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Supplementary method 1. Social network index

The original version of social network index[1] is categorized as three measures such as number of high-contact roles (network diversity), number of people in social network and number of embedded networks. These scales can be found elsewhere[2] and made up with 12 questions about marital status; number of children they have and contact frequently; cohabitation/ frequent contact with their parents; cohabitation/frequent contact with their in-laws (or partner's parents); intimate and frequent contact with other relatives; number of friends they have and contact with frequently; belongings to church, temple, or other religious group; attendance to any regular classes; employment status; number of neighbors frequently contact with; involvement in regular volunteer work; and belonging to any groups in which they have members whom they actively interact with. So far, the association between social network diversity measured with Cohen's social network index and several dimension of health are reported multi-culturally and among diverse aged population[3-7].

In our analysis, we used corresponding questions from K-CHILD study. The supplement table 1 showed original questions and corresponding questions and answers in K-CHILD study.

Supplementary method 2. Parental involvement

Parental involvement is measured with questions on the frequency of nine types of activities performed together between a child and parents. The assessed activities are tutoring/ supervision of child study; playing sports/ doing exercise; playing computer games; playing cards/ board games; talking about school; talking about socio-political issues; talking about recent TV programs; preparing meals; going out, which are chosen to reflect common daily parent-child interaction. Caregivers were asked to choose the most appropriate frequency (1 = merely; 2 = once or twice per month; 3 = once or twice per week; 4 = 3 or 4 times per week; 5 = every day) for each activity. Parental involvement score was calculated as arithmetic sum of the answers and ranged from 9 to 45 (Cronbach's $\alpha = 0.65$).

Supplementary method 3. Mediation analysis and sensitivity analysis for mediation analysis

We analyzed mediating roles of parent mental health and parental involvement using causal mediation analysis discussed elsewhere[8] with Stata command “medeff” and “medsens” in “mediation” package[9]. Causal mediation analysis is developed within counterfactual framework, which identifies causal effects by comparing the observed outcome and the potential outcomes. As a consequence, we would compute average causal mediation effect, direct effect and total effect. Causal mediation effect is defined as the change in outcomes corresponding to a change in the mediator from the value that would be realized under the non-exposed condition, to the value that would be observed under the exposed condition, while holding the exposure status constant. Direct effect is defined as the change in outcomes corresponding to a change in the exposure status with constant mediation status. Total effect is defined as the change in outcomes corresponding to a change in exposure status while allowing mediation status to change to coincide with a change in exposure status. Average causal mediation effect, average direct effect, and average total effect are obtained by averaging over the quantities of causal mediation effect, direct effect and total effect, respectively. In sensitivity analysis, we compute sensitivity parameter ρ , a correlation between the error for the mediation model and the error for the outcome model, which would arise when omitted confounders exist. Thus $\rho = 0$ implies sequential ignorability is intact. Since there is no threshold for ρ to conclude obtained findings are valid, we also compute additional two quantities as that how much omitted confounders should explain remained variance in mediation model and outcome model (denoted as % of residuals)/ total variance (denoted as % of total variances) for average causal mediation effect to be zero.

Supplementary table 1. Assessment of social network diversity

Assessed role	Original questions	Corresponding questions in K-CHILD study	Answer assumed to have role
Spouse	Which of the following best describe your marital status? - currently married/ never married/ separated/ divorced/ widowed	What is your marital status? - married/ divorced/ widowed/ never married	Married
Parent	How many of your children do you see or talk to on the phone at least once every 2 weeks?	N.A.	
Child	Do you see or talk on the phone to either of your parents at least once every 2 weeks?	Who is your child's family member cohabiting with?	Maternal mother/ paternal mother/ maternal father/ paternal father
Child-in-law	Do you see or talk on the phone to either of your partner's parents at least once every 2 weeks?	N.A.	
Close relative	How many of these relatives do you see or talk to on the phone at least once every 2 weeks?	Who is your child's family member cohabiting with?	Other relatives
Close friend	How many of these friends do you see or talk to at least once every 2 weeks?	Are you getting on well with your neighbors?	Be on very intimate relationships/ on intimate relationships/ have relationships
Church/ temple member	How many members of your church or religious group do you talk to at least once every 2 weeks?	N.A.	
Student	How many fellow students or teachers do you talk to at least once every 2 weeks?	What is your occupation?	Student
Employee	How many people do you supervise? / How many people at work do you talk to at least once every 2 weeks?	What is your occupation?	Any occupation except for house wife, student, retirement, looking for jobs, no jobs
Neighbor	How many of your neighbors do you visit or talk to at least once every 2 weeks?	Do you usually share food with your local residents?	On a daily basis/ frequently/ sometimes
Volunteer	How many people involved in this volunteer work do you talk to about volunteering-related issues at least once every 2 weeks?	N.A.	
Group member	Do you belong to any groups in which you talk to one or more members of the group about group-related issues at least once every 2 weeks?	Are you belonging to group activities such as sport, NPO, residents' association?	Yes

Supplementary table 2. The coefficients of interaction term between structural/ functional parental social network index and child's grade for child mental health

Interaction term	Total difficulties score		Prosocial behavior		Resilience	
	B	95%CI	B	95%CI	B	95%CI
Structural social network * child's grade	-0.01	-0.04 to 0.02	0.02	0.00 to 0.03	0.14	0.04 to 0.24
Functional social network * child's grade	-0.01	-0.04 to 0.01	0.00	-0.01 to 0.01	0.08	-0.00 to 0.16

Model adjusted for child's sex, respondents, marital status, maternal age, parental age difference, maternal educational attainment, paternal occupation, and caregiver's self-rated health

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