Environmental Mediators in the Link between Parental Socioeconomic Conditions and Child Health Outcomes: Structural Equation Modeling

Zhou Mo, MD; Hui Yin*, PhD
School of Public Health, Peking University

Abstract

This study examines how environmental factors mediate the relationship between parental socioeconomic status (SES) and child health outcomes. Using data from the China Health and Nutrition Survey (CHNS) with 15,140 children aged 0-14, we applied structural equation modeling to assess the impact of SES (measured by income, mother's education, and father's occupation) on health outcomes like body mass index, disease prevalence, and emotional health. Environmental mediators, such as housing conditions and neighborhood problems, were considered. Findings show that environmental factors significantly mediate the SES-health relationship, with poorer health linked to smaller living spaces and greater neighborhood issues, highlighting the need for targeted interventions.

Keywords: socioeconomic status, environmental factors, child health, life course epidemiology.

Introduction

Socio-economic conditions across the life course significantly influence adult health and disease risks. Addressing health inequalities, particularly the urban-rural divide, is critical to improving overall well-being. In China, despite interventions such as conditional cash transfers and social medical insurance, health disparities persist, especially among vulnerable groups.

A life course approach recognizes the cumulative impact of socio-economic factors, where early life conditions, shaped by social, economic, and cultural contexts, affect health outcomes across generations. Intergenerational health inequities may arise if early environmental exposures damage health during critical growth periods. Structural equation modeling (SEM) is an effective tool for exploring the complex relationships between parental socio-economic status (SES) and child health, considering both observable and latent variables. This study uses SEM to examine how environmental factors mediate the link between parental SES and child health in China, highlighting the importance of identifying modifiable factors that can improve children's health outcomes.

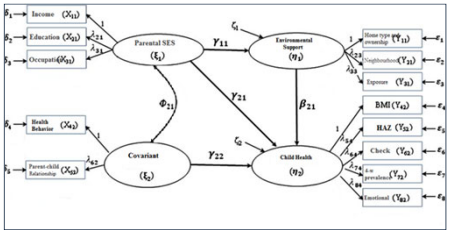

Figure 1. A diagrammatic illustration of the child health using structural equation modeling.

Methods and Materials

This study used data from the China Health and Nutrition Survey (CHNS), including 15,140 children aged 0-14 years. Structural equation modeling (SEM) was applied to explore how parental socioeconomic status (SES), measured by household income, mother's education, and father's occupation, influences child health outcomes, such as body mass index, disease prevalence, and emotional health. The study also examined environmental mediators, including housing conditions, exposure to allergens, and perceived neighborhood problems. SEM was used to model both observable and latent variables, allowing for the identification of the interrelationships between these factors and their mediation of the relationship between parental SES and child health outcomes. This approach helped to understand the complex pathways through which SES affects children's health. Figure 1 depicts the hypothesized model, outlining these relationships.

Results

The analysis revealed that environmental factors significantly mediate the relationship between parental socioeconomic status (SES) and child health outcomes ($\beta = 0.236$, $p < 0.001$). Smaller living spaces and higher levels of perceived neighborhood problems were associated with poorer health outcomes ($\beta = 0.483$, $p < 0.001$). These environmental factors also mediated the relationship between SES and child health ($\beta = 0.231$, $p < 0.001$).

Among the health outcomes studied, disease prevalence over the past four weeks was most vulnerable to environmental exposures, with a strong association ($\beta = 0.693$, $p < 0.001$). Emotional health was also significantly affected by environmental conditions ($\beta = 0.678$, $p < 0.001$), highlighting the crucial role of the early-life environment in shaping long-term health.

These findings underscore the importance of addressing environmental disparities to reduce health inequities related to socioeconomic status, suggesting that targeted interventions aimed at improving environmental conditions could have a significant impact on child health outcomes. The survey-derived data were aligned with the model, with findings detailed in Figure 2 and Table 1.

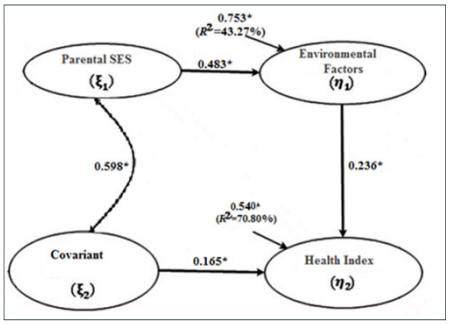

Figure 2. The fitted model, which includes the standardized parameter estimates of the latent variables and measurement errors (* denotes signficance at 0.05 level)

Latent variable	Indicator variable	Estimate	Standard error	R^2
Parental SES (ξ_1)	Income (X_{11})	0.286	0.017*	27.2
	Education (X_{21})	0.188	0.020*	52.9
	Occupational Class (X_{31})	0.253	0.016*	10.5
Covariant(ξ_2)	Health Behavior (X_{42})	0.322	0.012*	34.4
	Parental-child Relationship (X_{52})	0.585	0.015*	13.3
Environmental Factors (η_1)	Home type and ownership (Y_{13})	0.593	0.085*	73.9
	Neighborhood (Y_{23})	0.231	0.020*	34.7
	Exposure (Y_{33})	0.236	0.040*	25.6
Child Health Index (η_2)	BMI (Y_{44})	0.480	0.031*	7.3
	HAZ (Y_{54})	0.482	0.032*	7.9
	BCheck (Y_{64})	0.522	0.028*	2.3
	4-week prevelance (Y_{74})	0.693	0.044*	31.0
	Emotional health (Y_{84})	0.678	0.173*	17.1

Table 1. Parameter estimates, standard error estimates, and R2 for each measurement equation.

Discussion

The findings highlight the significant role of environmental factors in mediating the relationship between parental socioeconomic status (SES) and child health outcomes. Living conditions, such as housing quality and neighborhood problems, were identified as key mediators. These factors contributed to poorer health outcomes, particularly in disease prevalence and emotional health, emphasizing the importance of addressing early-life environmental conditions.

Targeted interventions aimed at improving environmental conditions, especially in underprivileged areas, could help mitigate the adverse effects of low SES on child health. By focusing on modifiable environmental factors, such interventions could reduce health disparities and improve long-term health outcomes for children across different socio-economic backgrounds.

Conclusions

The study found that child health inequities in China are influenced by parental socioeconomic status (SES), with environmental factors such as housing conditions, exposure to allergens, and neighborhood support acting as mediators. These adverse health outcomes are preventable and linked to broader social determinants shaped by policies beyond the health sector. To reduce health disparities, it is crucial for policymakers across sectors to incorporate health considerations into their decisions. Intersectoral governance actions, such as coordination, advocacy, and monitoring, are essential to align policies with health objectives and promote better population health.

Contact

< Zhou Mo, Hui Yin *>
< School of Public Health, Peking University >
*Author to whom correspondence should be addressed;
Email: yinhui@bjmu.edu.cn
Website: https://sph.pku.edu.cn/index.htm
Phone: +86-10-82805853.

References

1. Cohen S, Janicki-Deverts D, Chen E, et al. Childhood socioeconomic status and adult health [J]. Annals of the New York Academy of Sciences, 2009, 1186: 37-55.
2. Evans W, Eckenrode J, Marcynyszyn L. Poverty and chaos. In Chaos and Children's Development: Levels of Analysis and Mechanisms [M], American Psychological Association, Washington DC, 2008: 10-78.
3. Graham H. Building an inter-disciplinary science of health inequalities: the example of life course research [J]. Social Science and Medicine, 2002, 55:2005-2016.
4. Lawlor D, Ebrahim S, Davey G. Socioeconomic position in childhood and adulthood and insulin resistance: cross sectional survey using data from British Women's Heart and Health Study [J]. BMJ, 2002, 325: 805-809.
5. Lynch J, Kaplan G, Shema S. Cumulative impact of sustained economic hardship on physical, cognitive, psychological, and social functioning [J]. New England Journal of Medicine, 1997, 337: 1889-1895.
6. Marmot M, Friel S, Bell R, et al. Closing the gap in a generation: Health equity through action on the social determinants of health [J]. Lancet, 2008, 372:1661-1669..
7. Popkin BM, Du S, Zhai F, Zhang B. The China Health and Nutrition Survey: monitoring and understanding socioeconomic and health change in China 1989-2011. Int J Epidemiol 2010, 39: 1435-40.
8. Poulton R, Caspi A, Milne J, et al. Association between children's experience of socioeconomic disadvantage and adult health: a life-course study [J]. Lancet, 2002, 360: 1640-1645.
9. Slominski L, Sameroff A, Rosenblum K, et al. Longitudinal predictors of adult socioeconomic attainment: the roles of socioeconomic status, academic competence, and mental health [J]. Development and Psychopathology, 2011, 23(1):315-324.
10. Strand H, Kunst A. Childhood socioeconomic position and cause-specific mortality in early adulthood [J]. American Journal of Epidemiology, 2007, 165: 85-93.