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The Disparity between Parental Education and Urban Resident through Residential Mobility in Child Development: Taiwan Birth Cohort Study

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Abstract

Background: Children's development is associated with the quality of the environment in which they live in, including neighborhood socioeconomic status (SES) and parental level of education, which may reflect resource availability.

Aim: Using a national birth cohort database, this study investigated the influence of residential mobility, parental education and urban resident on children's developmental trajectory from six months to five years using pathway analysis and latent growth modeling (LGM). In addition, the interaction of these variables of interest was also investigated.

Methods: The Taiwan Birth Cohort Study dataset includes randomized community data on 21,663 children at six, 18, 36 and 66 months of age. The Taiwan Birth Cohort Study-Developmental Instrument was used to measure children's development.

Results: The LGM of the children's developmental trajectory from six months to five years old showed that children of more educated parents were associated with better initial level of development. Children who lived in the city were associated with better development than those who lived outside the city and children that relocated between the ages of three and five were associated with slower developmental growth than those who had not. Regression results showed mothers who were more educated were more likely to move, but fathers who were more educated were less likely to move.

Discussions: Parental level of education was associated with the rate of relocation, with an inverse effect between fathers and mothers. In addition, an interactive effect was found between residential mobility and father's level of education, with fathers living in rural areas associating with having a higher level of education being more likely to move. Follow-up on the influence of residential mobility in children's development is needed to investigate how pervasively and persistently the changes in the children's environment associates with their development.

Keywords: Taiwan birth cohort study; Latent growth model; Urban resident; Residential mobility, Child development

Introduction

Children's development is associated with the quality of the environment in which they live [1]. A longitudinal birth-cohort study in Northern Finland found that the growth environment (including maternal characteristics and the nature of the home environment) is associated with adult temperament profile thirty years later [2]. Neighborhood socioeconomic status (SES) reflects the availability of community resources [3], which may be associated with the mental well-being of both children and adults [4]. Evans, Jones-Rounds, Belojevic, Vermeylen [5] found that children who are from lower income families are more likely to reside in a neighborhood with less access to open green space, which leads to diminished physical activity and higher BMI. Along the same line, a growing body of evidence has pointed to the influence of neighborhood characteristics on children's mental health [6,7]. Residence in disadvantaged neighborhoods has been observed to increase adolescents' internalizing of problems, including depression and anxiety [8]. In a broader context, social inequalities exist in the disparities between urban and rural areas. A study in China found health care was more accessible and of better quality in urban than in rural regions [9], which may also affect children's development.

Maternal level of education has been found to influence children's development in a number of reports [10-12]. More educated parents may have more access to up-to-date information regarding childcare and make better use of family and community resources [13]. Lung et al. [12] found the effect of maternal education on child development increases with time, and the effect of maternal mental health on child development decreases with time. Moreover, parental level of education has been found to be a stronger predictor for child well-being than family income, single parenthood or family size [14].

However, another study found that half of the effect of maternal level of education on children's nutritional status can be explained by SES and area of residence [15]. A study in India also found that children of more educated mothers were fully immunized because they live in more affluent households in areas where other children are fully immunized [16]. Therefore, the interaction between maternal level of education and area of residence (urban resident in this study) and its effect on children's development is of interest in this study.

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Dupere, Leventhal and Vitaro [17] proposed a method of using residential mobility in investigating the influence of neighborhood characteristics on adolescents. Residential mobility can be disrupting to an individual's social world and functioning [18], however, moving out of a disadvantaged neighborhood is associated with better self-efficacy and mental health, compared to staying in such neighborhoods [17-19]. Consequently, residential mobility has been included in our investigations.

Latent growth modeling (LGM), a structural equation modeling (SEM) approach, has been used widely in studies of child development [20]. The LGM technique can be used to investigate changes in an individual over time [21], show the initial status and trajectory of the development of each child studied, and provide early indicators of problematic development [22]. Shek and Ma [23] pointed out the advantages of LGM, stating that it can be used to investigate within-person systematic change and between-person differences across different measurements over time in growth parameters (slopes and intercepts). Furthermore, it can also incorporate additional factors to investigate the pathways and relationships among the potential predictors in the expected trajectory [24]. Given that the focus of our study was child development and the effect of parental quality of life on child development, we considered LGM to be an appropriate method of analysis.

Thus, the aim of this study was to use a national birth cohort database in an investigation of the influence of the interaction between parental level of education and urban resident through residential mobility on the developmental trajectory of children 6 months to 5 years old using LGM.

Materials and Methods

Ethics statement

The TBCS protocol was approved by the institutional review board of Taipei City Hospital (TCHIRB-1021105-E) and is in accordance with the principles expressed in the Declaration of Helsinki. After detailed explanation of the study, written informed consent was obtained from the parents of all participants at each stage of the study.

Participants

The Taiwan Birth Cohort Study (TBCS) database was intended to build a sample that would be representative of the children in Taiwan, using the method of national household probability sampling. All babies born between October 2003 and January 2004 in Taiwan were eligible for inclusion in the TBCS, with no exclusion criteria. A 2-stage stratified random sampling method was used. In the first stage, the primary sampling unit was cities and towns; 85 townships were selected from 369 townships by systematic random sampling and then grouped into 12 strata according to 4 levels of urban resident and 3 levels of total fertility rate. In the second stage, newborns were proportionally selected according to the rate of birth from the 85 selected cities and towns [20]. The final sample at 6 months included 21,248 families (11.7% selection rate); 20,172 (94.94%) of these families agreed to remain in the study at 18 months, 19,908 (93.96%) at 36 months, and 19,721 (92.81%) at 66 months.

After the parents had agreed to participate, a trained researcher would visit their homes and conduct a structured interview, collecting data on all variables that may affect the children's health and development [20]. Residential mobility was one of the items asked in the structured interview. Any change of location of residence was considered residential mobility.

Materials

The children's developmental condition was measured using the Taiwan Birth Cohort Study-Developmental Instrument (TBCS-DI) for 6, 18, 36 and 66 months. The TBCS-DI is a parental-report instrument that measures child development on the basis of parental observation of the child's daily performance. There are 26 items in the 6 months' scale, 17 in the 18 months' scale, 19 in the 36 months' scale, and 16 in the 66 months' scale. The items are evaluated using a 3-point Likert scale, with higher scores implying better development. The TBCS-DI has shown high reliability, internal consistency, and validity [10,25-27].

Statistical analysis

The demographic distribution of the children and parents and regression analysis of the factors that were associated with residential mobility were analyzed using SPSS 15.0 software for Windows (Chicago, IL, USA). Missing data and participants who were lost to follow-up were replaced using Bayesian analysis. Bayesian analysis is an approach that uses all the available information to produce a maximum likelihood estimate. The combined use of Bayesian analysis and pathway analysis to fill in missing data has been found to be ideal for longitudinal studies of child development (Lung, et al).

LGM and SEM were used to analyze the pathway relationship among the variables of interest. Both Bayesian analysis and SEM were carried out using the AMOS 7.0 statistical software package (SPSS, Chicago, IL, USA). Chi-square distribution was used to test the overall fit of the data, and an adjusted goodness-of-fit index (AGFI) greater than 0.09, a root mean square error of approximation (RMSEA) less than 0.08, and a Comparative Fit Index (CFI) and Tucker–Lewis Index (TLI) close to 1.0 showed a good fit, which indicates that the model describes the observed data adequately. The relationships among these investigated variables are represented by beta (β) values of regression or path coefficients. The models presented are parsimonious SEM, which means that only statistically significant pathways (p values less than 0.05) are presented.

Results

The dataset from 6, 18, 36, and 66 months were combined, missing data was filled using Bayesian analysis, resulting in the final sample of 21,663 children and families. Of the 21,663 children who participated in the study, approximately half were male (52.5%), and 2.6% of the children were one of a twin. Only a little less than half of the children lived in the city (47.6%); 13.5% had moved prior to the age of 3, and 18.9% moved between the ages of 3 and 5 (Table 1).

Parsimonious regression was used to analyze the interaction of area of residence and parental education in association with moving at 36 and 66 months (Table 2). Results showed area of residence and parental level of education were associated with moving at 36 months (β=.24, p<.001; β=.06, p=.046; β=-.11, p<.001). Children who lived in the city and whose fathers had a lower level of education or whose mothers had a higher level of education were more likely to have moved prior to the age of 3. Area of residence and parental level of education were also associated with moving at 66 months (β=-.39, p<.001; β=.06, p=.021; β=-.13, p=.007). In addition, the interaction between paternal level of education and area of residence was also correlated with moving at 66 months (β=-.05, p=.050). Children who lived in the city and whose mothers had a higher level of education or whose fathers had a lower level of education were more likely to move when the children were

Variable	n (%)
Boys	11,367 (52.5)
Twins	561 (2.6)
Low birth weight (<2500g)	1,720 (7.9)
Premature (<37 weeks)	964 (4.4)
Living near an incinerator (<3 km)	960 (4.4)
Breastfed	17,787 (82.1)
Living in the city	10,306 (47.6)
Moved at 36 mo	2,928 (13.5)
Moved at 66 mo	4,092 (18.9)
Maternal education:	
Elementary school	857 (4.0)
Junior high	2,359 (10.9)
High school	8,630 (39.8)
University/college	9,045 (41.8)
Graduate school	772 (3.6)
Paternal education:	
Elementary school	311 (1.4)
Junior high	2,670 (12.3)
High school	8,621 (39.8)
University/college	8,429 (38.9)
Graduate school	1,632 (7.5)
Variable (range)	**Mean (SD)**
Parental education (years)	
Maternal education (0–20)	12.67 (2.70)
Paternal education (0–21)	12.98 (2.51)
Parental age (years)	
Mother's age (14–49)	29.39 (4.89)
Father's age (17–80)	33.31 (5.45)

Table 1: Demographic distribution of the children and parents (N=21,663).

a) Variable	β	SE	p
Area of residence	0.25	0.03	<.001
Maternal level of education	0.06	0.03	.046
Paternal level of education	-0.11	0.03	<.001
b) Variable			
Area of residence	0.39	0.09	<.001
Maternal level of education	0.06	0.03	.021
Paternal level of education	-0.13	0.05	.007
Interaction of area of residence and paternal level of education	-0.05	0.03	.050
Dependent variable: Move at 66 months; Area of residence: 3-city, 2-town, 1-country			

Table 2: Interaction between parental education and area of residence associated with residential mobility at a) 36 and b) 66 months in the parsimonious regression model.

between the ages of 3 and 6 years. However, fathers who had a higher level of education and who lived in rural areas were more likely to move when their children were between the ages of 3 and 6 years.

LGM showed that the factors that were associated with children's 6 to 66 months' intercept (initial) development included parental level of education, children's sex, whether the child was born preterm or of low birth weight, and whether the child had been breastfed, lived within 3 km of an incinerator, or lived in the city. The children of parents who were more educated had a better initial level of development (β=.04, p<.001; β=.08, p<.001). Males had a better initial level of development than females (β=.10, p<.001), and those who were breastfed had better initial development than those who had never been breastfed (β=.05, p<.001). In addition, children who lived within 3 km of an incinerator had slower initial development than those who did not (β=-.02, p=.022), and those who lived in the city had better initial development than those who lived in towns or rural areas (β=.08, p<.001).

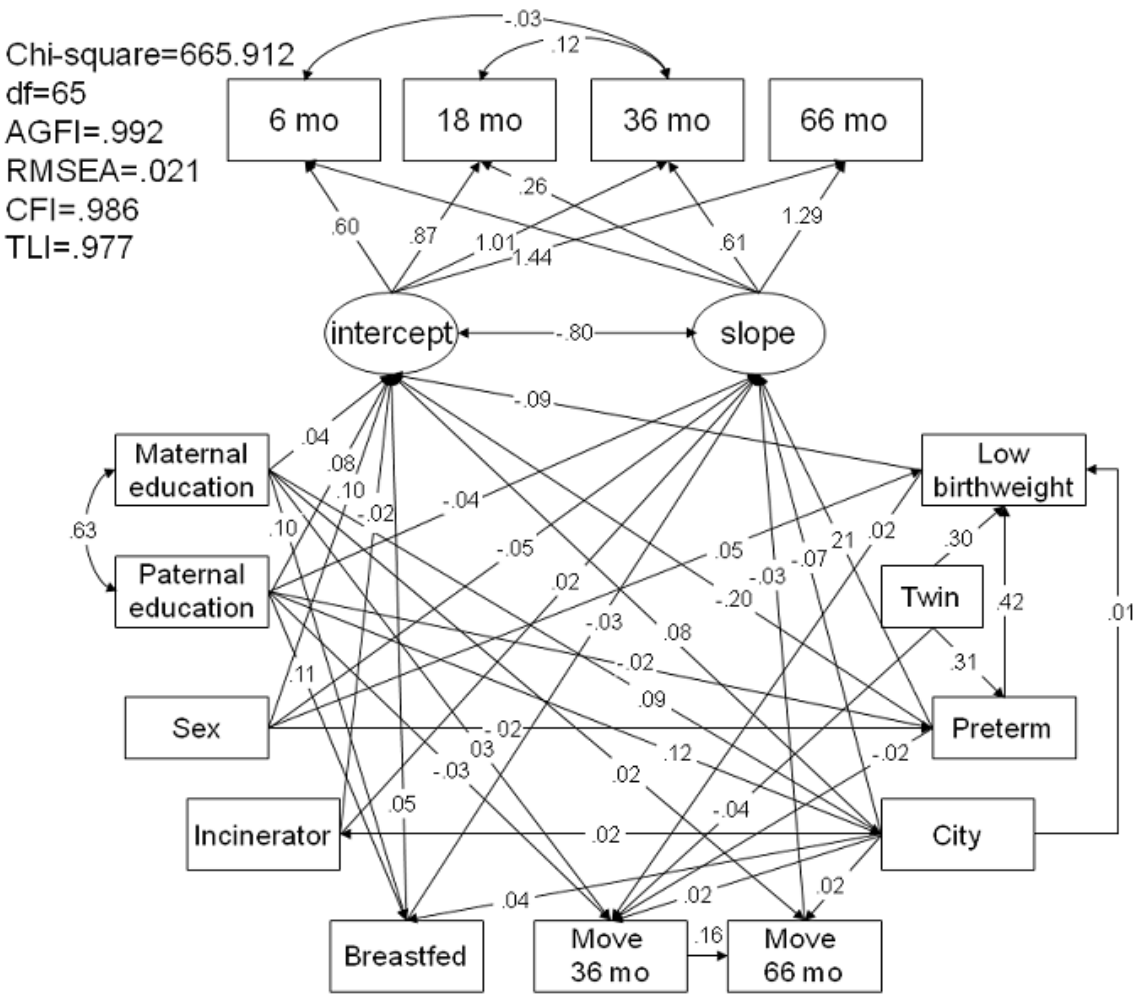
Factors that were associated with the slope of the children's growth trajectory from 6 to 66 months included paternal level of education, children's sex, whether they were born preterm, whether they had been breastfed, and whether they lived near an incinerator, in the city, or had moved between the ages of 3 and 5. Some of these factors compensated for initial development, which correlated negatively with the slope of the growth trajectory (r=-.80, p<.001). These included paternal level of education (β=-.04, p<.001), children's sex (β=-.05, p<.001), preterm at birth (β=.21, p<.001), having been breastfed (β=-.03, p=.005), living within 3 km of an incinerator (β=.02, p=.017), and living in the city (β=-.07, p<.001). Furthermore, those who had moved between the ages of 3 and 5 had a slower developmental slope than those who did not (β=-.03, p=.008).

Besides the factors that were associated with the children's initial development and the slope of their developmental trajectory (Figure 1), SEM also showed the relationship among parental education, place of living and residential mobility. Parents who were more highly educated were more likely to live in the city (mother: β=.09, p<.001; father: β=.12, p<.001). Fathers who were more educated were less likely to move (β=-.03, p<.001), on the other hand, mothers who were more educated were more likely to move before their children reached age 3 (β=.03, p<.001). Mothers who had a higher level of education were also more likely to move when their children were between the ages of 3 and 6 (β=.02, p=.002). Finally, those who lived in the city were more likely to move before their children were age 3, and when they were between 3 and 5 years old (β=.02, p=.004; β=.02, p=.025).

Discussion

LGM of children's developmental trajectory from 6 months to 5 years old revealed that children of more highly educated parents had a better initial level of development. With regard to urban resident and residential mobility, children who lived within 3 km of an incinerator had worse initial development, and children who lived in the city had better development than those who did not. However, children whose initial development was slower would gradually catch up in their later development (slope), showing less effect. In terms of the relationship between residential mobility and children's development, those who moved between the ages of 3 and 5 had slower developmental growth (slope) than those who had not moved. In addition, the regression results showed that mothers who were more educated were more likely to move, but fathers who were more educated were less likely to move. Nevertheless, fathers who were more educated and lived in rural areas were more likely to move when their children were between the ages of 3 and 5; these findings show an interactive effect between the area of residence, parental level of education and residential mobility.

The finding that children of more highly educated parents had a better initial level of development is consistent with previous research [10-12]. Parents' level of education was found to have a more persistent effect than maternal mental health on children's development [26]. More highly educated parents may have more access to up-to-date information regarding childcare and make better use of family and community resources [13]. Vikram et al. [16] investigated the relationship between maternal level of education and immunization in India, and found that more highly educated mothers had better knowledge of good medical care, and their education also provided them with socially valued general skills, leading to greater confidence and better social interaction with medical providers. In contrast, children of parents with a lower level



AGFI: adjusted goodness-of-fit; CFI: Comparative Fit Index; TLI: Tucker-Lewis Index; RMSEA: root mean square error of approximation; sex (dummy variables: 1: male; 2: female)

Figure 1: Latent growth model of the environmental, parental and children's characteristics associated with children's 6 to 66 months' developmental trajectory.

of education, poorer maternal health, and greater parenting stress were less likely to perform parent-initiated behaviors, such as reading, which have the potential to enhance children's development [28]. Although mothers generally are the main care providers in the family, a previous study also found that paternal level of education predicted the children's language and cognitive development [29], thereby revealing the vital impact of parental level of education on children's development.

Regarding urban resident and residential mobility, children who lived within 3 km of an incinerator had worse initial development, and children who lived in the city were better developed than those who did not. This is consistent with the results of a study by Lung, Chiang, Lin and Shu [30] that showed incinerators have an influence on children's early development, and children living in cities have better development than those in rural areas. Taiwan, like China, has urban-rural inequalities, with cities providing a better socioeconomic environment and having more resources. Therefore, urban-rural inequality is also a reflection of socioeconomic neighborhood differences. The results of both LGM and regression showed that more educated parents were more likely to live in cities. Differences in neighborhood resources were reported in a study by Evans et al. [5], which found more open green spaces in neighborhoods with higher income families, thereby encouraging physical activity. Similarly, Kohen, Leventhal, Dahinten, and McIntosh [31] found a pathway relationship among neighborhood characteristics, family function and children's verbal abilities, showing that neighborhood SES had an influence on children's verbal ability through the mediating factors of neighborhood cohesion, family function and literacy activities. Therefore, with the confounding factor of parental level of education controlled, urban inequality and neighborhood socioeconomic differences were still influential to children's development.

Besides parental level of education, residential mobility was also associated with children's development, with children who had moved between the ages of 3 and 5 being associated with slower developmental growth than non-movers. Residential relocation is a stressful life event [32] for both parents and children. Furthermore, a high rate of mobility in childhood is associated with adverse and long-term educational [33], emotional, mental health, and physical health outcomes [34].

Although moves were associated with a slower developmental

slope, mothers who were more highly educated were more likely to move, and fathers who were more highly educated were less likely to move. However, fathers who were more highly educated but lived in rural areas were more likely to move when their children were between the ages of 3 and 5. Tunstall, Pickett and Johnsen [35] investigated the association between residential mobility during pregnancy and during infancy in the UK, and found that "unhealthy migrants", with the sociodemographic characteristics of younger mothers, unintended pregnancies and lower SES, made most of the moves during pregnancy and infancy, which led to poorer health outcomes [35]. This was consistent with our result of more frequent moves being associated with slower child developmental growth. However, there is another group of high SES adults, known as "healthy migrants", that may move for the positive reasons of pursuing higher education and professional employment [36,37]. The Bureau of the Census in the United States reported a high rate of mobility among Americans in their early twenties [38]. In response to the lifecycle changes of marriage or parenthood, these young Americans may to seek new housing appropriate for their new statuses. In addition, those who were highly educated (college degree or higher) were more likely to move farther away in response to career opportunities, and less-educated people (high school degree or lower) would move locally in response to the housing situation or personal difficulties [38]. This phenomenon may explain the interactive effect of paternal level of education and residential mobility -- fathers who are more highly educated are more willing to move further (from rural to urban areas) to seek better job opportunities.

Other factors associated with better initial development of children included being born full term or normal weight or having been breastfed. Low birth weight and prematurity have been found consistently to be associated with developmental delay [39]. Furthermore, breastfeeding has also been found to be beneficial to children's health and development [31,40-42].

We also found a correlation between those who moved before the children were age 3, and when they were between 3 and 5, showing that those who moved previously were more likely to move again. Oishi, Lun and Sherman [43] found frequent movers felt happier when others perceived their personal selves, whereas non-movers felt happier when a partner accurately perceived their collective selves. In the process of development, moving can disrupt the social environment and routines of children and adolescents [18,44]. Childhood experiences of moving can change one's basis for happiness felt in social interactions through shaping the relative importance of the personal versus collective self [43]. Cross-cultural studies also found that Americans, who live in a high-mobility society, more often use personality traits to define who they are than do the Japanese, who live in a low mobility society [43]. In addition, our study found that those who lived in the city were more likely to move, which is consistent with a previous study showing people living in metropolitan areas regarded their personal self as more important than did their counterparts in regional cities [45]. Therefore, in future studies, the personality traits of parents and their prior moving history should be investigated, and, whether there are differences in the personality development of frequent movers and non-movers should also be followed-up in the future.

Previous studies showed parental mental health plays an important role in children's development [10-12], therefore parental mental health were controlled in our analysis (data not shown). The results showed parents who were higher educated had better mental health, which is consistent with a previous study [12]. Additionally, parental mental health did not have an influence on the relationship between residential mobility and children's developmental trajectory. However, mothers who were more emotionally stable when children were three years old were less likely to move when children were five and a half years old. This result is consistent with previous studies showing the rate of residential mobility is higher in those with mental disorders than those without [46,47]. On the other hand, paternal mental health did not have an association with residential mobility. The limitation of our study is that although we have attempted to control the confounding factors associated with residential mobility, such as parental mental health; however, there are other psychosocial factors which may affect residential mobility, such as personality characteristic of the parents [18,44], which was not included in our study. Another limitation was distance of relocation was not measured in our study, future studies could investigate whether distance of relocation impacted children's development and mental health trajectories.

A limitation of this study is that reasons for moving were not analyzed. The definition of "healthy" or "unhealthy" migrants is hard to determine. For instance "wanting a larger home" can be defined as positive while "overcrowding" as negative, but both reflects a similar situation [35]. However, our study showed a consistent result, that relocating before the age of 5 influences the children's developmental growth.

This study investigated the interactive effect of parental level of education and urban resident on residential mobility and children's development in a large national birth cohort. Our results showed parental level of education was associated with the rate of moves, with an inverse effect between fathers and mothers. In addition, an interactive effect was found between residential mobility and father's level of education, with those fathers living in rural areas and more highly educated being more likely to move. Follow-up on the influence of residential mobility in children's development is needed to determine how pervasively and persistently the changes in the children's environment influence their development.

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