations, our study highlighted the potential role of diverse parental social networks in improving child mental health. In addition, the current study showed that not only perceived social supports, but also structural social networks, may be beneficial for children. Increasing the diversity of people with whom parents have regular social contact, as well as the number of people to whom parents can turn for support, might benefit children by enhancing their mental well-being and preventing mental illness. In addition, considering the difficulties of establishing social support interventions that are applicable in any context,[27] merely increasing the diversity would be easier and less mentally burdensome for parents. Although social networks have potential negative aspects in terms of the stress and difficulty they might pose,[21] further exploration of interventions that focus on caregivers as possible key players may offer an effective approach for improving child mental health.

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