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The relationship between 1-2 year old children sleep time and pre-school children obesity

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Abstract: *This study aims to investigate the sleep duration of preschool children in Longgui Street during early childhood (1-2 years) and other related data, to evaluate whether early childhood sleep duration is a risk factor for obesity in preschool children, thereby providing a reference for the prevention of childhood obesity. Using BMI exceeding 25 as the criterion for identifying obese children, this study employed cluster sampling, setting up a control group and an obese children group, and recruited 1281 children aged 5-6 years from Longgui Street through questionnaire surveys. The research outcomes aim to explore whether early childhood sleep duration is a risk factor for obesity in preschool children.*

Keywords: *sleep time, preschool; obesity; risk factors*

1. Introduction

There is a condition in children's nutritional diseases where children consume too much energy over a long period of time, with the calories ingested by the body exceeding those expended on growth, development, and physical activity. As a result, excess fat accumulates within the body, leading to weight exceeding the normal reference range, which is referred to as childhood obesity.

Nowadays, in both developed and developing countries, childhood obesity has become an important public health issue, and its adverse consequences have attracted widespread attention from all sectors of society. In 2017, the prevalence of childhood obesity among preschool children in urban areas rose sharply, exceeding 15%[1].By 2020, the overweight and obesity rate among children under 6 years old in China reached 10.4%[2]. According to the estimates of the Global Burden of Disease Study in 2015, referring to WHO standards, considering the large population, China became the country with the highest number of children obese[3]. Becoming a major social issue in China. Due to the physiological differences between obese children and normal children, their daily experiences are often different; they are more prone to anxiety, depression, and even depression compared to normal children. Moreover, childhood is a critical period for obesity development and also the best time to prevent childhood obesity[4], Currently, the main criteria for childhood obesity in China are defined by the World Health Organization based on the BMI 95th percentile for gender and age derived from the child growth curve, which is the most widely used measure of obesity. Other related indicators include waist circumference, hip circumference, waist-to-hip ratio, and skinfold thickness.

There is growing evidence that the reduction in children sleep duration is linked to a variety of obesity-related factors, such as eating, physical activity and body composition. Research has found that sleep deprivation may contribute to weight gain through poor diet in both eating and physical activity[5]. A survey of children aged 5 to 12 years showed a significant association between BMI and shorter sleep duration, and in school-age children, higher food responsiveness played a significant mediating role in the relationship between sleep and BMI[6]. Based on this, a study was conducted mong 1,300 preschool children to identify the modifiable risk factor.

2. Research subjects

2.1. Object source

All subjects were children in the senior class who had been registered in the Longgui Street nursery institutions in Baiyun District, Guangzhou City, Guangdong Province before November 2024.

The criteria for inclusion in the study are: children aged 5-6 years at the time of investigation. For a

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child to be included in the study, their guardian must be informed of the purpose and significance of the study and sign an informed consent form. Children with severe physical illnesses or mental disorders will be excluded from this study. Children who have missing height and weight measurement data are also excluded. Children with incomplete sleep duration data at ages 1-2 years are also excluded.

2.2. Data collection

In April 2024, data will be collected through a questionnaire survey. The health doctors are from various kindergartens in Longgui Street, Baiyun District, and they will serve as investigators for this survey.

For the attending kindergarten health doctors, training is conducted according to the research objectives, explaining the purpose and significance of this study as well as the requirements for completing the questionnaire. Parents receive guidance from the kindergarten health doctors and teachers and complete the relevant information filling and questionnaire responses under their supervision. After completing the information filling and questionnaire responses under the guidance and supervision of the health doctors and teachers, the health doctors will consolidate the information so that the research team members can promptly understand the completion status and verify the relevant information. During this period, any questions arising during the questionnaire filling process should be answered in a timely manner, and the quality of the questionnaire should be checked. After the survey is completed, the data will be exported in Excel format.

2.3. Investigation content

2.3.1. Basic information

The basic survey content involved in this study includes: firstly, the general demographic characteristics of parents such as educational level, marital status, age, education level, and family income; ② the basic survey content related to children includes gender, whether they are only children, and general demographic characteristics such as age; ③ how to measure the weight of newborns.

2.3.2. Measurement of children ' s height and weight and definition of obesity in preschool children

Let preschool children remove their hats, stand barefoot in close-fitting lightweight clothing, and place themselves at the center of a calibrated weight scale placed on a level surface. After the reading stabilizes, record and save the measurement value with an accuracy of 0.1 kg. The column-type anthropometric height gauge can be used to measure height, with values accurate to 0.1 cm. The column-type anthropometric height gauge should be placed vertically against a wall on a level surface. Children should stand on the platform with their heels together, feet at a 60-degree angle, head up, chest out, abdomen in, eyes looking straight ahead, then push the slider to the top of the childs skull. Next, read the measurement value from the line of sight at the height of the slider. When calculating Body Mass Index (BMI), it is done by dividing body weight (in kilograms) by the square of height (in meters).

2.3.3. Sleep duration of children aged 1-2 years

The survey content of this study regarding children sleep duration for ages 1-2 years includes: the average total daily sleep duration in hours during the 1-2 year age stage. According to the sleep duration distribution of the study population and the "Chinese Guidelines for Sleep Hygiene for Children Aged 0-5 Years"[6] Recommended sleep time, divide the sleep time into two categories: 11 hours and above, less than 11 hours.

2.4. Statistical analysis

The analysis describes and examines general demographic characteristics such as children gender and age, their parents age at childbirth, educational level, marital status, family monthly income, and whether they are only children. It also analyzes birth weight, mode of delivery, sleep duration during the first 1-2 years of life, and obesity status. Continuous variables are described using mean ± standard deviation, while categorical variables are described using frequencies and proportions. Additionally, a simple correlation analysis is conducted on sleep duration for children aged 1-2 years.

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2.4.1. Relationship between sleep duration of children aged 1-2 years and obesity in preschool children

Taking the sleep time of children aged 1-2 as independent variables and the obesity of preschool children as dependent variable, the relationship between the above independent variables and the obesity of preschool children was analyzed by Logistic regression model.

2.4.2. Statistical software and significance level

Statistical analysis was carried out by software R studio 4.2.2, and the significance level α of bilateral test was set to 0.05.

2.4.3. Data organization stage

Specialized researchers will, after the questionnaire information is exported from the APP, carry out data cleaning work using Excel and R studio software according to a standardized process, keep proper records during the data cleaning process, and strictly follow the research plan for inclusion and exclusion of subjects.

3. Results

3.1. Social demographic characteristics of the subjects of study

In this study, the average age of the surveyed children is 5.85 (SD: 0.84) years, with boys accounting for 50.8% and girls accounting for 49.2%. In the surveyed population covered by this study, the average age of children is 5.85 (SD: 0.84) years, with boys accounting for 50.8% and girls accounting for 49.2%; while these children mothers and fathers had an average age of 28.43 (SD: 4.27) years and 30.56 (SD: 4.83) years respectively during pregnancy, where 62.46% of mothers and 64.17% of fathers obtained a college degree or higher. See Table 1.

Table 1: Demographic characteristics of the subjects

Demographic characteristics of society	Mean ± standard deviation/frequency (%) (N= 1281)	Demographic characteristics of society	Mean ± standard deviation/frequency (%) (N= 1281)
sex		Family monthly income	
man	651 (50.8)	10,000 or more	225(17.6)
woman	630 (49.2)	3000~6000	478(37.3)
Age of child (years)	5.85±0.84	3000 and below	279(21.8)
Method of delivery		6000~10000	299(23.3)
Vaginal delivery	6298(72.84)	the only child	
C-sect	2348(27.16)	yes	304(27.7)
Fathers educational level		deny	792(72.2)
junior college	337(26.3)		
High school level and below	379(29.6)		
senior middle school	547(42.7)		
Bachelors degree or above	18(1.4)		

3.2. Description of childrens sleep time from 1 to 3 years old

Among the 8,646 preschool-aged children born with small for gestational age included in the study, children aged 1-2 years had a mean daily sleep duration of 12.01 hours (SD: 2.17). Among the 428 children aged 1-2 years, accounting for 27.2%, less than 11 hours of daily sleep was reported. The classification boundary for daily sleep duration of children aged 1-2 years was set at 11 hours, dividing

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the sleep duration into two categories. Details are provided in Table 2

Table 2: Description of children sleep time at age 1-3

Sleep patterns in children aged 1-3	N= 1281
1-2 years of age, sleep every night*	12.01±2.17
1-2 years old, sleep in groups every day**	
11 hours and above	933 (72.8)

*: Continuous variables are expressed by mean ± standard deviation; **: Categorical variables are expressed by examples (composition ratio).

3.3. Obesity among preschool children

Among preschool children, 383 children were obese, accounting for 383%. Among 651 boys, 249 were in an obese state, accounting for 12%. Among 630 girls, 134 were obese, accounting for 11%. See Table 3 for details.

Table 3: Current prevalence of obesity among preschool children

Obesity status	Frequency (%) (N = 1281)	Number of obese people in gender groups (%)	
		Male (N = 651)	Female (N = 630)
deny	830(64.8)	573(88)	561(89)
yes	383(29.9)	78(12)	69(11)

3.4. Relationship between sleep time and obesity in children aged 1-3 years and preschool children

Logistic The regression analysis results show that compared with children who sleep 11 hours or more per day at age 1-2, those who sleep less than 11 hours per day have a significantly higher risk of obesity (AOR: 1.35,95%CI: 1.15 ~ 1.57) before school age; see Table 4 for details.

Table 4: Relationship between sleep duration and obesity in children aged 1-2 years and preschool children

Sleep at 1-2 years of age	Number of cases (N=1281)	Frequency of obese children (%)	AOR(95%CI) a
Sleep duration per day for ages 1-2			
11 hours and above	933 (72.8)	43 (4.6)	1.00
Less than 11 hours	348 (27.2)	104 (29.9)	1.35(1.15,1.57)***

Gender, age, parents age of childbearing, parents education level, parents marital status, family monthly income, whether the child is an only child, mothers pre-pregnancy BMI and mode of delivery were used as control variables in the model. **P<0.01; ***P<0.001.

4. Conclusion

This study found that less sleep at ages 1-2 years increases the risk of childhood obesity before school age, which not only corroborates previous findings that short sleep duration is an important factor in the risk of childhood obesity, but also further reinforces the close link between infant sleep habits and long-term health.

A landmark cross-sectional study conducted in Shanghai, China, provides strong data support for this perspective. The study shows that the issue of overweight and obesity among children and adolescents is significantly positively correlated with insufficient sleep duration (OR: 1.32,95% CI: 1.06~1.64). Notably, this association is not influenced by sleep quality, indicating that sleep duration itself is an independent risk factor.

Numerous in-depth studies have shown that there is an undeniable association between obesity risk during early childhood and school-age years and sleep habits during infancy. Especially in the first 1000 days of life, infant sleep duration is considered a key predictor of childhood obesity risk. This finding highlights the importance of sleep habits during early life stages for long-term healthy weight management.

From the perspective of mechanism, children who are sleep-deprived are more likely to increase

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their eating frequency and amount due to extended wake time, thus tending to adopt a fattening dietary behavior. These behaviors may include excessive consumption of high-calorie foods, preference for high-sugar and high-fat foods, and irregular eating habit. These unhealthy eating patterns can disrupt the balance between energy intake and expenditure, thereby increasing the risk of obesity.

In addition, the study found a strong link between sleep and physical activity intensity as well as body composition. Lack of sleep can lead to lower levels of physical activity in children, which in turn reduces energy expenditure and promotes fat accumulation. This energy metabolism imbalance is one of the important mechanisms of obesity development.

More profoundly, sleep deprivation may also have a negative impact on gene expression associated with oxidative stress and metabolism. This effect is not limited to the interference with the levels of appetite-regulating hormones (such as leptin, growth hormone-releasing peptide and gastric hunger hormone), thus affecting appetite and feeding behavior; It may also adversely affect the secretion of cortisol and thyroid-stimulating hormone and insulin sensitivity, which in turn affects glucose and lipid metabolism and increases the risk of obesity.

Finally, sleep deprivation may also activate gene expression associated with inflammation and oxidative stress responses which are closely linked to the development of obesity and may accelerate the onset and progression of obesity and related metabolic diseases by promoting chronic inflammation and oxidative damage.

In summary, this study not only emphasizes the importance of sleep duration during infancy for the obesity risk in preschool children but also reveals the complexity of how insufficient sleep affects children healthy weight management through multiple mechanisms. These findings provide a scientific basis for developing targeted interventions and preventive strategies aimed at improving children sleep habits and reducing their obesity risk.

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