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Original Article

Observed relationships between nap practices, executive function, and developmental outcomes in Tunisian childcare centers

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ABSTRACT

The objective of this design was to conduct an observational study comparing anthropometric characteristics, cognitive functions, as well as gross and fine motor skills. The study included 118 preschool-aged children (47 boys, 71 girls) enrolled in childcare centers. They were categorized into two groups based on their nap habits. The nap group comprised 59 children (23 boys, 36 girls), age (mean $\pm$ standard deviation) ([3.96 $\pm$ 0.54] years) who took naps after lunch, while the no-nap group included 59 children (24 boys, 35 girls) age (mean $\pm$ standard deviation) ([4.18 $\pm$ 0.61] years) who remained awake during this period. The results showed that the napping group had significantly higher scores for body mass index (BMI) ($p < 0.000\ 1$), height-for-age z score (HAZ) ($p = 0.003$), and higher BAZ (BMI-for-age z score) scores ($p < 0.000\ 1$), compared to the No-nap group. In terms of cognitive function, the study revealed that the napping group had better working memory performance compared to the No-nap group ($p = 0.002$), but no significant impact on inhibition was observed. The results also showed that taking a nap may improve functional mobility ($p = 0.003$) and upper body strength ($p = 0.026$) especially in boys. Future research could investigate the long-term effects of inadequate nap time on children's health and development and also develop and evaluate interventions to improve nap time habits in preschool children.

1. Introduction

Sleep in early childhood is influenced by both biological factors and environmental opportunities. During early infancy, there is a natural decline in the biological drive for napping.[1,2] Typically, infants sleep multiple times throughout a 24-hours (h) period. However, as they progress into their second year of life, they transit into a biphasic sleep pattern, characterized by a single daytime nap. By the age of 4, most children will have discontinued regular daytime napping.[1,3–7]

These variations suggest the potential influence of environmental factors, which aligns with findings from studies in behavioral genetics. Genetic modeling analyses revealed environmental influences for all daytime sleep duration trajectories. In contrast, strong genetic influences were found for consolidated nighttime sleep duration.[8] These studies indicate that the way sleep patterns are distributed throughout a 24-h period is increasingly shaped by environmental elements.[8,9] Touchette et al.[8] observed that, by the age of 4, approximately 80% of the differences in nap duration can be attributed to environmental factors. These results underscore the significance of the caregiving environment, specifically the variations in opportunities provided for napping. The opportunity for young children to take naps is closely linked to the caregiving environment they are in. A study conducted in the UK found that when parents held positive attitudes towards napping and exhibited supportive behaviors, it was associated with an increased likelihood of preschool-aged children taking naps.[10] It is plausible that this trend is also observed in non-parental caregiving settings, where variations in attitudes towards napping may be reflected in the policies and duration of mandated nap times. Although this hypothesis has not been directly tested, studies that have examined sleep in the context of child care settings (where mandatory nap times are provided) have reported higher-than-expected rates of napping, often ranging from 80% to 90%, compared to population norms.[11,12] Additionally, different child care sleep policies have been linked to variations in sleep patterns.[6,13,14]

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Abbreviation list

WHO	World Health Organization
SUNRISE	the International Study of Movement Behaviors in Early Childhood
EYT	the Early Years Toolbox
S-TUG	Supine-Timed up and go
BMI	body mass index
HAZ	height-for-age *z* score
WAZ	weight-for-age *z* score
BAZ	BMI-for-age *z* score
S-TUG	Supine Timed up and go
h	Hours
min	Minutes
s	Seconds

Sleeping patterns were investigated using a questionnaire administered to 441 young children (229 boys and 212 girls) attending kindergartens or nursery schools at the ages of 3–6 years old. Results showed that nighttime sleep did not exhibit any significant change, while daytime naps decreased drastically and almost disappeared by the age of 6.[14]

Inadequate nighttime sleep in young children significantly raises the risk of negative health and developmental consequences.[15] These include an increased likelihood of behavioral difficulties, impaired cognitive function, a higher risk of injuries, and a greater chance of pediatric obesity.[16–19] Many studies suggest that the benefits of naps on cognition may extend to executive functions as well. For instance, when children are presented with unsolvable puzzles (including one incorrect piece preventing completion of the puzzle), children aged 30–36 months were more frustrated and exhibited more negative emotions when nap-deprived compared to when they were presented with the same task following a routine nap. Moreover, positive emotions were dampened when nap-deprived compared to the nap condition.[20] These results suggest that naps may promote healthy emotion regulation and inhibitory control in early childhood. Obesity in childhood can lead to health issues in the future, such as diabetes, heart problems, and stroke. It also contributes to psychological challenges like low self-esteem and dissatisfaction with one's body, impacting the quality of life during childhood.[21] Previous research on the correlation between daytime napping and the risk of obesity has yielded conflicting and inconsistent results. Some studies have suggested a potential link between increased daytime napping and a heightened risk of obesity.[22] For instance, one study discovered that excessive daytime napping was associated with a higher body mass index (BMI) and an increased likelihood of being obese.[23] On the contrary, other studies have presented divergent findings, indicating no significant association or even a potential inverse relationship between daytime napping and the risk of obesity.[24] Furthermore, additional research has proposed that daytime napping could be linked to a reduced risk of obesity.[25]

Evidence regarding the implications of nap on physical health was scarce.[26] Two studies reported that, among preschool-aged children, napping serves as a protective measure against accidental injuries.[18,27] Furthermore, some investigations[19,28] highlighted a shorter sleep duration as a predictor of overweight or obesity but did not identify an independent indicator for the nap's effect. Napping has been proposed as a potentially adjustable aspect of children's sleep that could help mitigate the effects of insufficient nighttime sleep.[8,10] However, studies examining the effects of napping in early childhood do not consistently report positive outcomes,[9,29,30] which has led to questions about the value of promoting napping. Restricting naps for children who typically nap has been shown to have adverse effects on their emotional regulation and cognitive performance.[20,31] In contrast, Lam et al.[29] conducted a study in childcare settings where naptime is part of the daily routine and found that napping was associated with poorer cognitive functioning. A key factor that distinguishes these conflicting findings is the age and natural sleep patterns of the children involved. Studies that restricted naps typically focused on younger children (under 3 years old) who habitually nap.[20,31]

The impact of such environmental exposures is likely meaningful. For example, hygiene encompasses a range of shared factors such as not having a television in the bedroom,[32] adhering to bedtime routines, dietary hygiene, and socio-economic status.[33] Environmental, and not biogenetic factors, account for almost 80% of the variance in napping duration by age 4-years.[8,9,34] Such environmental influence has already been demonstrated in the association between parent's attitudes toward napping, and the duration of napping in preschool aged children.[10] Whether such effects are also seen in the context of childcare, where napping is actively promoted, has not been determined. Furthermore, among preschool-aged children, a disparity exists where certain individuals struggle to engage in naps, while others of the same age find it challenging to remain awake.[35] Presently, official recommendations concerning the optimal timing and duration of naps, as well as the transition from napping, have yet to be established by organizations like the American Academy of Pediatrics Sleep Foundation.[36]

Regarding behavior, evidence concerning the connections between brain development and shifts in napping habits can be gleaned from research comparing cognitive abilities in children of the same age who either habitually nap or do not. In a particular study of this nature, children exhibiting superior performance on a cognitive assessment were observed to have fewer instances of napping compared to those with lower performance.[29] For example, a study involving 30–36 month old children showed that when presented with unsolvable puzzles containing one incorrect piece, nap-deprived children exhibited more frustration and negative emotions compared to those who had taken a routine nap prior to the task. Furthermore, positive emotions were observed to be dampened in the nap-deprived group when compared to the nap condition, suggesting that napping may promote healthy emotion regulation and inhibitory control during early childhood.[20]

Naps play a crucial role during infancy and early childhood by boosting learning through memory consolidation, it's a natural developmental milestone for children to gradually transition away from them.[37] Similarly, napping following learning has been shown to enhance various forms of memory the following day, as well as improve executive functions such as attention and emotional regulation. Collectively, this body of research supports the importance of napping in early childcare settings.[38] Despite the fact that napping may reduce time available for educational activities,[39] naps facilitate learning objectives by consolidating memories formed in the morning and improving attention that is essential for afternoon learning.

As there is a scarcity of research examining the relationships between napping and anthropometric characteristics, cognitive function, and gross and fine motor skills in early childhood, our analyses were exploratory in nature. This study aimed to fill this research gap by investigating these relationships within the context of preschool children. The primary objective of this design was to conduct an observational study comparing anthropometric characteristics, cognitive functions, as well as gross and fine motor skills among preschool-aged children enrolled in centers with and without nap practices.

2. Material and methods

2.1. Participants

A total of 118 preschool-aged children, aged 3–5 years, were included in this study. The children were divided into two groups: those who took naps and those who did not. The nap group comprised 59 children (23 boys, 36 girls) who took naps after lunch, while the no-nap group included 59 children (24 boys, 35 girls) who remained awake during this period.

2.2. Procedure

The primary objective of this design was to conduct an observational study comparing anthropometric characteristics, cognitive functions, as well as gross and fine motor skills among preschool-aged children enrolled in centers with and without nap practices.

Data were collected in Tunisia: Children and parents ($n = 118$) (or primary guardians) were recruited from two randomly selected schools childcares in Zahrouni and three schools in Tunis.

2.3. Ethical approval statement

All procedures were approved by the Ethics Committee of the Faculty of Medicine of Sousse (CEFMS 121/2022). Written informed parental consent, and participants' assent were obtained prior to commencement of study. All participants and their parents/legal representatives were fully informed about the protocol and its potential risks and benefits. Written informed consent was obtained from the parents of all children and the parents agreed to complete the SUNRISE parent questionnaire. Two field workers were trained in the study protocol. Two training sessions for 2 consecutive days were organized for the study. The sessions were facilitated by the Principal Investigator of SUNRISE (A.O.).

In this study, all data were collected from children within childcares during regular school hours. Parent questionnaires were administered by interviewers and completed at a time convenient to the child's home or preschool. Data were collected by a research coordinator and two assistants who were trained in data collection protocols. All questionnaires were explained and completed in Arabic to ensure that participants understood the questions and could provide accurate responses.

The study was carried out during winter (November 2022 to January 2023). Parents were invited to attend a meeting at the childcare where they were provided with information about the study. Following the meeting, appointments were made with parents who expressed their willingness to participate in the study on Saturdays. Eligible children were invited to participate in the study and written informed consent was obtained from their parents.

It's worth mentioning the high motivation of both parents and children in this study. All parents consented to their child's participation, and every child completed all necessary tests, showing strong commitment.

2.4. Proportion and number naptime minutes of children meeting naptime

In Tunisia, preschool centers are divided into two types: those that provide nap beds and rooms, and those that do not due to financial constraints. Parents have the option to choose between these centers. Children recruited for the study have enrolled in their respective centers for at least a year, thus being accustomed to their center's nap policy. Therefore, our study is based on an observational approach, without altering the nap policies of each center.

Two methods were utilized to determine the proportion and number of naptime minutes for children who took a nap during the study. Firstly, a questionnaire called the Center Information Questionnaire was administered to the childcares participating in the SUNRISE study, which collected data on the start and end times of the daily nap for each eligible child. Secondly, Two investigators independently recorded the start and end times of the daily nap for each group of children, Additionally we did not observe any interruptions in sleep for children who took a nap, to ensure the reliability of the data collected from the childcare staff, this evaluation was conducted over a period of two weeks.

2.5. Anthropometry

We used customizable and repositionable adhesive measuring tapes to measure the height (to the nearest 0.1 cm) of children (We repeated the measurement procedure twice. If the two measurements differed by more than 0.5 cm, we conducted a third measurement using the same method). The weight (to the nearest 0.1 kg) of children was measured using a calibrated scale SECA 750 Viva (If the two measurements differ by more than 0.25 kg, we repeat the procedure for a third measurement). Measurements were taken when children were wearing light clothing and no shoes to ensure accuracy. Body mass index (BMI) ($kg \cdot m^{-2}$) was calculated using height and weight. We also computed Height-for-Age z-score (HAZ), Weight-for-Age z-score (WAZ), and BMI-for-Age z-score (BAZ) using WHO reference standards[40] to further assess the nutritional status of the children.

2.6. Executive function (EF)

Inhibition and working memory, two key indicators of cognitive function, The EYT Early Years Toolbox,[41] was used to assess two executive function in this study.[42] The French version of the games was translated verbatim into Arabic by a field worker. Who was also a physical education teacher. Forward translation was employed to ensure faithful adaptation of the content. The translated versions had been previously utilized,[43] suggesting they were deemed acceptable and comprehensible by the target group. The primary objective was for children to understand the task requirements during the practice phase. Each game took around 10 minutes (min) to complete. Executive function tests were performed to assess children's behavioral impulse control and impulse inhibition (Go/No-Go),[41] and visuospatial working memory (Mr Ant).[41] The research assistant explained each game which has a built-in practice period at the start. The tasks were performed in a quiet environment.

2.7. Gross and fine motor skills

2.7.1. Gross motor skills

2.7.1.1. Lower body strength and mobility: standing long jump. In this test, a line is marked on the ground and the child stands behind it. The child then jumps with both feet as far as possible. The child is given one practice jump and two attempts. The average of the recorded distances is used as the final score.

2.7.1.2. Mobility and posture: Supine-Timed up and go (S-TUG). In this test, a line is drawn 3 meters (m) away from a wall, and a large target is marked on the wall at the child's eye level. The child starts lying on their back with their feet on the line. At the start, the child gets up as quickly as possible, runs and touches the target, and then runs backwards on the 3-m line. The child is given one practice trial and two attempts to perform the test.

2.7.1.3. Posture: one-leg standing balance test. During the test, the child stands on one leg with their arms held along their body. The free leg is not allowed to be hooked around the standing leg, but the arms can move to the sides. Timing begins when the free leg leaves the floor, and the test is stopped if the child moves the standing leg or hooks the free leg around the other leg. If the child maintains balance for 30 seconds (s), the evaluation is stopped, and the test is repeated on the other leg. The length of time the child spends balancing on each leg is recorded, and the average time is used as the final score.

2.7.1.4. Upper body strength: hand grip dynamometer. This test measures the ability of the hand and arm muscles to produce the tension and power needed to maintain posture. During the test, the child must continuously squeeze the grip dynamometer with full force using their right hand for at least 3 s without letting their arms touch their body. One practice and two trials are performed with each hand.[44]

2.7.2. Fine motor skills

2.7.2.1. Manipulation: 9-hole peg-board test. This test measures the speed and precision of hand movements during the task of picking up nine pegs one at a time and placing them into a pegboard and then returning them. The evaluator starts the timer as soon as the child begins the task and stops it when the last peg is removed from the well. The child should use the non-tested hand to stabilize the board. The evaluator may also assist in stabilizing the board by placing their hand on the child's hand. The child undergoes two trials (one with the right hand and one with the left hand), as well as two practice sessions (one with the right hand and one with the left hand). The test has been found to be reliable and valid for assessing fine motor skills in children.[45]

We used tests from the SUNRISE study to measure gross motor skills, fine motor skills, and executive function.[43,46] The SUNRISE study examines how 24-h movement behaviors (physical activity, sedentary behavior, and sleep) are associated with the health and development of young children, and the proportion of children who met the WHO global guidelines for children under 5 years of age. There is a lack of data on these behaviors in low- and middle-income countries, and the SUNRISE study aims to fill this gap.[46]

2.8. Questionnaire

The SUNRISE parent questionnaire was administered to the child's parent or guardian ($n = 118$). The questionnaire was translated into the two most common local languages, Arabic and French, and parents were asked to choose the language they felt most comfortable with. The questionnaire included questions about children's typical sleep schedules. Sleep duration was calculated by summing the nighttime sleep (i.e., calculated as the difference between typical bedtime and wake-up time) and the duration of naps taken during the day. This includes questions on the child's dietary diversity, eating behaviour and food insecurity at the family level. Additionally, sociodemographic data based on an adapted version of the WHO STEPS survey[47] is documented. The questions assessing children's movement behaviours were based on the recommendations made by the surveillance subcommittee of the Guideline Development Group for the Australian 24-h movement behaviour guidelines for the early years in 2017.[46] The questionnaire in its entirety has not yet been validated.[46]

2.8.1. Center Information Questionnaire

The Center Information Questionnaire was conducted through interviews with the kindergarten director. Just like the parent and director questionnaires, face-to-face interviews were conducted where each question was read aloud by the data collector, and participants provided verbal responses. Subsequently, the data collector directly entered these responses into the questionnaire. The questionnaire inquired about the total number of eligible children at the center, the number of eligible children who consented to participate, and the timing of the daily nap.[43,46]

In addition, it is important to note that the nap durations included in our analysis were based on the observed nap durations at the centers, from Monday to Friday. Furthermore, based on our observations within the centers, children from the same center with nap practices were found to have similar nap durations. All test procedures (Executive function, Gross and Fine Motor Skills) were conducted approximately 30 min after the afternoon nap, which typically occurred around 1:00 p.m., to ensure that the children were fully awake.

2.9. Statistical analysis

Data were analyzed using SPSS Statistics for Windows (V 20). Data were presented as mean ± standard deviation. To examine differences between groups of children by childcare centre napping policy (yes vs. no) and by sex (boys vs. girls), Kruskall-Wallis tests (for continuous variables) and Pearson's *Chi*-squared test (for categorical variables) were performed.

3. Results

This study involved a total of 118 children who completed the study protocol, consisting of 47 boys (23 who took a nap and 24 who did not) and 71 girls (36 who took a nap and 25 who did not).

Table 1 presents anthropometric characteristics of the participating children, stratified by group (Napping and No-nap groups) and by sex. Specifically, the no-nap group comprised of older children ($p = 0.03$), while the napping group had higher scores for height ($p = 0.017$), BMI ($p < 0.000\ 1$), HAZ ($p = 0.003$), and BAZ ($p < 0.000\ 1$) than the no-nap group. Sex-stratified analysis showed no significant differences in any of the characteristics between boys who took naps and those who did not. On the other hand, girls who did not nap had significantly higher weight ($p = 0.038$) than girls who napped.

Table 2 presents the number and proportion of children who took a nap, stratified by group (Napping and No-nap groups) and by sex. The data reveals that there were no statistically significant differences in nap durations based on sex within each specific naptime category. In the context of the "≥ 60 min/day of naptime per day" category, proportions of children who engaged in naps exceeding 60 min were similar between boys and girls ($p = 0.965$). Similarly, the "< 60 min/day of naptime per day" category demonstrated comparable nap durations between sex ($p = 0.965$).

Table 3 presents the mean and standard deviation scores for two executive function tasks (working memory and inhibition) and for gross and fine motor skill measures for the overall sample of 118 children, as well as for subgroups stratified by group (Napping and No-nap groups) and sex. For inhibition, the boys, those who took a nap had a higher mean score than those who did not, but the differences are not significant as the difference is very small ($p = 0.113$). The mean scores for girls who took a nap and those who did not were (mean ± standard deviation) 0.68 ± 0.20 and (mean ± standard deviation) 0.66 ± 0.22, respectively, with no significant difference between the two groups ($p = 0.809$).

The mean score for the working memory task was (mean ± standard deviation) 1.81 ± 0.59 for the overall sample. For those who took a nap and those who did not, there was a statistically significant difference between the two groups ($p = 0.002$). For boys, those who took a nap had a higher score than those who did not, but the difference was not statistically significant ($p = 0.117$). For girls, those who took a nap had a higher score than those who did not, and the difference was statistically significant ($p = 0.006$).

Functional mobility was significantly better in the group that took a nap compared to the group that did not ($p = 0.010$). In addition, functional mobility was significantly better in boys who took a nap compared to those who did not ($p = 0.001$). Postural steadiness, lower body strength, and dexterity did not show any significant differences between the groups. However, upper body strength was significantly better in the Nap group compared to the no-nap group ($p = 0.026$). Moreover, for boys, those who took a nap had significantly better upper body strength compared to those who did not ($p = 0.005$). There were no significant differences between girls who took a nap and those who did not in terms of functional mobility, postural steadiness, lower body strength, upper body strength, and dexterity.

4. Discussion

The objective of this design was to conduct an observational study comparing anthropometric characteristics, cognitive functions, as well as gross and fine motor skills among preschool-aged children ($n = 118$) enrolled in centers with and without nap practices. The results showed that the napping group had significantly higher scores for BMI, HAZ, and higher BAZ scores, compared to the No-nap group. Additionally, the

Table 1
Descriptive characteristics, stratified by napping/no-nap group and sex (mean ± standard deviation).

Variables	All (n = 118)	Napping G (n = 59)	No-nap G (n = 59)	p value	Boys Nap (n = 23)	Boys No-nap (n = 24)	p value	Girls Nap (n = 36)	Girls No-nap (n = 35)	p value
Age (years)	4.07 ± 0.59	3.96 ± 0.54	4.18 ± 0.61	**0.030**	3.91 ± 0.53	3.95 ± 0.58	0.670	3.98 ± 0.54	4.36 ± 0.59	**0.005**
Weight (kg)	107.3 ± 6.74	106.46 ± 6.61	108.15 ± 6.82	0.200	107.04 ± 6.36	105.74 ± 7.00	0.496	106.13 ± 6.63	109.72 ± 6.55	**0.038**
Height (cm)	18.63 ± 2.86	19.22 ± 3.22	18.04 ± 2.33	**0.017**	19.29 ± 3.37	19.21 ± 3.23	0.496	18.08 ± 2.94	18.37 ± 1.97	0.662
BMI (kg·m^{-2})	16.17 ± 1.99	16.89 ± 1.97	15.45 ± 1.75	**< 0.001**	16.77 ± 2.13	17.11 ± 1.88	0.250	16.08 ± 1.97	15.31 ± 1.67	0.112
The categories of body weight	Obesity range	Obesity range	Underweight range		Obesity range	Obesity range		Obesity range	Underweight range	
HAZ	0.9 ± 1.19	1.21 ± 1.21	0.59 ± 1.09	**0.003**	1.29 ± 1.36	1.2 ± 1.18	0.733	0.75 ± 1.22	0.57 ± 0.94	0.306
WAZ	0.92 ± 1.26	0.92 ± 1.40	0.92 ± 1.11	0.906	1.15 ± 1.60	0.77 ± 1.28	0.544	0.81 ± 1.15	0.99 ± 1.10	0.645
BAZ	0.52 ± 1.36	0.99 ± 1.29	0.04 ± 1.27	**< 0.001**	0.92 ± 1.38	1.13 ± 1.28	0.221	0.4 ± 1.39	0.04 ± 1.15	0.146

Differences were tested using Kruskall-Wallis Test; bold values indicate statistically significant difference between groups at $p < 0.05$.
BMI body mass index, HAZ, height-for-age z score; WAZ, weight-for-age z score; BAZ, BMI-for-age z score.

Table 2
Number and proportion of children who took a nap, stratified by group and sex.

Variables	All (n = 59)	Boys Nap (n = 23)	Girls Nap (n = 36)	p value
Short nappers ≤ 60 min/day of naptime per day	13 (22.1 %)	5 (21.8 %)	8 (22.3 %)	**0.965**
Long nappers > 60 min/day of naptime per day	46 (77.9 %)	18 (78.2 %)	28 (77.7 %)	**0.965**

Differences between sexes were tested using Pearson *chi*-square tests.

study revealed that girls who did not nap had significantly higher age and weight than girls who napped. In terms of cognitive function, the study revealed that the napping group had better working memory performance compared to the No-nap group, but no significant impact on inhibition was observed. The results also showed that taking a nap may improve functional mobility and upper body strength, especially in boys. The present study also revealed that there were no significant differences in gross and fine motor skills between girls who napped and those who did not.

The findings of this study were based on population of 118 children who were divided into (Napping and No-nap groups), with 47 boys (23 in the napping group and 24 in the No-nap group) and 71 girls (36 in the napping group and 25 in the No-nap group) completing the study protocol. The objective of this design was to conduct an observational study comparing anthropometric characteristics, cognitive functions, as well as gross and fine motor skills among preschool-aged children enrolled in centers with and without nap practices.

The results demonstrated significant differences in BMI, HAZ, WAZ, and BAZ between the two groups (napping vs. no-nap group). Specifically, the napping group had higher scores for BMI, HAZ, and WAZ compared to the no-nap group. Additionally, the napping group had significantly higher BAZ scores, indicating a higher body adiposity index, than the no-nap group.

Some researchers investigated the relationship between daytime napping and obesity.[22] They conducted a comprehensive search of various databases and included twelve studies involving a total of 170, participants from different regions. The findings of the meta-analysis indicated a significant positive association between daytime napping and the risk of obesity, indicating a higher risk of obesity in individuals who nap compared to those who do not. Our results may be added to a supplementary dimension in this discussion, while our observational study reveals a significant correlation between daytime napping and adiposity indicators, it's important to note that long-term research is needed to fully assess this effect, especially in low-middle income countries.

Furthermore, our study revealed no significant differences in BMI, WHZ, or BAZ scores between girls or boys who napped and those who did not. Additionally, boys who did not nap had higher BAZ scores (1.13 = Possible risk of overweight) compared to boys who napped (0.92 = Normal range). However, it is important to note the need for further long-term research to analyze these findings.

The lack of significant differences in nap time between boys and girls in this study is also in line with previous research[48] which found no sex

Table 3
Overall scores (mean ± standard deviation) on the executive function task and the gross and fine motor skill by group and sex.

Variables	All (n = 118)	Napping G (n = 59)	No-nap G (n = 59)	p value	Boys Nap (n = 23)	Boys No-nap (n = 24)	p value	Girls Nap (n = 36)	Girls No-nap (n = 35)	p value
Inhibition	0.68 ± 0.22	0.71 ± 0.23	0.65 ± 0.23	0.232	0.74 ± 0.25	0.63 ± 0.25	0.133	0.68 ± 0.20	0.66 ± 0.22	0.809
Working Memory	1.81 ± 0.59	1.97 ± 0.51	1.66 ± 0.51	**0.002**	2.04 ± 0.56	1.79 ± 0.56	0.117	1.92 ± 0.62	1.56 ± 0.46	**0.006**
Functional mobility (s)	5.13 ± 1.14	4.92 ± 1.25	5.34 ± 99.00	**0.010**	4.33 ± 0.86	5.47 ± 1.03	**0.001**	5.31 ± 1.32	5.25 ± 0.96	0.977
Postural steadiness (s)	12.19 ± 6.18	12.84 ± 7.79	11.54 ± 3.92	0.628	14.96 ± 8.14	10.36 ± 3.83	0.259	11.49 ± 7.36	12.35 ± 3.83	0.137
Lower body strength (cm)	55.93 ± 14.91	58.35 ± 17.46	53.50 ± 11.48	0.205	60.72 ± 19.01	51.94 ± 12.50	0.210	56.84 ± 16.49	54.56 ± 10.78	0.964
Upper body strength (kg)	6.75 ± 1.96	7.18 ± 2.28	6.31 ± 1.47	**0.026**	8.35 ± 2.35	6.33 ± 1.53	**0.005**	6.43 ± 1.91	6.30 ± 1.45	0.970
Dexterity (s)	40.89 ± 9.17	38.58 ± 8.41	43.19 ± 9.40	**0.029**	36.94 ± 10.80	43.84 ± 9.26	0.076	39.63 ± 6.39	42.74 ± 9.60	0.627

Differences were tested using Kruskall-Wallis Test; bold values indicate statistically significant difference between groups at $p < 0.05$.

differences in nap duration among toddlers, indicating that sleep needs may be similar for both sexes during early childhood.

The results presented in Table 3 suggest that daytime napping have a positive effect on working memory in preschool children, but no significant effect on inhibition was observed. These findings are in line with previous studies that have investigated the effects of napping on cognitive function in young children. For instance, Kurdziel L. et al.[39] investigated the effects of a midday nap on memory consolidation in preschool children and found that the nap group performed better on a visual-spatial memory task compared to the no-nap group. The current study's findings align with the idea that daytime napping can have a positive impact on cognitive function in preschool children, particularly in the domain of working memory. Our results showed a significant difference in working memory scores between the napping and No-nap groups, with the napping group displaying better working memory performance. This suggests that taking a nap during the day might enhance working memory in this age group, which is an important aspect of cognitive functioning. These findings are consistent with the results of the study by Spencer R.M.C.[38] who reviewed recent research indicating that naps can indeed benefit various aspects of cognition in early childhood. They found that naps were associated with improved declarative memory, motor skills, emotional memory, attention, and emotion processing in young children. This broader context supports the notion that napping can be beneficial for cognitive development and education in preschool-aged children. While our study focused specifically on working memory and found a positive effect of napping in this area, the cumulative evidence from both our study and the findings reviewed by Spencer, R.M.C.[38] underscores the potential value of incorporating naps into early childhood education, especially for children who may face learning challenges. Further research should continue to explore the mechanisms underlying these cognitive benefits and their applicability to different forms of learning and executive functions in preschool-aged children.

It's interesting to note that the effects of napping on working memory appeared to be more pronounced in girls compared to boys, even though the difference in means was not statistically significant for boys. This observation could indicate potential sex-related differences in the cognitive benefits of daytime napping, although further research with a larger sample size would be needed to confirm this pattern definitively.

These findings are consistent with reviews of the literatures[38] on the role of naps in early childhood development. Spencer R.M.C.[38] highlights the importance of napping in memory consolidation, which is crucial for learning and academic success. Additionally, Spencer notes that napping can have positive effects on executive function, which is important for regulating behavior and making decisions.

Overall, the findings from these studies suggest that afternoon napping can have positive effects on cognitive functioning, particularly in the domains of memory and executive function. For instance, as illustrated in Table 3, daytime napping appears to positively influence working memory in preschool children, aligning with the notion that afternoon napping can enhance specific cognitive functions. However, the analysis did not reveal a significant impact on inhibition, indicating that the effects of napping may vary across different cognitive domains. These findings have important implications for individuals of all ages, as well as for parents, educators, and employers who may be able to implement nap policies to improve productivity and cognitive performance. However, further research is needed to better understand the specific mechanisms underlying the cognitive benefits of napping, as well as to determine the optimal nap duration and timing for different populations.

The present study also investigated the effects of napping on gross and fine motor skills in early childhood children. The results showed that taking a nap may improve functional mobility and upper body strength, especially in boys. These findings are consistent with previous research that has shown a positive effect of napping on motor skills in children.[49,50]

We investigated the effects of napping on gross and fine motor skills in girls. The finding that there were no significant differences in gross and fine motor skills between girls who took a nap and those who did not is interesting and warrants further investigation. It is possible that there may be sex differences in the effects of napping on motor skills, but more research is needed to confirm this hypothesis. However, additional studies are required to validate these findings and explore the underlying mechanisms.

Despite the observed scarcity of studies on the effects of napping on gross and fine motor skills in early childhood children, our study is among the first to investigate the effects of napping on gross and fine motor skills for both boys and girls aged 3–5 years. However, there is a substantial body of research highlighting other developmental benefits of napping. For instance, Ren et al. found that as early as age 6, children can effectively develop finger tapping skills through daytime napping.[50] Additionally, Desrochers et al. reported that daytime naps also enhance skill learning in preschool-aged children (aged 3–6 years).[49] However, it remains to be determined whether children of different ages and regions share the same benefits.

In conclusion, the results of this study highlight the importance of monitoring and promoting adequate nap time in children. Future research could investigate the long-term effects of inadequate nap time on children's health and development. Additionally, interventions aimed at improving nap time habits in children could be developed and evaluated.

5. Conclusions

In conclusion, this study underscores the importance of nap time for preschool-age children, not only for anthropometric characteristics but also for cognitive functions and motor skills. The results demonstrate that regular naps are associated with better working memory performance and may enhance functional mobility and upper body strength, especially in boys. While the differences between girls who nap and those who do not are not significant in terms of gross and fine motor skills, the results of this study highlight the importance of monitoring and promoting adequate nap time in children. Future research could investigate the long-term effects of inadequate nap time on children's health and development and also develop and evaluate interventions to improve nap time habits in preschool children.

5.1. Study limitations

- Observational Nature: The observational design of the study limits our ability to establish causal relationships between nap habits and the observed outcomes.
- Confounding Factors: Unmeasured variables such as dietary habits, physical activity levels outside of nap times, home environment, and the influence of parents and their lifestyle within the household could have influenced the results.
- Sample Size: While sufficient for detecting significant differences, the sample size may limit the detection of more subtle effects, particularly by gender or other demographic factors.
- Need for Further Research: Our observational study suggests associations between nap habits and various developmental parameters, but cannot establish causality. Experimental research, such as randomized controlled trials, is needed to better understand this relationship. Longitudinal studies would also help assess the long-term effects of nap practices on child development.
- Comparison of Preexisting Groups: Comparing children who nap with those who do not is influenced by individual, familial, and socioeconomic factors, making it challenging to isolate the specific influence of napping.
- Lack of Covariate Control: It was not possible to control for potential covariates, which limited our ability to explain the role of other factors in the relationship between napping and health outcomes.

- Cross-Sectional and Exploratory Nature: The results should be interpreted as exploratory associations, requiring future research with more robust methodologies for validation.
- Nap duration data were collected at the center level via director questionnaires. These reported schedules were then confirmed by our data collectors through observations. It was assumed that all children napped for the same duration within centers as reported. This assumption may not reflect actual variations in nap duration among individual children.

6. Practical implications

The observational study on 118 preschool-aged children in childcare centers reveals practical implications for educators and caregivers:

- Cognitive enhancement: Breaks after lunch, especially naps, may enhance working memory performance, suggesting the integration of rest or relaxation activities for cognitive development.
- Promotion of physical activity: Specific physical activities could be incorporated to support overall motor development, with nap-taking children, especially boys, showing potential improvements in functional mobility and upper body strength.
- Guidance for parents: Informing parents about the benefits of napping and providing advice on optimal nap duration may contribute to children's overall development.
- Need for further research: Continued research is necessary to determine the optimal nap duration and when children naturally transition away from napping.

Ethical approval statement

All procedures were approved by the Ethics Committee of the Faculty of Medicine of Sousse (CEFMS 121/2022). Written informed parental consent, and participants' assent were obtained prior to commencement of study. All participants and their parents/legal representatives were fully informed about the protocol and its potential risks and benefits.

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CRediT authorship contribution statement

Mohamed-Amine Ltifi: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Kar Hau Chong:** Writing – review & editing, Writing – original draft, Visualization, Software, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Ghaith Ben-Bouzaiene:** Validation, Resources, Methodology, Investigation, Data curation, Conceptualization. **Anthony D. Okely:** Writing – review & editing, Writing – original draft, Validation, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Mohamed-Souhaiel Chelly:** Writing – review & editing, Writing – original draft, Visualization, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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