ORIGINAL RESEARCH

Association Between Family Context and Sleep Trajectory in Middle-Aged and Elderly Chinese Adults

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Objective: The study aims to reveal the association between family context and sleep trajectories in middle-aged and elderly Chinese adults.

Methods: Subjects (n=7777) aged between 40 and 65 years were selected from the China Family Panel Studies (CFPS). Latent class analysis and the multi-trajectory method were used to identify the family context and sleep trajectories from 2010 to 2018. Multinomial (polytomous) logistic regression was performed to explore the relationship between family context and sleep trajectories.

Results: Five family context classes were identified according to family demographic characteristics. Simultaneously, four sleep trajectories were determined based on three sleep-related indexes. Subjects from family that had only sons or multiple-child are liable to shorten or prolong sleep duration and increase midday nap ratios compare with subjects who from family that had one or more daughters, and in future public health prevention and control, more attention could be paid to such families.

Conclusion: The study found that family context is associated with sleep trajectories among middle and old Chinese adults. Subjects from families with only girls seemed to have more stable sleep trajectories, while those with one or more boys' families had unstable sleep trajectories. Further interventions would be carried out for sleep disorders, it is necessary to pay more attention to the family context, especially the number and gender of children.

Keywords: family context, sleep trajectory, China Family Panel Studies, CFPS, sleep disorders

Introduction

The relationship between sleep issues and health is an increasing cause for global concern. It is linked to higher morbidity and mortality rates,[1] compromised quality of life, and increased social and economic burdens.[2] Sleep disorders affect up to one-third of the United States population.[3] Meanwhile, the figures from World Health Organization also indicated that more than one-third of the world's population is sleep-deprived.[4] In China, at least 300 million adults experience insomnia and sleep disorders,[5] which would be a sustainable lift-up.

Sleep quality associated with family context has been reported in previous studies.[6–8] With rapid socio-economic development of China, apparent changes have occurred in family structure. Socio-economic status has become increasingly heterogeneous following the country's reform; household economic level and family health may be closely related.[9] In China, middle-aged and elderly have experienced tremendous social changes over the past decades, which might play a mediating effect on their lifestyle and bring about health challenges.[10] Since 2000, children's education has become the major socio-economic burden faced by Chinese families, and an association between the number of children and their gender with parents' sleep quality was observed.[11] Thus, the burden of education might relate to health conditions,[12,13] which could modify the quality of parental sleep or sleep trajectories.

915

Sleep is a dynamic process throughout an individual's lifespan,[14] the changes in sleep characteristics were associated with a higher risk of adverse outcomes,[15] which showed using the trajectory of sleep characteristics to predict health risk was an advantageous alternative. Most studies about the relationship between family context and sleep issues focus on children and adolescents,[16] however, the literature gap still exists about the evidence on the middle and elderly. The present study aims to clarify the association between family context and sleep trajectory in middle-aged and elderly Chinese adults using the China Family Panel Survey (CFPS) longitudinal data.

Methods
Data Source
Subjects were selected from the CFPS, a nationally representative, annual longitudinal survey of Chinese communities, families, and individuals launched in 2010 by the Institute of Social Science Survey (ISSS) at Peking University, China.[17] The CFPS sample covers 25 provinces, municipalities, and autonomous regions, the baseline survey was conducted in 2010 and covered 14,960 households, 33,600 adults, and 8990 children,[18] and covering personal information such as work status, education level, cognitive ability, personality characteristics, and entrepreneurship. For our purposes, we considered data released from five consecutive survey waves: 2010, 2012, 2014, 2016, and 2018.

Study Population
Subjects in the present study needed to satisfy the following criteria: 1) participated in five consecutive survey waves; 2) age in the first survey year (2010) was between 40 and 65 years, due to they had relatively stable working and living environment than younger; and 3) with no medical diagnosis of chronic disease. In total, 7777 subjects were extracted for the current study. The Biomedical Ethics Committee of Peking University (approval number IRB00001052-14,010) and Ningxia Medical University General Hospital Scientific Research Ethics Committee (approval number 2023–18) approved this study, and all survey participants provided informed consent. Research procedures involving human participants conformed with the 1964 Helsinki declaration and its later amendments.

Latent Class Definition of Family Context
The family context was measured by the number of siblings of subjects to give an indication of the participants' childhood experience that might have contributed to their mental health in adulthood;[19] whether their parents are alive, which might be related to parental support in current Chinese context, especially in terms of reducing the participants' own parenting stress;[20] education level of the subjects' parents, education level of spouse, and education level of participants themselves, all of which are related to socio-economic level; number of children was used to depict family financial stress, with separate counts of boys and girls to reflect the Chinese traditional preference.[21] The number of sons could be directly associated with future financial stress. We also redefined the number of boys, girls, and total children using category variables where 0 represents none, 1 indicates only one child and 2 and 3 mean two and more than two children, respectively. Parents' educational level of subjects was collapsed into illiterate/semi-literate, primary school, junior high school, and above. Education levels of subjects and their spouses were categorized into primary school and below, junior high school, high school, and above. The number of siblings was grouped into four levels: 0, 1, 2, and 3, indicating none, only one, two, and more than two siblings, respectively.

Latent class analysis (LCA) was performed to group family context based on the 2010 survey. The theory and application of LCA can be found in previous publications.[22–24] Akaike information criteria (AIC), Bayesian information criterion (BIC), adjusted Bayesian information criterion (aBIC), and entropy were considered to determine the optimal classes. Smaller values for BIC, adjusted BIC and AIC indicated a better model fit,[25] and Entropy ≥ 0.8 indicates classes are sufficiently separated.[26] By fitting from one class, we can obtain the best model.

Sleep Trajectories Identified During the Following Years

The traj command in Stata 15.0 was used to describe sleep trajectories in the following period, which was assessed by sleep duration calculated as the time interval between bedtime and wake-up time; sleep onset time was categorized according to responses to the question: "What time do you usually go to bed?" with four possible options: before 20h00, from 20h00 to 22h00, between 22h00 to 00h00, or later than 00h00; nap habits were measured by the question: "Do you have a midday napping habit?" and response options of "yes" and "no". Sleep duration was omitted from the 2012 survey due to the design of the questionnaire. Data of sleep duration in the final analysis were used as post-normalization data. The optimal model was determined using BIC and average posterior probability for each group.[27]

Covariates

Demographic information, socio-economic status, health conditions, and lifestyle factors like residence (0=rural, 1=urban), sex (0=female, 1=male), age, ethnic group (1=Han, 2=Others), marital status (1=married with a spouse, 2=others). Income level in local currency, social status, life satisfaction, and degree of confidence in the future were measured using a five-point Likert scale. Body Mass Index (BMI) was calculated using weight (kg)/height (m^2). Self-reported health occurred by asking participants to rate their health (1=excellent, 2=good, 3=fair, 4=unhealthy, 5=very unhealthy). And respond to a yes/no question: "Have you been unwell in the last two weeks?" to measure unwell status. Physical exercise in the last week, current smoking status, and alcohol use were measured by single questions requiring a yes/no response.

Statistical Analysis Strategies

StataMP 15.0 software was employed to analyze the final data. All quantitative variables are expressed as means ±standard deviations (SD), and comparisons between family context groups were performed using one-way analysis of variance. Qualitative variables are displayed as frequency and percentage, and Chi-square tests were used to compare the proportion of variables among family context groups. Multinomial (polytomous) logistic regression was used to describe the relationships between family context and sleep trajectories. Unadjusted and adjusted (all covariates were controlled) relative-risk ratios (*rrr*) are reported.

Results

The results in Table S1 and Figure S1 show that a five-class model was optimal for family context. Figure 1 depicts the five classes of family context, with determined factors of the number of children and their gender. We renamed the family context classes as follows: 1-C: only two boys in a family; 2-C: only two girls in a family; 3-C: only one boy in a family; 4-C: only one girl in a family; 5-C: Large family.

A four-trajectories model was selected, the average posterior probabilities and sleep trajectories are shown in Table 1 and Figure 2. The first group showed stable characteristics of three sleep items from 2010 to 2018: shorter sleep duration, regular sleep onset time between 20h00 and 00h00, and a consistently lower nap rate. We defined the first group (8.2%) as the stable-with-lower sleep characteristic group (G1). The second group (36.9%) showed moderate sleep duration that decreased slightly in the follow-up year. This group had a stable sleep onset time-similar to G1-and a moderately increasing midday nap rate, which was considered to counteract the reduced sleep duration (G2). The third group (18.9%) had the longest sleep duration that increased moderately over follow-up, a stable sleep onset time similar to the first two groups, and moderately increasing midday nap rate. We designated it as a medium increase in sleep characteristics (G3). The last group (36.0%) had moderate sleep duration at the outset, slightly increasing over the following years, and a lower midday nap rate at baseline that increased slightly in the final survey years. This group had a constant sleep onset time, and we described it as having slightly increased trends of sleep characteristics overall (G4).

Table 2 depicts the distribution of family context information and demographic indexes among sleep trajectories. Most variables showed a significant distribution except for marital status, current smoking habit, number of siblings, and number of girls.
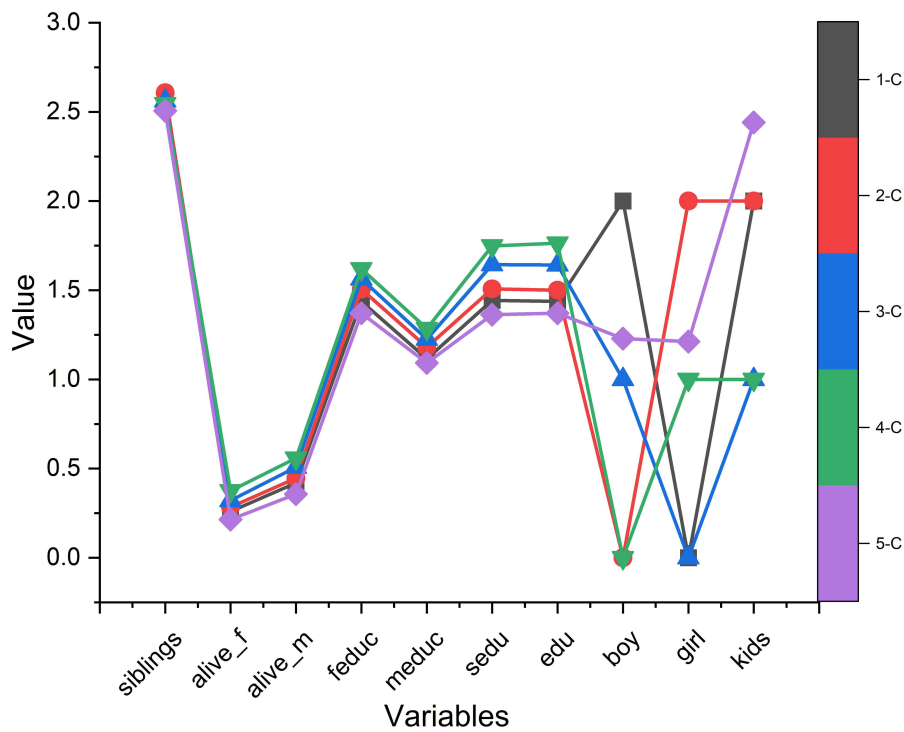
Figure 1 Results of Latent Class Analysis of family context from 2010 CFPS survey.
Notes: siblings: number of siblings of participants; alive_f: father was alive at the time of the survey (2010); alive_m: mother was alive at the time of the survey (2010); feduc: educational level of father; meduc: educational level of mother; sedu: educational level of spouse; edu: educational level of respondent; boy: number of boys in a family; girl: number of girls in a family; chi: number of children in a family; 1-C (black square): only two boys in a family; 2-C (red round): only two girls in a family; 3-C (blue triangle): only one boy in a family; 4-C (green triangle): only one girl in a family; 5-C (purple diamond): Large Family.

The frequencies of sleep trajectories among family context are presented in Table 3. Group 2-C (two girls in the family) showed the highest proportion of stable sleep trajectory (G1) that is characterized by shorter sleep duration and lower midday nap ratio. Group 4-C (one girl in the family) showed the highest proportion of slightly decreasing nocturnal sleep duration and increasing midday nap ratio (G2). Groups 1-C (two boys in the family) and 5-C (Large family) had the highest sleep trajectory with medium increases in sleep duration and midday nap ratio (G3). Group 3-C (only one boy in the family) showed the highest scale of slightly increasing trends of sleep duration and nap ratio (G4), while the nap ratio was at the lowest position in 2010 with G1.

The relative risk-ratio (*rrr*) of family context with sleep trajectories is displayed in Table 4. Families that had two girls, one boy, or only one girl negatively associated with G3 sleep trajectory that featured as moderately increased sleep duration and elevated midday nap ratio compared with two boys' family. Robust output was driven by the adjusted and unadjusted model (*rrr*: 0.658, 0.671, and 0.654, respectively, from the adjusted model). Negatively association (*rrr* in the adjusted model: 0.620) was also observed between families with only two girls and slightly

Table 1 Average Posterior Probabilities of Group Assignment and Bayesian Information Criterion (BIC) Statistics of Model Fit

	Group 1	Group 2	Group 3	Group 4	Group 5	BIC (N=107713)	BIC (N=7777)
2 Classes	0.925	0.928				−121,856.91	−121,830.63
3 Classes	0.781	0.813	0.903			−129,525.10	−129,485.68
4 Classes	0.790	0.813	0.786	0.870		−120,632.06	−120,593.95
5 Classes	0.765	0.765	0.704	0.758	0.761	−120,551.54	−120,504.23

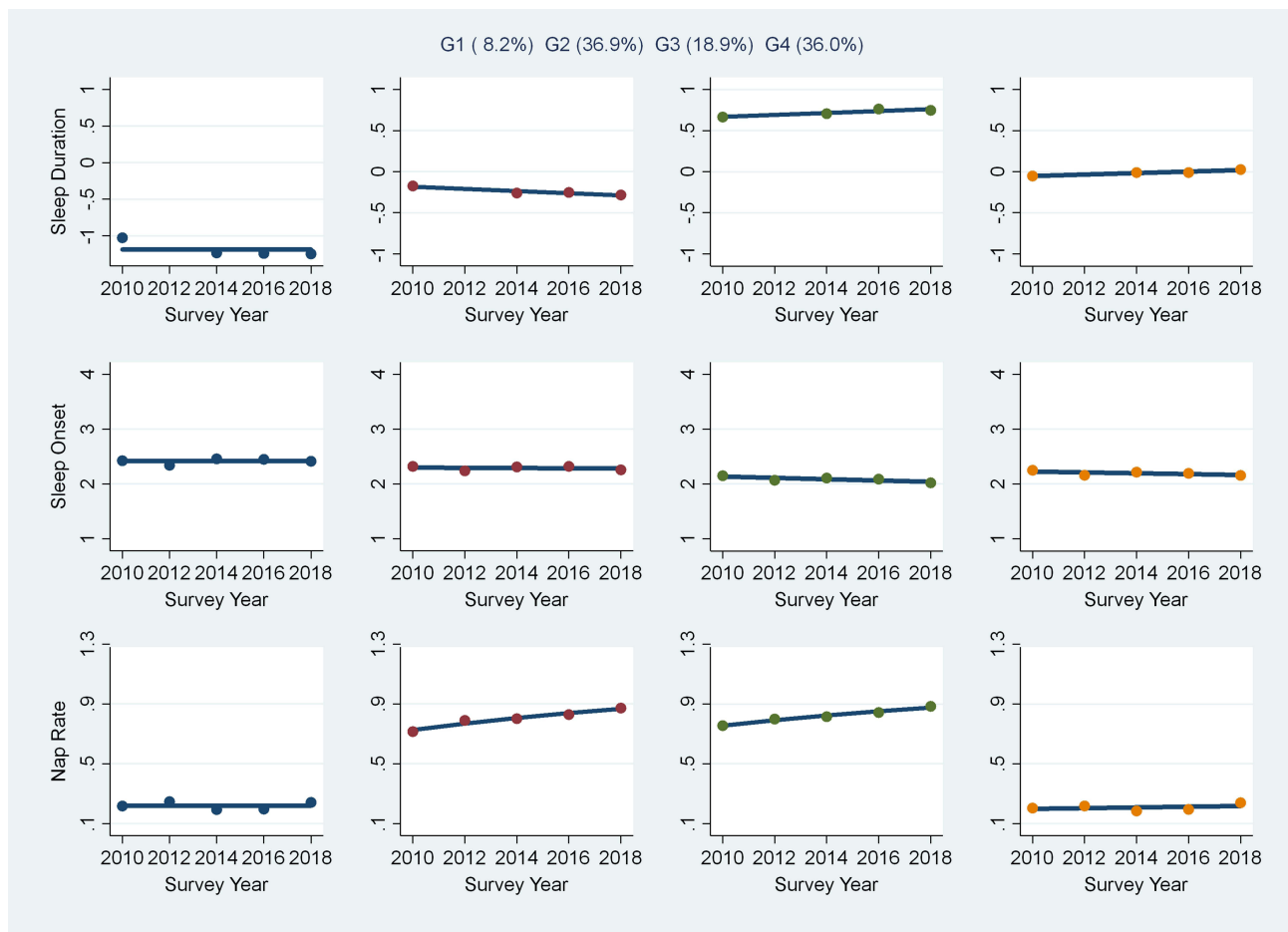**Abbreviation**: BIC, Bayesian information criterion.

Figure 2 The visual trajectories of sleep defined by sleep duration, sleep onset time, and nap rate in CFPS from 2010 to 2018. G1 (blue point): stable-with-lower sleep characteristic group. G2 (red point): counteracting reduced sleep duration. G3 (green point): medium increase in sleep characteristics. G4 (red point): slightly increasing sleep trends.

increasing trends of sleep duration and nap ratio (G4). Moreover, in the adjusted model, this family context observed a negatively relationship with G2 sleep trajectory that slightly decreased nocturnal sleep duration and increased midday nap ratio (*rrr*: 0.693).

Table 2 Distribution and Comparison of Demographic Characteristics, Health Conditions, Lifestyle Factors, and Family Context in the CFPS 2010 Survey Wave, by Sleep Trajectory Groups

Variable	N	G1	G2	G3	G4	$\chi2$/F	P
Demographic and health-related information							
Residence, n (%)						164.74	<0.001
Rural	4632	267(5.76)	1626(35.10)	965(20.83)	1774(38.30)		
Urban	3145	305(9.70)	1383(43.97)	388(12.34)	1069(33.99)		
Sex, n (%)						39.92	<0.001
Female	3987	360(9.03)	1472(36.92)	673(16.88)	1482(37.17)		
Male	3790	212(5.59)	1537(40.55)	680(17.94)	1361(35.91)		
Ethnicity, n (%)						111.17	<0.001
Han	7261	538(7.41)	2896(39.88)	1281(17.64)	2546(35.06)		
Others	516	34(6.59)	113(21.90)	72(13.95)	297(57.56)		
Marital status, n (%)						4.27	0.233
Married (with spouse)	7324	528(7.21)	2833(38.68)	1276(17.42)	2687(36.69)		
Others	453	44(9.71)	176(38.85)	77(17.00)	156(34.44)		

(Continued)

Table 2 (Continued).

Variable	N	G1	G2	G3	G4	χ2/F	P
Age (mean±SD)	7777	52.83±7.00	51.02±7.31	51.92±7.57	50.20±7.09	30.90	<0.001
Income level (mean±SD)	7456	2.13±0.97	2.26±0.96	2.29±1.01	2.25±0.97	3.75	0.010
Social status (mean±SD)	7718	2.70±1.08	2.81±0.98	2.89±0.95	2.80±0.98	5.50	<0.001
Satisfaction with life (mean±SD)	7760	3.35±1.13	3.55±1.03	3.64±1.01	3.47±1.02	14.31	<0.001
Confidence in future (mean±SD)	7741	3.49±1.21	3.68±1.09	3.62±1.16	3.60±1.10	5.29	0.001
BMI (mean±SD)	7777	22.34±4.64	22.60±4.76	22.14±5.03	21.66±5.18	17.51	<0.001
Self-perceived health (mean±SD)	7776	1.99±1.02	1.78±0.94	1.86±1.04	1.77±0.93	10.85	<0.001
Unwell in past 2 weeks, n (%)						20.71	<0.001
No	5718	382(6.68)	2212(38.68)	976(17.07)	2148(37.57)		
Yes	2058	190(9.23)	796(38.68)	377(18.32)	695(33.77)		
Lifestyle							
Physical exercise, n (%)						82.73	<0.001
No	5966	404(6.77)	2173(36.42)	1096(18.37)	2293(38.43)		
Yes	1804	167(9.26)	831(46.06)	257(14.25)	549(30.43)		
Current smoking, n (%)						4.52	0.211
No	5116	400(7.82)	1970(38.51)	883(17.26)	1863(36.42)		
Yes	2648	172(6.50)	1030(38.90)	468(17.67)	978(36.93)		
Current drinking, n (%)						11.08	0.011
No	6256	478(7.64)	2365(37.80)	1099(17.57)	2314(36.99)		
Yes	1507	94(6.24)	635(42.14)	251(16.66)	527(34.97)		
Family Context							
Number of siblings (mean±SD)	7694	3.66±1.85	3.61±1.84	3.73±1.81	3.58±1.86	1.96	0.117
Father alive, n (%)						14.28	0.003
No	4940	388(7.85)	1923(38.93)	875(17.71)	1754(35.51)		
Yes	2202	137(6.22)	855(38.83)	348(15.80)	862(39.15)		
Mother alive, n (%)						4.87	0.182
No	3573	272(7.61)	1383(38.71)	638(17.86)	1280(35.82)		
Yes	3329	242(7.27)	1305(39.20)	535(16.07)	1247(37.46)		
Educational level of father, n (%)						25.47	<0.001
Illiterate/semi-literate	4334	323(7.45)	1600(36.92)	758(17.49)	1653(38.14)		
Primary school	1859	129(6.94)	764(41.10)	329(17.70)	637(34.27)		
Junior high school and above	966	69(7.14)	426(44.10)	140(14.49)	331(34.27)		
Educational level of mother, n (%)						21.03	0.002
Illiterate/semi-literate	6296	468(7.43)	2398(38.09)	1132(17.98)	2298(36.50)		
Primary school	909	56(6.16)	396(43.56)	133(14.63)	324(35.64)		
Junior high school and above	302	23(7.62)	132(43.71)	35(11.59)	112(37.09)		
Educational level of respondents, n (%)						114.64	<0.001
Primary school and below	4385	321(7.32)	1499(34.18)	853(19.45)	1712(39.04)		
Junior high school	2206	155(7.03)	928(42.07)	349(15.82)	774(35.09)		
High school and above	1186	96(8.09)	582(49.07)	151(12.73)	357(30.10)		
Spouse educational level, n (%)I						69.06	<0.001
Primary school and below	4087	271(6.63)	1439(35.21)	786(19.23)	1591(38.93)		
Junior high school	2165	163(7.53)	911(42.08)	349(16.12)	742(34.27)		
High school and above	1077	96(8.91)	478(44.38)	138(12.81)	365(33.89)		

(*Continued*)

Table 2 (Continued).

Variable	N	G1	G2	G3	G4	χ2/F	P
Number of kids (mean±SD)	7777	1.48±0.75	1.42±0.68	1.57±0.75	1.47±0.73	14.45	<0.001
Number of boys (mean±SD)	7777	0.82±0.92	0.79±0.83	0.94±0.94	0.86±0.87	10.44	<0.001
Number of girls (mean±SD)	7777	0.65±0.89	0.63±0.87	0.63±0.93	0.61±0.91	0.50	0.681

Notes: G1: stable-with-lower sleep characteristic group. G2: counteracting reduced sleep duration. G3: medium increase in sleep characteristics. G4: slightly increasing sleep trends.
Abbreviation: SD, standard deviations.

Table 3 Univariate Analysis of Sleep Trajectories Among Family Context Groups by n (%)

Group	G1	G2	G3	G4	χ2	P
1-C, n (%)	86(5.96)	516(35.76)	311(21.55)	530(36.73)	60.84	<0.001
2-C, n (%)	89(8.46)	399(37.93)	208(19.77)	356(33.84)		
3-C, n (%)	207(7.48)	1088(39.31)	434(15.68)	1039(37.54)		
4-C, n (%)	134(7.38)	763(42.02)	253(13.93)	666(36.67)		
5-C, n (%)	56(8.02)	243(34.81)	147(21.06)	252(36.10)		

Notes: G1: stable-with-lower sleep characteristic group. G2: counteracting reduced sleep duration. G3: medium increase in sleep characteristics. G4: slightly increasing sleep trends. 1-C: only two boys in a family. 2-C: only two girls in a family. 3-C: only one boy in a family. 4-C: only one girl in a family. 5-C: Large family.

Table 4 The Relationship of Family Context and Sleep Trajectories from 2010 to 2018 in Chinese Adults, *rrr* (95% CI)

Sleep trajectory Group	Unadjusted *rrr* (95% CI)	*Adjusted *rrr* (95% CI)
G1	*ref.*	*ref.*
G2		
LCA		
1-C	*ref.*	*ref.*
2-C	0.747(0.540, 1.033)	0.693(0.495, 0.971)
3-C	0.876(0.667, 1.150)	0.820(0.615, 1.093)
4-C	0.949(0.708, 1.272)	0.896(0.655, 1.225)
5-C	0.723(0.500, 1.046)	0.781(0.527, 1.157)
G3		
LCA		
1-C	*ref.*	*ref.*
2-C	0.646(0.458, 0.912)	0.658(0.459, 0.944)
3-C	0.580(0.434, 0.775)	0.671(0.493, 0.913)
4-C	0.522(0.380, 0.717)	0.654(0.465, 0.920)
5-C	0.726(0.492, 1.072)	0.798(0.526, 1.210)
G4		
LCA		
1-C	*ref.*	*ref.*
2-C	0.649(0.469, 0.899)	0.620(0.441, 0.871)
3-C	0.814(0.620, 1.069)	0.810(0.607, 1.081)
4-C	0.806(0.601, 1.082)	0.813(0.594, 1.115)
5-C	0.730(0.505, 1.055)	0.787(0.531, 1.168)

Notes: G1: stable-with-lower sleep characteristic group. G2: counteracting reduced sleep duration. G3: medium increase in sleep characteristics. G4: slightly increasing sleep trends. 1-C: only two boys in a family. 2-C: only two girls in a family. 3-C: only one boy in a family. 4-C: only one girl in a family. 5-C: Large family. *Adjusted model controlled all of the covariates that displayed in Table 2.
Abbreviations: rrr, relative-risk ratios; ref, reference; CI, confidence interval; LCA, Latent class analysis.

Discussion

Five family context classes were identified, mainly according to the number of children and their gender. Subjects in the current study experienced different periods before and after the implementation of the one-child family planning policy[28] and its inconsistent execution time and implementation intensity in the provinces of China. This explains why the variance in family context derives from the number of children produced and their gender. Four optimal sleep trajectories were identified based on sleep duration, sleep onset time, and midday nap habits. The family context was a potential factor that could not be ignored in attempting to understand factors influencing sleep quality.[5,29] Our results indicated that family context is significantly associated with sleep trajectories.

Along with the reform and opening up of China from the 1970s, parenting perceptions were profoundly altered in the 21st century from "food and clothing worry-free" to work towards a "high-quality of talent fostering". Although misleading, commercial slogans such as "You can't let your child lose on the starting line!" reflect the pressure and anxiety in China regarding children's education and investing, driven by competition for unfairly distributed educational resources.[30] Parents in larger families faced strong financial pressure, and its negative association with sleep quality has been well documented.[31,32] Our study revealed that subjects from families with one or two girls or one boy did not demonstrate increased sleep duration and midday nap ratio, compared with families with two boys. In families with two boys, the subjects' sleep trajectory is more inclined to change over time. The unavoidable explanation might be that the preference for sons dominates in East Asia,[33] and that boys—default successors and providers for parents in future—give their parents hope of an outstanding vocational future along with associated demands for increased financial support. Another potential reason is the pressure of bride price[34] that has increased dramatically in recent decades in China, especially in poverty-stricken areas. Both of those situations are financially demanding for parents, placing them under great pressure. Additionally, in China, affected by Confucianism, parents believe that it is their responsibility to care and educate their children well, and with more children means more responsibility and duty.[35] Those responsibilities and pressure were potentially deteriorating their sleep quality, and leading them to nap more to make up for the lost sleep.

Our study also revealed that subjects from families with two girls did not show changes in sleeping habits, and they tended to remain constant in sleep habits compared with families of two boys. It may be that families with girls face significantly less financial pressure in the Chinese social context. Meanwhile, subjects from larger families have sleep trajectories that are similar to those with two or more boys—more children mean more education expenses and daily cost of living. On one hand, having a large family size increases the financial burden and accumulation of this effect on sleep disorders.[36] On the other hand, their parents need to spend more time to care and accompany them so that they reduce the opportunity to communicate with others or participate social activities, the previous study reported that social supports can improve parenting stress[37] and contribute to good sleep habit.[38]

Although we used a nationwide cohort sample, a part of the subjects was missing from the following survey, which may have lowered the efficacy of the analysis. Other limitations should also be noted. First, sleep-related items were collected via questionnaire interview, suggesting that recall bias may be possible, although a previous study showed a generally consistent assessment of objective and subjective sleep items.[39] Second, there were limitations in the secondary data analysis, and we omitted some possible factors (eg, dwelling environment) from the CFPS data variables list. Third, despite controlling for many covariates in the final model, a few potential confounders were not included in this study.

Conclusion

In conclusion, the number of children and their gender played a key role in grouping of Chinese family context. Over time, sleep trajectories showed different trends, and the study found that family context is associated with it. Subjects from families only with girls seemed to have more stable sleep trajectories, while those with one or more boys' families had unstable sleep trajectories. This provided new insights for interventions of sleep problem, governors may be can adopt more policy to reduce pressure of those families with one or more boys.

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Disclosure

The authors have no conflict of interest to declare.

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