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## SLEEP SMART: SYSTEMATIC REVIEW OF SLEEP EDUCATION'S ROLE IN PREVENTING CHILDHOOD OBESITY

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**Abstract:** Childhood obesity and sleep problems are two major public health issues. There is a growing body of evidence to suggest that these two problems are linked. Short sleep duration has been associated with an increased risk of childhood obesity. This is thought to be due to a number of factors, including hormonal changes that affect appetite regulation, increased calorie intake, and decreased physical activity. Sleep timing patterns may also play a role in childhood obesity risk. For example, children who go to bed late and wake up late are more likely to be obese than children who go to bed early and wake up early. The relationship between childhood obesity and sleep problems is complex and not fully understood. However, the evidence suggests that these two problems are interconnected and that addressing sleep problems may be an important strategy for preventing childhood obesity.

**Keywords:** childhood obesity, sleep problems, sleep duration, sleep timing, hormones, appetite regulation

### Introduction

The increased prevalence of childhood obesity is a major international public health issue. Beyond the association with health complications, it shows that obesity and overweight in childhood are very dangerous factors for serious chronic illnesses in childhood (Datar 2004). Over the last thirty years, there has been an alarming increase in the prevalence of overweight and obese children in the US and worldwide (Datar 2004). Sleep problems in children and adolescents are common and global. Problem sleeping habits are associated with the risk factor for obesity in children. Poor sleep is associated with a variety of physical and psychological problems, and is also related to childhood obesity. Beyond sleep duration, sleep timing patterns may contribute to obesity risk.

Despite the fact that the association between sleeping disorders and childhood obesity is not absolutely clear, it is shown that short sleep duration is leading to increase of weight gain through hormonal changes associated with appetite regulation, specifically leptin and ghrelin secretion (Miller 2015).

Adolescence is a time of disorganization in sleep patterns and the sleep education programs in school aged period may be a conductor for a healthy lifestyle (Kira 2014). Sleep promotion through education is a very important tool for the prevention of childhood obesity but its involvement in interventions should be more investigated (Agronov 2018). This study examines the sleep interventions to prevent childhood obesity and has highlighted several items,

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which should be considered to effectively determine whether sleep intervention can improve childhood sleep and influence health outcome (Kira 2014).

Last but not least, this paper will review the current evidence base of sleep education and interaction programs. To provide the best patient care and to keep growing as professionals, nurses should embrace the chance to learn and implement new evidence-based practice. It will conclude with a discussion of how the sleep education may improve the prevention of childhood obesity.

### **Background**

The National Sleep Foundation is a non-profit, charitable organization that was founded in 1990. Its mission is to improve health and well-being through sleep education and advocacy. It is identified indicators of sleep quality for all age groups as: sleep onset latency, number of awakenings lasting less than 5min, wake time after sleep onset, and sleep efficiency (ratio of total sleep time to time in bed) (Ohayon 2017). Poor sleep, short sleep duration and problem sleeping habits are associated with the increased prevalence of childhood obesity. Concerning sleep duration, short duration of sleep has been associated with a 45% increased risk of developing obesity (Li 2017). In fact, interventions such as earlier bedtimes, later wake times, and other healthy sleep behaviors could be a low-cost and effective intervention (Chen 2008, Hager 2016).

According to the National Sleep Foundation recommended sleep durations are as follow: 14-17 sleep hours for newborns, 12-15 sleep hours for infants (4-11 months old), 11-14 sleep hours for toddlers (1-2 years old), 10-13 sleep hours for preschoolers (3-5 years old), 9-11 sleep hours for school-aged children (6-13 years old), 8-10 sleep hours for teenagers (14-17 years old) (Hirshkowitz 2015).

### **Design of obesity prevention program**

The early childhood may be the best opportunity for obesity prevention and few attempts have been made to prevent obesity during this period of the first years of life. That is why during infancy and early childhood, healthy lifestyle behaviors are just being learned, and it is easier to establish healthier lifestyle habits than to change existing ones (Fitzippon 2005).

For any sleep education program to be effective and have a lasting impact, common myths, misconceptions and barriers regarding hygiene sleep need to be clear (Hauck 2015). Misconceptions about the hygiene sleep need to be considered from both the point of view of the nurse and the family caring for the infant. These considerations include risk of aspiration, resistance to change in practice, family and cultural traditions, and media portrayal of safe and quality infant sleep (Hauck 2015).

The priority is the development of strategies for the prevention of overweight and obesity. The aim of obesity intervention programs is the promotion of physical activity, reduction of screen time and finally the development of nutrition and sleep habits. The main interest for the researchers is the outcome of promotion hygiene sleep habits and childhood obesity. As previously noted, all interventions promoted sleep also targeted diet, physical activity or internet use, and therefore sleep was often promoted in tandem with other energy-balance behaviors. Sleep knowledge acquisition therefore represents the major goal of sleep education in the first instance (Rigney, 2012).

### **Methods**

According to research question, which is how effective are the intervention programs for healthy sleeping habits promotion for the prevention of childhood obesity, it conducted a search using two scientific databases.

### **Design**

This study draws on data from a recent systematic review in PubMed and science Direct databases using childhood; education; intervention; obesity; prevention; sleeping hygiene as key words. Eligible articles included original papers describing interventions to prevent childhood obesity through sleep promotion.

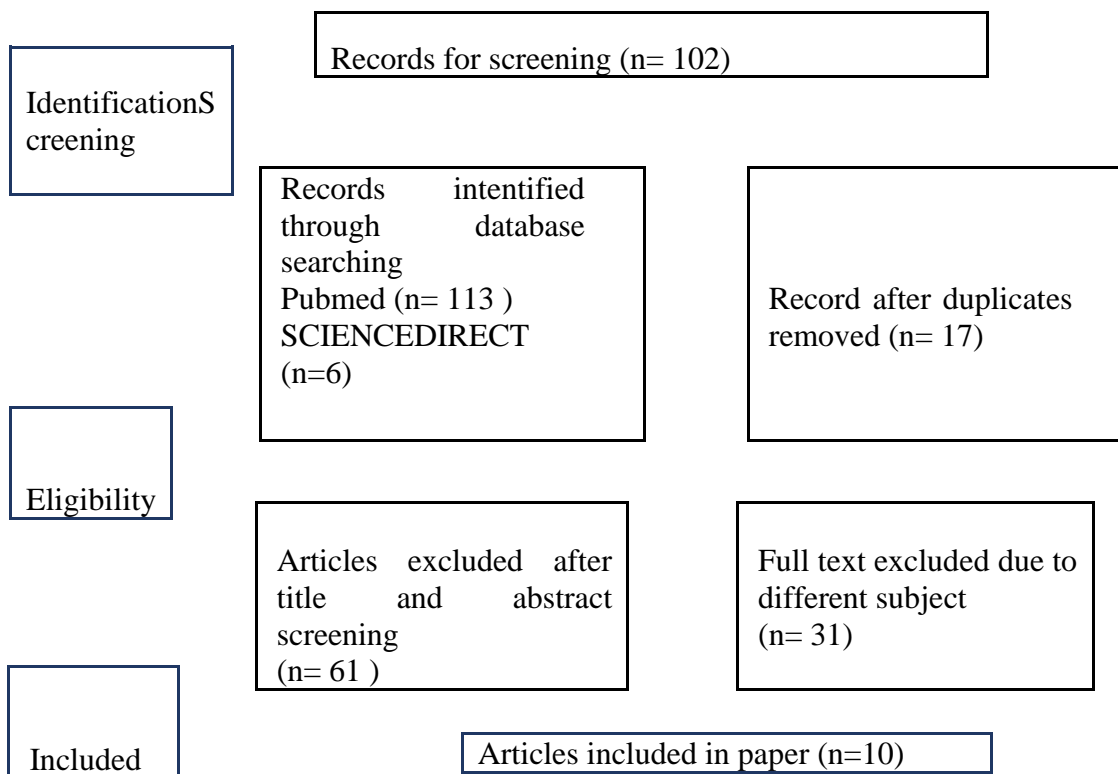
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Studies were included if they (1) were published from September 1st 2014 to December 31st, 2019, (2) documented intervention programs which included sleep education in case of childhood obesity's prevention, (3) included only original papers written in English language and (4) were used papers which investigate only the childhood obesity's prevention. This systematic review was completed following the guidance of Kitchenham and Bacca methodology, which divides the process into three parts: planning, conducting and reporting results (Kitchenham 2010, Bacca 2014). Accordingly, the authors used the PRISMA statement and flow chart to select studies for inclusion and to provide a systematic search (Liberati 2009).

### Search outcome

Throughout the both databases literature search process we came across with a total of 119 items. All titles were screened against these criteria; excluded 61 papers after title and abstract screening, excluded 31 papers after full text reading and 17 articles excluded due to duplication. Finally, 10 articles included in the paper.

The whole flow diagram of the search and selection process is shown in Fig. 1.



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Figure.1. Flow diagram illustrating the search and screening process

Study, author, Year	Studyaim	Design	Sample	Methods Educationpat tern	Result
1.Hammersley et al 2019 Australia	Toevaluate the effectiveness of a parent-focused, internet-based healthy lifestyle program for, overweight or at above the fiftieth percentile for body mass index preschoolaged children. To assess the obesityrelated behaviors, parent patterns, and parent self-efficacy. Time2bHealthy Program	randomize d controlled trial	N= 86 42 =the intervention group 44 =the comparison group	Intervention groupexperien ced an 11-week internetbased healthy lifestyle program, followed by emails for 3 months in fortnightly basis Comparison participants received communicatio n via mails. OnlyObjectiv ely measured child BMI was the primary outcome. Secondary outcomes included objectively measured physical activity, parentmeasur ed and objectively measured sleep habits, and parent-	Through this parent-focused eHealth childhood obesity prevention program may be able to success the improvement of dietaryrelated practices and selfefficacy but was not successful in reducing BMI. The sample size was not achieved, so the statistical power was not affected

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				reported dietary intake, screen	
				time, child feeding, parent modeling, and parent self-efficacy. All data were collected at face-to-face appointments at baseline, 3 months, and 6 months by blinded data collectors	
2.Skouteris2016 Australia	To assess the efficacy of a parent-based obesity prevention intervention for preschooler's children on eating habits, physical activity/sedentary behaviors, and body	Randomized controlled pilot trial	N= 201 Parent-child dyads 104=intervention group 97=control group	The Behavioral Management focused on the Tantrums at bedtime routines, bedtime rituals, limit screen time, especially TV	In the intervention group, there was significant positive group effects for vegetable and snack food intake, and satiety responsiveness, immediately post-intervention. At 12 months follow-up, intervention children

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	mass index (BMI)			time before bed	exhibited less neophobia than controls
3.Pablos 2017 Spain	To evaluate the impact of the Healthy Habits Program (HHP)	Controlled trial	N=158 82= Intervention group 76= Control group	The intervention group received education worksheets about healthy sleeping and eating habits and physical activity session for 8 months	The intervention group had significant improved habits included the eating and sleeping habits
4.Wing 2015 Hong Kong	To evaluate the effectiveness of a multilevel and multimodal schoolbased education program	cluster randomize d controlled trial	N= 3713  1545=interve ntion group 2168=control group	The students by intervention group included a town hall seminar, small class workshops, a slogan competition, a brochure, and an educational Web site. Parents and teachers experienced sleep education seminars. The control group did not receive any sleep	The students in the intervention group had significantly improved sleep knowledge compared with the control group. Weekday sleep duration was reduced in both groups, and the significant difference in weekday sleep duration was lost in the intention-to-treat analysis the intervention group had a lower incidence of consuming caffeinecontaining energy drinks and had better behavioral and mental health outcomes

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				program. Data were collected before and 5 weeks after the intervention.	
5.Wolfson 2015 USA	To primarily improve sleep health behaviors and secondarily improve academic performance and behavioral well-being. Sleep Smart Program	Randomized control trial	N=103 70=Intervention group 73=Control group	The intervention group assigned to an 8-session Sleep Smart Program	Intervention group had greater sleep health efficacy, improved physiological and emotional sleep hygiene, more time in bed, and earlier bedtimes vs comparison group. Intervention group reported a significant decrease in internalizing behavior problems and sustained academic performance
6.Kira 2014 New Zealand	To distinct the feasibility of a pilot sleep education program in high school students	Two-arm randomized controlled pilot trial	N=29 15=intervention group 14= control group	The intervention group received the sleep education program which was four 50-minute classroom-based education sessions	The intervention group slept longer during weekend No differences were found between groups for sleep duration on weekday nights. No significant differences were observed between groups for any of the secondary outcomes (sleep hygiene, sleep

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				Students completed a 7-day sleep diary and a sleep questionnaire at baseline, postintervention (4 weeks) and 10 weeks follow-up	problems, or sleep knowledge)
7. Bonnar et al 2015 Australia	To evaluate school-based motivational sleep education programs (SEPs) with adjunct bright light therapy (BLT) and/or	Randomized controlled trial	N=193 adolescents As control group: 52=classes as usual (CAU) as intervention groups: 63=sleep education	Three school-based motivational sleep education programs (SEPs) with adjunct bright light therapy (BLT) and/or	In intervention groups observed improvements in sleep knowledge, sleep onset latency and mood. Similar improvements were observed in a subgroup of students
	parental involvement (PI).		program (SEP) + parental involvement (PI) 35= sleep education program (SEP) + bright light therapy (BL) 43= sleep education program (SEP) + parental involvement (PI) + bright light therapy (BL)	parental involvement (PI). The study used a 4 (program: SEP + PI, SEP + BL, SEP + PI + BL, CAU) × 3 (time: preintervention, postintervention, 6 week follow-up) mixed-model design. Primary outcome	identified as having delayed sleep timing. Increases in motivation to regularize out of bedtimes



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				measures were bedtime, TST, sleep onset latency (SOL) on school nights, and the secondary outcome of depressed mood	
8.Fialkowski <sup>[1][SEP]</sup> 2014 USA filiated Pacific Islands (USAPI), Hawaii, and Alaska	To describe the community engagement process (CEP) used by the Children's Healthy Living (CHL) Program, to report community-identified priorities for an environmental intervention addressing early childhood (ages 2–8 years) and to share lessons learned in the CEP	Randomized controlled trial	N=900 community members including parents, teachers, and community leaders participated	Over a 14 month period the community members including parents, teachers, and community leaders participated in the CEP which was used to identify intervention priorities to address six behavioral outcomes: increasing fruit/vegetable consumption, water intake, physical activity and sleep; and decreasing screen time and intake of	In the most CHL region participants limit screen time, change government policies to promote healthy lifestyle, regulate use of government assistance and improve drinking water access/facilities

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				sugar sweetened beverages	
9.Fangupo 2015 New Zealand	To assess the effect of intervention from 0 to 18 months old on food and nutrient intake, eating behaviors, and parental feeding practices in 18- to 24month-old children.	Randomized controlled trial	N=802 Mother-infant dyads randomly allocated in 4 groups: Usual Care (UC) Food, Activity, and Breastfeeding (FAB) Sleep FABand Sleep (Combination ).	All groups received standard —well-child care. The FAB intervention comprised 7–8 additional contacts for education about breastfeeding, food, and activity. The Sleep intervention comprised 2 additional contacts for guidance about sleeping habits. Combination	There was no statistically significant differences in eating behaviors in the groups receiving the FAB intervention compared with the groups who did not there was small but statistically significant differences in parental feeding practices

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				families received both interventions. 2 years after intervention there was evaluation of food intake by questionnaire	
10.Savage 2016 USA	To examine the effect of a responsive parenting (RP) intervention on infant weight gain between birth and 28 weeks and overweight status at age 1 year	A Randomized Clinical Trial.	N=291 Mother-infant dyads	intervention: Home and clinic visits for parents on 4 child behavior states (Sleeping, Fussy, Alert and Calm, and Drowsy) to promote responsive parenting, plus growth charts; Control: Home safety	An RP intervention is associated with reduced rapid weight gain during the first 6 months after birth and overweight status at age 1 year

**Table 1. Summary table of included papers**

### Results

The main findings are oriented towards the intervention programs, education and sleep promotion for prevention of childhood obesity (Table 1). Of the 10 papers included, 8 followed a familiar way of search design. More particularly, the articles that included in this systematic review allocated the sample in control and intervention groups in which the intervention group received education or information. It is showed that in the 90% of papers (n=9) the intervention group improved the lifestyle habits including the sleeping habits. Only one of these

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demonstrated that there was no statistically significant difference between intervention and control groups (Fanguro 2015).

The internet-based information is an effective way for information and education. It is proved through the—Time2bHealthy, which is a parent-focused healthy lifestyle intervention on BMI in preschool-aged children, and delivered entirely Web-based. In this recently trial demonstrated that a parent-focused eHealth childhood obesity prevention program can help to improve dietary-related practices and self-efficacy but did not manage to reduce BMI. As far as the sleep promotion is concerned, only the half of participants in the intervention group agreed that the information about sleep was helpful (Hammesley 2019).

In another pilot trial with 29 participants was found that despite the fact that the intervention group slept longer during weekend, there was no difference between groups for sleep duration on weekday nights (Kira 2014). Also, no significant differences were observed between groups for any of the secondary outcome (sleep hygiene, sleep problems, or sleep knowledge).

In a familiar report with 3713 participants the researchers came across with the same outcome about the weekday sleep duration (Wink2015). This report proved that the significant difference in weekday sleep duration was lost in the intention-to-treat analysis. Moreover, the intervention group had a lower incidence of consuming caffeine-containing energy drinks and had better behavioral and mental health outcome. Also in this study, the students in the intervention group had significantly improved sleep knowledge compared with the control (Wink2015).

As for the sleep knowledge, Bonnar et al found improvements in sleep knowledge, sleep onset latency and mood (Bonnar 2015). In two studies the intervention program focused on the parental education (Hammesley 2019, Skouteris 2016). In Both of these parent-based studies, the intervention group improved the obesity-associated habits despite the fact that in the first study the sample target size was not achieved (Hammesley 2019).

There were founded two papers which investigated the obesity intervention in infants. (Fanguro 2015, Savage 2016). Both of them investigated mothers-infants in dyads, and the aim was the establishment of healthy lifestyle habits in the early of childhood. Fanguro concluded that the additional education and support for parents from birth did not improve nutrition behaviors (Fanguro 2015) and Savage had the opposite result because, in this report the conclusion was that the responsive parent intervention is associated with the reduction of weight gain during the first 6 months after birth and overweight status at age 1 year (Savage 2016).

The latter one was the INSIGHT (Intervention Nurses Start Infants Growing on Healthy Trajectories) study, in which mothers randomized to the sleep arm of the intervention were trained in distinguishing between child behavioral states to reduce instances of inappropriately feeding their children in response to non-hunger behavioral cues (Savage 2016).

In the half of the reports (n=5) educated parents on sleep hygiene, such as age-appropriate sleep duration, the health benefits and the consequences of sleep behaviors, and soothing strategies. The 30% (n=3) of researches carried out in the USA and the same number of studies carried out in Australia, too. Almost all reports tried to promote the healthy lifestyle emphasizing the nutrition improvement. Moreover, the intervention increased pupils' theoretical sleep knowledge and knowledge about good sleep practices. One of the records promoted the sleep hygiene through bed routine, (Skouteris 2016) and the others occupied with the sleep duration (Wolfson 2015, Kira 2014, Bonnar 2015).

In the only European research found, the intervention group received information through 29 worksheets, organized into 6 topics: 1) Why do we eat? 2) What and when should we eat? 3) Mealtimes 4) Doing exercise 5) Sleep duration 6) Hygienic habits. This study took place in Spain and there was proved that the sample in the intervention group had been improved in quality of diet and eating habits. As far as sleep habits are concerned, there was no significant difference after intervention (Pablos 2018).

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According to Wolfson et al the psychological outcome of obesity is associated with the sleeping disorders. So, in this study there was described the Sleep Smart Program which aimed to improvement of sleep habits, academic status and behavioral well-being. In this study, the intervention group experienced significantly greater sleep, improvement of physiological and emotional sleep hygiene, a significant decrease in internalizing behavior problems and sustained academic performance (Wolfson 2015).

### **Discussion**

To the best of our knowledge, this study emphasizes the education program for the prevention of childhood obesity. Therefore, it is critical to understand short sleep duration and problem sleep habits as a risk factor for obesity in this vulnerable population. In fact, the evidence that the problem sleeping habits contributes in the risk of childhood obesity is common in all age groups. In a Study for Children 2-4 years old proved that the children with greater variability in sleep duration and timing had greater energy intake from fat and protein sources (Petrov 2017). Also in other study, it was showed that the toddlers' aged 12-32 months old with a shorter nighttime sleep duration were at higher risk for obesity and inactivity. In the same study the interventions to promote healthy sleep behaviors among toddlers from low-income families improved nighttime sleep duration and reduced obesogenic behaviors and obesity (Hager 2016).

It is obvious that sleep promotion is a main intervention activity and sometimes was promoted in reference to other energy-balance behaviors. The combination of sleep and other energy-balance behaviors is reported by review of Yoong et al, who found that sleep interventions may have a positive impact on children's energy-balance behaviors, like diet and physical activity (Yoong 2016). Moreover, the family-based interventions seem to be a worthy tool because parents are valuable partners in the effort for changing in the childhood obesity epidemic (Hingle 2010, Golan 2006, Campbell 2007). The family-based interventions targeting childhood obesity suggested as a successful way in producing weight loss in the short and long-term (Berge 2011).

On the other hand, health professionals should promote the healthy sleep and eating behaviors. In UK, the sleeping coaches play this role. More particularly, sleeping coaches are a group of pediatric providers whose scope of services and regional distribution have not been well characterized. Although there is identified just more than 100 sleep coaches in the US who offer their services (Ingam 2015). Their role is to educate parents or children on the importance of maintaining regular, adequate sleep and relationships between sleep and dietary intake which may decrease the risk of childhood obesity in this high-risk pediatric population (Ingam 2015).

### **Summary**

The promotion of healthy sleeping patterns may be an integral part for the design of childhood obesity intervention programs. Certainly, future research should examine the clinical benefits of increasing sleep duration on eating behaviors and body weight control and determine the importance of adequate sleep to improve the treatment of obesity. Moreover, concluding it suggested that the role of the health professional who provide education and intervention in children is very important, so the findings of this review could be the evidence that sleeping coaching in this vulnerable population by specialized health professional should make the childhood obesity intervention programs more efficient. Especially the nurse involvement can be in the form of providing increased awareness and education for all of the hospital staff and the community at large.

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