Original article

The association of power napping with obesity and dietary habits among the age group of 6-18 years

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Abstract. *Introduction:* Obesity, characterized by excessive fat accumulation, is often defined by the WHO using BMI. Power naps, short daytime sleeps of 10 to 90 minutes, impact body metabolism and weight regulation. The aim of this research was to explore the association between power napping and the risk of obesity using anthropometric measurements, waist circumference percentile, BMI percentile, and usual dietary intake to evaluate the risk of obesity-related metabolic conditions. *Material and Methods:* This was a cross-sectional and comparative study conducted among 300 children and young adolescents aged between 6 and 18 years. Anthropometric measurements (weight, height, waist circumference, BMI) were taken according to WHO guidelines. Dietary history was obtained through a 24-hour usual dietary recall and a food frequency questionnaire. The Chronometer tool was used for dietary analysis, and statistical analysis was performed using SPSS 28.0 software. *Results:* The results showed that 36.30% of power nappers were normal, 2.60% were overweight, while 2.30% were obese. However, 32% of non-nappers were normal, 7.60% were overweight, and 6% were obese. The mean prevalence of overweight and obesity was higher in non-nappers than power nappers, but no significant association was found between them ($P > 0.05$). Dietary habits were better in power nappers than in non-nappers, with a significant association found ($P < 0.05$). *Conclusion:* Interventions for pediatric obesity are limited, and understanding all factors contributing to the risk of obesity is crucial. Although research supports biphasic sleeping patterns, the topic requires further investigation to fully understand its implications. Limitations of this study highlight the need for additional research to validate and expand upon these findings.

Key words: powernap, obesity, waist circumference, body mass index, dietary habits

Introduction

Obesity, a medical condition characterized by excessive or abnormal fat accumulation, represents a significant worldwide public health concern in children and adolescents. The global prevalence of overweight and obesity among aged 5-19 years has exceeded 330 million and by 2025, around 167 million individuals, including both adults and children, will experience compromised health due to excessive weight, raising a substantial concern (1). The World Health organization (WHO) typically defines obesity in children and adolescents as a Body Mass Index (BMI) greater than the 95th percentile (2). Pediatric obesity not only increases the risk of various health problems, such as type 2 diabetes, high cholesterol, and high blood pressure but also contributes to psychological issues like poor self-esteem and depression (3). Contributing factors to pediatric obesity encompass genetic, environmental, and behavioral elements, including poor diet, sedentary lifestyle, and emotional eating. Addressing the multifaceted challenges posed by obesity in children requires a comprehensive approach. While the focus often centers on dietary and lifestyle interventions, emerging research suggests a potential link between midday napping, commonly known as a power nap, and improved health outcomes in children. Recent studies have indicated that napping may reduce metabolic disorders among children. A power nap defined as a short period of daytime sleep, lasting for 20-30 minutes has been associated with enhanced cognitive ability, psychological well-being, and metabolic health in children (4). Powernap duration varies from 10-90 minutes. Evidence shows that a power nap lasting for 20-30 min is more effective (14). The optimal length of a power nap can vary from person to person (15). Some people may benefit from longer naps of up to 90 minutes to allow time to complete one sleep cycle, which is important for memory consolidation and learning (16). Disrupted sleep quality and duration play a crucial role in weight gain and obesity. Lack of sleep increases production of ghrelin, a hormone that stimulates hunger while reduces leptin production, a hormone that signals fullness (5), leading to increased appetite and a preference for high-calorie foods (6,7). Additionally, a power nap may improve the circadian cycle, the natural internal clock regulating our sleep-wake cycle and other bodily functions, which has been linked to obesity. Studies have shown that people who have irregular sleep schedules or who are exposed to artificial light at night are more likely to have higher BMI, greater fat mass, and increased risk of obesity (8-10). Furthermore, research suggests that people who take daytime naps, considered a form of biphasic sleep, may have a low risk of obesity. A study revealed that individuals who took regular daytime naps had a lower BMI than those who did not nap. It is hypothesized that daytime naps may help regulate hormones controlling appetite and metabolism, thus contributing to a lower risk of obesity. Additionally, daytime naps have been shown reduce stress levels, which can be a contributing factor to weight gain (11). Despite the existing body of research, studies examining the dietary habits of power nappers are lacking. Therefore, our study aims to establish a causal relationship between power naps, dietary habits, and their combined effect on sleep to better understand the relationship between power naps and obesity.

Material and Methods

It was a cross-sectional comparative study between power nappers and non-nappers. The total sample size of 300 participants (150 cases and 150 controls) was distributed across six distinct groups based on age and gender. Sample size was calculated using the Taro Yamane formula with a level of precision of 5% (12). The groups were categorized as follows: 6-8 years old males, 6-8 years old females, 9-13 years old males, 9-13 years old females, 14-18 years old males, and 14-18 years old females.

The specific distribution of participants within each group is detailed below:

- 6-8 Years Old Males (n=8)
- 6-8 Years Old Females (n=21)
- 9-13 Years Old Males (n=60)
- 9-13 Years Old Females (n=58)
- 14-18 Years Old Males (n=84)
- 14-18 Years Old Females (n=69)

The inclusion criteria are children between the ages of 6 and 18 (13) who take power naps between 10 and 90 minutes at least five days a week and have a minimum of six hours of night sleep. Power naps should be taken at mid-day. This criterion for power naps has been taken from the literature already present (14,15). Exclusion criteria include children who were not taking power naps between 10 and 90 minutes for at least five days a week with any diseases and those taking supplements. After consent, data was collected from schools and colleges. Ethical approval was taken from the Office of Research Innovation and

Commercialization (ORIC), University of Management and Technology (UMT), Lahore.

Data collection techniques and procedures

Data collection was conducted through one-on-one interaction with participants. Open-ended questions were asked to determine power nappers. Questions pertaining time, duration, frequency of nap as well as hours slept during the night were asked. Children's dietary habits were assessed by interviewers through 24-hour usual dietary recall. Daily energy, protein, carbohydrates, fat, fiber, vitamin B-12, folate, vitamin A, vitamin D, vitamin-C, calcium, iron, and zinc intake was assessed using a software, Cronometer (17,18). The Cronometer was used to analyze and compare estimated nutrients with nutrition data system for research (NDSR) database. The app was chosen as it has the ability to capture food timing accurately and is user friendly. It has been highly rated for usability (19). These micronutrients were selected because, according to the Pakistan National Nutrition Survey (NNS) 2018, they are deficient, and these nutrients play a key role in obesity (35). The percentage RDAs (Recommended Dietary Allowance) are evaluated based on recommended AMDR (Acceptable Macronutrient Distribution Ranges): 55% carbohydrates, 30% fat, 15% protein (20), and micronutrients by their required RDA respective to gender and age as shown in Table-2 (21). Height was measured using growth charts in feet, barefoot, according to WHO guidelines. Children were asked to straighten their legs and keep their shoulders leveled and height was measured when the child's heels touched the flat surface (22), weight was measured on a digital weight machine in kilograms to the nearest decimal fraction based on the center of disease control (CDC) guidelines. The children we asked to remove their shoes and heavy clothing such as jackets, mobile phones, and wristwatches and at the measuring scale's center (23). Age was recorded in years. Waist circumference was measured using an inch tape in inches, following WHO and IDF guidelines. It was measured between the lowest ribs and the iliac crest horizontally (24). BMI percentiles and waist circumference percentiles measured the risk of obesity. An online calculator of Centers for Disease Control and Prevention (CDC) to assess BMI percentile (23) and categorize them as <5% percentile is considered underweight, 5% to <85% percentile is considered normal, 85% to <95% percentile is considered overweight, and ≥ 95% considered in the obese category. According to the National Health and Nutrition Examination Survey (NHNES) conducted by the CDC, a waist circumference percentile between 85^{th} and 95^{th} percentile indicates a risk of metabolic syndrome, while ≥ 95^{th} percentile in children and adolescents is considered to be at high risk for metabolic syndrome (25).

Statistical procedure

The statistical package for social sciences (SPSS), version 22.0 (IBM Corporation, Armonk, NY), was utilized for statistical analysis. Descriptive data were presented in percentages, means, and standard deviations. The means for different groups with continuous variables were assessed using the independent t-test. Relationships between categorical variables were evaluated using a chi-square test (26). For BMI percentiles, waist circumference percentiles, and the percentage of Recommended Dietary Allowances (RDAs) of the power-napper and non-napper groups, comparisons were made using the chi-square test and independent t-test.

Ethical considerations

Ethical approval was obtained from the Office of Research Innovation and Commercialization (ORIC), University of Management and Technology, Lahore, Pakistan with reference number: RE-009-2021 and a permission letter was issued from the institution to obtain consent from students and caretakers (parents and teachers). Confidentiality was maintained at all times.

Results

This study explored the potential relationship between power naps, obesity indicators, and dietary habits in a cohort of 300 children and adolescents aged 6-18 years.

Gender distribution

Figure 1 shows the gender distribution among participants; our sample demonstrated a balanced representation whereby 21.6% (n=65) were male power nappers compared to 28.3% (n=85) were female power nappers. Meanwhile 29.3% (n=88) males were non-nappers, and 20.6% (n=62) females were non-nappers. Chi-square showed significant difference between power-nappers and non-nappers ($p<0.05$).

Anthropometry

In Figure 2, Power nappers demonstrated a higher prevalence of normal weight 36.3% (n=109) than non-nappers 32% (n=96). Conversely, non-nappers exhibited a slightly higher combined percentage of overweight and obese individuals 13.6% (n=41) than power nappers 4.9% (n=15). There were no significant differences between the Body Mass Index (BMI) percentiles power nappers versus non-napper as shown in Figure 2 ($p = 0.783$).

In Figure 3 comparing the results, it is evident that power nappers exhibit a more favorable distribution of waist circumference percentiles. A higher percentage 27.3% (n=82) of power nappers had waist circumference percentiles below or equal to the 50th percentile, whereas non-nappers had 23.6% (n=71) in this category. Additionally, power nappers showed a lower prevalence in the higher percentiles, with only 0.3% (n=1) at or above the 95th percentile, compared to 1% (n=3) of non-nappers.

In contrast, our analysis of waist circumference percentiles yielded compelling results. Power nappers exhibited a mean waist circumference percentile of 35±0.3 while non-nappers had a significantly higher mean of 41± 0.41 cm? This discrepancy was statistically significant ($p = 0.009$).

Dietary intake

Turning our attention to dietary habits, we compared participants' dietary intake of key nutrients with percentage of the Recommended Dietary Allowance (RDA) showed in the Table 1. Table 2 showed the recommended nutritional requirement for different age and gender Groups (6-18 years). Notably, power nappers displayed several significant associations compared to their non-napping counterparts. Fiber intake emerged as a particularly significant factor, with power nappers exhibiting a substantially higher mean intake (95.34%) than non-nappers (82.09%) ($p = 0.003$). Calcium intake also displayed a noteworthy positive association, with power nappers reporting a significantly higher mean intake (60.44%) compared to non-nappers (46.56%), and this difference was statistically significant ($p = 0.004$) may have a more favorable dietary calcium profile. Vitamin A intake continued to exhibit

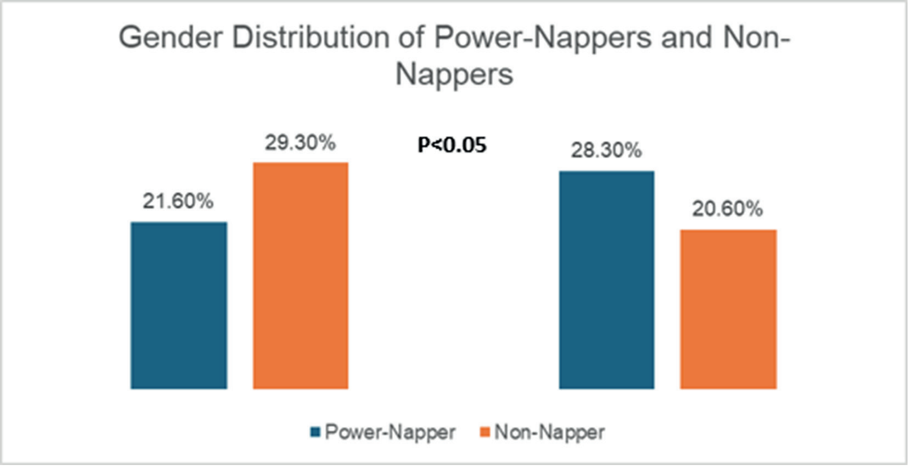

Figure 1. Gender Distribution of Power-Nappers and Non-Nappers

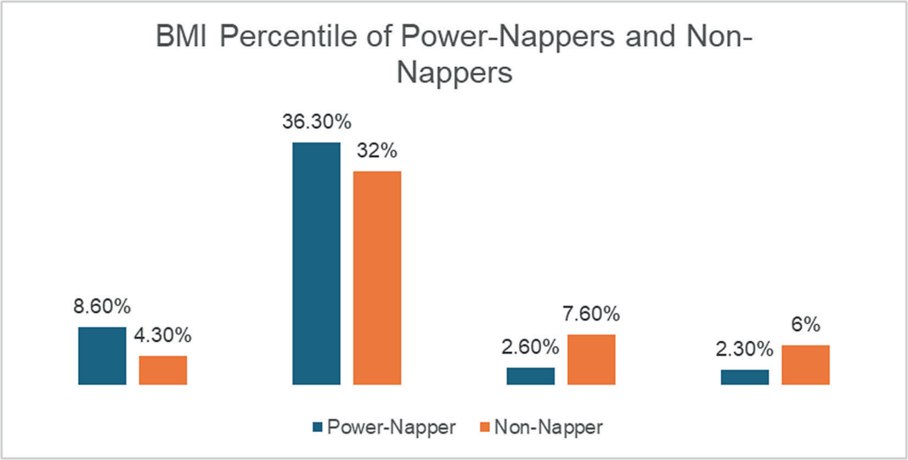

Figure 2. Body Mass Index Percentile of Power-Napper and Non-Nappers

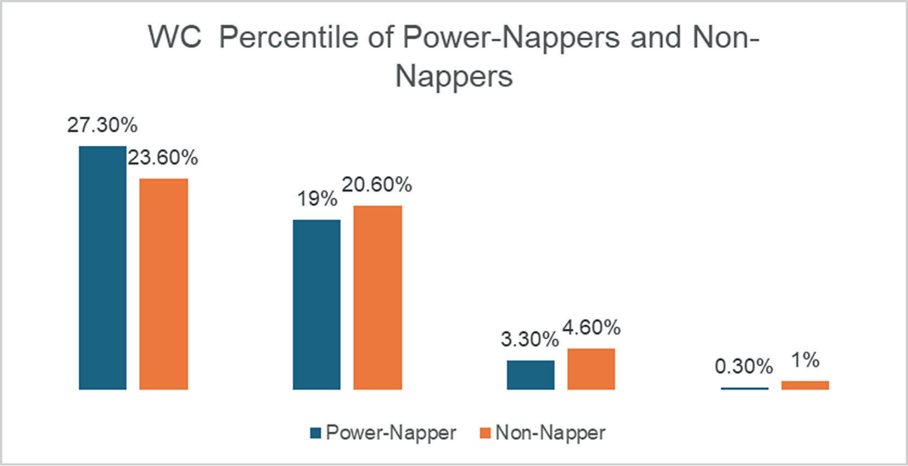

Figure 3. Waist circumference Percentile of Power-Nappers and Non-Nappers

a significant association, with power nappers reporting a higher mean intake (67.69%) than non-nappers (38.29%), with a p-value of 0.003.

Our study unveils intriguing insights into the relationship between power napping, health indicators, and dietary habits among children and adolescents. While BMI percentiles remained unaffected by power napping, our results indicate a potential protective effect against metabolic syndrome, as reflected by lower waist circumference percentiles among power nappers. Furthermore, power nappers exhibited significantly higher Fiber and calcium intakes, underscoring the potential for power napping to contribute to healthier dietary choices within this age group. These findings call for further research to elucidate the mechanisms behind these associations and their implications for overall health and well-being.

Discussion

This study aimed to investigate the relationship between obesity and dietary habits among power nappers and non-nappers aged 6-18 years, using cross-sectional data. The findings yielded statistically significant associations between dietary fiber intake (p-value 0.003), calcium intake (p-value 0.004), and vitamin A intake (p-value 0.003). Between the entire sample, the

Table 1. Differences of Power-Napper and Non-Napper with percentage RDA, BMI, and WC Percentile

Variables	Sample	Mean	p-value
BMI percentile	Power-napper	44.00±.84	0.783
	Non-napper	52.00±.79	
Waist circumference	Power-napper	35.00±.30	0.009
Percentile	Non-napper	41.00±.41	
Energy % RDA	Power-napper	71.30±21.25	0.885
	Non-napper	65.13±21.80	
Protein %RDA	Power-napper	73.68±70.28	0.173
	Non-napper	77.63±163.28	
Carbohydrates %RDA	Power-napper	64.73±21.49	0.850
	Non-napper	60.21±20.66	
Fat % RDA	Power-napper	75.63±29.49	0.898
	Non-napper	69.65±28.64	
Fiber % RDA	Power-napper	95.34±43.52	**0.003**
	Non-napper	82.09±30.50	
Vitamin-B12% RDA	Power-napper	99.92±57.71	0.427
	Non-napper	84.15±78.10	
Folate%RDA	Power-napper	112.89±86.03	0.028
	Non-napper	98.31±61.29	
Vitamin-A%RDA	Power-napper	67.69±115.46	**0.003**
	Non-napper	38.29±27.28	
Vitamin-C% RDA	Power-napper	93.51±115.72	0.453
	Non-napper	93.63±89.15	
Vitamin-D%RDA	Power-napper	24.99±17.56	0.095
	Non-napper	19.07±12.75	
Calcium% RDA	Power-napper	60.44±56.34	**0.004**
	Non-napper	46.56±23.71	
Iron% RDA	Power-napper	125.58±100.53	0.193
	Non-napper	110.45±52.24	
Zinc% RDA	Power-napper	83.61±40.54	0.961
	Non-napper	80.22±75.18	

N=150 both for nappers and non-nappers (equal sample size)

collective prevalence of overweight and obesity was 18.5%, with a higher prevalence observed among non-nappers (13.6%) than power nappers (4.9%). Similarly, waist circumference measurements above the 85th percentile were found in only 9.3% of the overall sample, whereby 4% of them were n power nappers and 5.3% were non-nappers. Furthermore, it was evident that individuals who engaged in power naps met their RDA for essential nutrients more closely than those who did not nap. In line with previous research, a study within a Mediterranean population explored the connection between siestas and obesity. It revealed that extended siestas (>30 minutes) were linked to higher body mass index (BMI), increased waist circumference, and a higher prevalence of metabolic syndrome. Conversely, shorter siestas (≤30 minutes) were associated with lower systolic blood pressure. Additionally, lifestyle factors such as smoking, sleep patterns, eating schedules, energy intake at lunch, and siesta duration were identified as mediators in these associations (27). Another study examined the association between daytime napping and obesity in middle-aged and older Chinese adults. It was discovered that both moderate (1-60 minutes/day) and extended long (>60 minutes/day) daytime napping were associated with an elevated risk of obesity. Importantly, this association was predominantly observed in women, and a dose-response relationship was identified, with longer napping durations correlating with a higher prevalence of obesity among women (28). Furthermore, a comprehensive meta-analysis involving twelve studies that included one each from the UK and Spain, five from the USA, and five from China delved into the link between daytime napping and obesity. The pooled results indicated a higher risk of obesity among individuals who napped compared to non-nappers. Notably, subgroup analyses unveiled variations by country, with Spain exhibiting the highest risk. In the American population, napping increases obesity risk in adults and children, particularly when nap duration exceeds one hour. It is worth noting that the relationship is more pronounced when defining obesity by a BMI of 28, 30, or higher. Nonetheless, the study underscored the importance of future prospective and large-scale research to confirm

Table 2. Nutritional requirement for different Age and Gender Groups (6-18 years)

Variables	6-8 yrs. (M)	9-13 yrs. (M)	14-18 yrs. (M)	6-8 yrs. (F)	9-13 yrs. (F)	14-18 yrs. (F)
Energy (Kcal/d)	1742 ± 403.75	2279 ± 496.28	3152 ± 565.06	1642 ± 381.58	2071 ± 512.19	2368 ± 467.60
Carbohydrates(g/d)	239 ± 59.69	313 ± 59.46	433 ± 67.47	226 ± 54.64	285 ± 69.89	326 ± 81.11
Protein (g/d)	65 ± 17.24	85 ± 200.36	118 ± 110.29	62 ± 17.28	78 ± 19.62	89 ± 23.35
Fat (g/d)	58 ± 17.28	76 ± 25.48	105 ± 26.12	55 ± 13.03	69 ± 17.42	79 ± 24.82
Fiber (g/d)	25 ± 8.52	31 ± 11.87	38 ± 12.07	25 ± 8.57	26 ± 13.46	26 ± 10.10
Vitamin C (mg/d)	25 ± 16.43	45 ± 56.22	75 ± 48.01	25 ± 31.13	45 ± 46.47	65 ± 78.45
Vitamin B12(μg/d)	1.2 ± 0.62	1.8 ± 0.92	2.4 ± 1.25	1.2 ± 1.91	1.8 ± 0.82	2.4 ± 1.01
Folate (μg/d)	200 ± 210.05	300 ± 170.94	400 ± 246.89	200 ± 194.14	300 ± 280.59	400 ± 261.65
Vitamin-A (μg/d)	400 ± 95.28	600 ± 758.90	900 ± 259.77	400 ± 129.08	600 ± 764.78	700 ± 351.28
Vitamin-D (IU/d)	600 ± 69.98	600 ± 91.28	600 ± 116.60	600 ± 68.33	600 ± 70.92	600 ± 88.23
Calcium (mg/d)	1000 ± 230.28	1300 ± 451.00	1300 ± 653.45	1000 ± 311.34	1300 ± 365.11	1300 ± 719.89
Iron (mg/d)	10 ± 3.78	8 ± 10.026	11 ± 5.49	10 ± 4.02	8 ± 7.31	15 ± 4.81
Zinc (mg/d)	5 ± 1.46	9 ± 2.63	11 ± 3.66	5 ± 9.11	9 ± 2.55	9 ± 2.86

these associations, explore underlying mechanisms, and consider potential confounding factors (29). In addition to these findings, previous studies have highlighted the crucial role of a high-fiber diet in managing obesity through several mechanisms. The intake of soluble fiber has been shown to slow down cholesterol absorption and lower serum cholesterol levels (30). Another study has shown that adequate fiber consumption promotes satiety which helps prevent overeating (31). Moreover, Fiber is a prebiotic, positively impacting gut health and associated with a reduced risk of obesity and metabolic diseases (32). Calcium also plays a significant role in body weight management. It binds fatty acids in the large intestine, inhibiting fat absorption (33). Reduced intake of dietary calcium increases the level of 1,25 di hydroxyl vitamin D and parathyroid hormone (PTH), which, in turn, raises intracellular calcium in adipose cells (adipocytes), inhibiting fat breakdown and stimulating fat storage (34). Furthermore, calcium has been found to suppress appetite, which contributes to effective weight management (34). According to research, Vitamin A plays a role in regulating hepatic glucose and lipid metabolism, influencing carbohydrate metabolism, and affecting fat regulation. Vitamin A deficiency can lead to increased fat accumulation and decreased fat breakdown (34).

Conclusion

To the best of our knowledge, this study is the first to compare the association between power naps and dietary habits. Significant associations were observed between dietary habits, waist circumference, and power napping. The mean prevalence of overweight and obesity was higher in non-nappers than in power nappers. However, some limitations exist in this study, including the focus on the 6-18 age group, the criteria used to assess obesity, and the study's concentration on a healthy population. Recommendations for future research include developing software to assess the composition of traditional foods for the Asian population, considering variations in food processing, establishing a global waist circumference percentile, conducting studies with a more specific power nap window, and establishing a standard for the recommended daily allowance (RDA) or adequate intake (AI) of fat. Addressing these limitations and implementing the recommended changes will strengthen future research in this field.

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