

# Growing Up with Siblings in the Age of One Child: The Potentially Confounding Role of Socioeconomic Background

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## Abstract

We read with great interest the study by Tang and colleagues, which investigated how growing up without siblings (GWS) affects adult brain structure, function, and behavior using a large-scale dataset. Their findings challenge long-standing stereotypes about only children by reporting positive associations between sibling absence and neurocognitive outcomes as well as mental health indicators. Importantly, their work went beyond simple association analysis by incorporating proximal environmental exposures (PEEs), including multiple socioeconomic and family environmental factors, which they showed mediated most of the observed brain-behavioral associations. This multidimensional design represents a major step forward in understanding how social structure interacts with neurodevelopment.

## Full Text

### Preamble

**Title:** Growing Up with Siblings in the Age of One Child: The Potentially Confounding Role of Socioeconomic Background

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We read with great interest the study by Tang and colleagues, which investigated how growing up without siblings (GWS) affects adult brain structure, function, and behavior using a large-scale dataset. Their findings challenge long-standing stereotypes about only children by reporting positive associations between sibling absence and neurocognitive outcomes as well as mental health indicators. Importantly, their work went beyond simple association analysis by incorporating proximal environmental exposures (PEEs), including multiple socioeconomic and family environmental factors, which they showed mediated most of the observed brain-behavioral associations. This multidimensional design represents a major step forward in understanding how social structure interacts with neurodevelopment.

However, we argue that the interpretation of these findings requires careful consideration of the historical and demographic context of the sample, specifically, the heterogeneity in the enforcement of China's one-child policy (1979-2015). Rather than representing a random distribution of family sizes, sibling status in China during this period was strongly structured by socioeconomic and geographic factors. Urban families, particularly those employed in government or state-owned sectors, faced strict enforcement, making them far more likely to have only one child [2,3]. In contrast, rural families and informal labor populations had greater flexibility in practice, especially when the firstborn was female [2,3]. As a result, being an "only child" during the period of the one-child policy was not simply a family preference or social circumstance; instead, it was often an outcome shaped by state regulation and socioeconomic opportunity.

Tang et al. themselves reported robust group differences between only children and those with siblings in family SES indicators, including parental education and occupation, income-to-needs ratios, family resources, and particularly urbanicity scores (pre-adult urban living) [1]. These factors formed core components of the PEE latent variables (family SES and city-level SES) and were shown to significantly mediate the associations between GWS and brain and behavioral outcomes. In fact, their own causal mediation analysis demonstrated that a large proportion of the variance initially attributed to GWS was explained by SES-linked environments. This is not a peripheral result; instead, it is central to the interpretation of their study. SES-related environments are not simply mediators of sibling effects but also shape the likelihood of being an only child in the first place due to policy-dependent enforcement. Thus, SES cannot be treated exclusively as an intermediate pathway; it may also function as an antecedent determinant of sibling status (Fig. 1 [Figure 1: see original paper]).

**Fig.1 Schematic models of sibling status and family SES in relation to brain and behaviour.** Sibling status indicates whether a child is an only child or has siblings. (a) SES mediates the effect of sibling status. (b) Sibling status mediates the effect of SES. (c) SES and sibling status show reciprocal

and direct effects.

Tang et al. acknowledge one key limitation: they were unable to collect data on why participants were only children. This prevents disentangling policy-related, socioeconomic, cultural, and personal motivations underlying family size. Acknowledging this limitation is important, as it shifts the interpretation of their findings away from individual or familial choice and towards historically constrained demographic structure.

To isolate the developmental effects of GWS more rigorously from simple SES-related influences [4], future studies could benefit from several methodological extensions. For example, stratified analyses across urban and rural cohorts, or across birth cohorts differing in policy exposure, would help reduce SES confounding by creating more comparable subgroups. Natural experiment approaches exploiting regional variation in policy enforcement or implementation intensity could further strengthen causal inference. In addition, sensitivity analyses testing the robustness of GWS effects after jointly residualizing multiple SES indicators would help assess the extent to which results depend on SES adjustment strategies.

Finally, while the authors discussed potential policy implications, caution is needed when translating these findings to contemporary demographic policy. China, now facing declining birth rates, has shifted from decades of birth restriction to encouraging larger families. In this context, findings about only-child development may be misinterpreted as evidence against the value of sibling relationships [5,6] (see also [7]). Instead, both Tang et al.'s data and our argument support a different message: developmental outcomes are shaped not by sibling number alone, but by the socioeconomic and caregiving environments in which children grow up. Future research should continue to disentangle these intertwined influences to inform family and education policy more responsibly.

**Competing interests** The authors declare no competing interests.

**Author contributions statement** B.W., H.Z. and X.K. wrote the paper.

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