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Posted Date: 6 July 2023

doi: 10.20944/preprints202307.0415.v1

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The Influence of Emotional Regulation on Sleep Habits of Spanish Children and Adolescents through the Lens of Parents

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Abstract: Background: Previous research studies have suggested the importance of studying the relationship between emotional regulation and sleep habits. Some investigations have especially focused on how emotional regulation could impact sleep habits in children and adolescents. Therefore, these researchers have stated there exists a two-way direction in this relationship. **Objective**: This study aimed to analyze the influence of emotional regulation on sleep habits in Spanish children and adolescents, and the mediating role of anxiety in this relationship. **Method**: Participants were 953 Spanish parents who completed the assessment protocol according to their children and adolescents' information. **Results**: The results revealed moderate-strong correlations between emotional regulation problems and sleep habits disturbances ($r=0.375$, $p<0.001$), trait ($r=0.488$, $p<0.001$) and state ($r=0.589$, $p<0.001$) anxiety. Also, emotional regulation showed a direct impact on sleep habits ($\beta=0.011$, $p=0.005$). Trait and state anxiety demonstrated a significant mediating role in the relationship between emotional regulation and sleep habits. **Conclusions**: Emotional regulation may have an impact on sleep habits during childhood and adolescence, suggesting the importance of early intervention focused on the emotions management and the prevention of sleep habits disturbances.

Keywords: emotional regulation; sleep habits; anxiety; children; adolescents

1. Introduction

Childhood and adolescence are developmental stages in which health habits and the regulation of emotional well-being are essential for an appropriate balance of mental health [1,2]. Health habits in children and adolescents are considered the set of learned behaviors that provide physical, cognitive and emotional wellbeing to the individual once they become habits [3]. Some authors therefore have suggested that these health habits are closely related to emotional regulation, which is understood as the higher cognitive mechanisms and processes mainly executive, which we activate whenever an emotional response arises [4–7].

Previous studies state sleep as one of the main indicators in health habits and its association with cognitive-emotional variables [8,9]. Sleep habits seem to play an important role in the proper maturation of the brain during childhood and early adolescence [10], and several studies have stated the relevance of the connection between the modulation of some cognitive processes and sleep disturbances [11–15]. These cognitive processes take part of the executive functions (EF), which can be influenced by changes in sleep habits, causing some attentional and memory difficulties, mood fluctuations, behavioral problems and decreased school performance in youngsters [16]. Moreover, upon the outbreak of the COVID19 pandemic, the number of children and adolescents presenting emotional and behavioral problems has significantly increased [17]. These emotional and behavioral problems in youngsters tend to appear since they are six years old and they are associated with difficulties in emotion regulation strategies [18].

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Emotional regulation and cognitive flexibility are also the dimensions of the EF that have been most commonly related to sleep [19–25]. Impairments in executive functions are related to emotional and behavioral problems, and this may contribute towards the maintenance of emotional disorders [26].

Additionally, previous investigations demonstrate the association of sleep disturbances and dimensions of EF, such as emotional regulation [27–29] and cognitive flexibility [30,31] with the anxiety [32–37]. According to recent research, all these associations may be explained due to the fact that executive disorders appear to be triggers of anxiety [27–32,37–41]. Thus, as previously mentioned, anxiety can potentially impact on the sleep habits of children and adolescents [41,42].

Many recent researchers have focused their interest on exploring how sleep problems negatively influence emotional regulation and cognitive flexibility [43,44]. Some of them have fixed their attention on investigating the bidirectional correlation between sleep habits and emotional regulation [43,44], whereas others have observed the influence of emotional regulation on health habits such as sleep [45,46]. We hypothesized that the alteration of the processes and functions of the executive system may be a predictor of sleep habits, and anxiety as a mediator of this relationship. Given the aforementioned, the current study aimed: (1) to analyze the correlations among sleep habits, anxiety and executive functioning, including its dimensions (emotional regulation and cognitive flexibility), (2) to determine the influence of emotional regulation and cognitive flexibility on sleep habits; and (3) explore the mediating role of anxiety between executive functioning and sleep habits.

2. Materials and Methods

2.1. Study population and design

The present research was a cross-sectional correlational and explicative study. The sample consisted of the initial sample was comprised of 953 children and adolescents, of which 953 (512 males and 441 females) finally participated, with ages between 6 and 18 years (M = 10.85; DT = 3.29). The sample was recruited after sending telematic questionnaires, residing in Spain. The collaboration of the legal guardians was required, with them answering the questionnaires in relation to children's information. Of these, 804 were females and 149 males, aged between 19 and 68 years (M = 43.30; DT = 6.70). All the legal guardians were aware of the different phases and characteristics of the study, signed the informed consent and completed the questionnaire. In the case of people over 18, they could sign the informed consent and complete the questionnaire themselves. Those who did not fully complete the questionnaire or did not provide the informed consent were excluded from the study. The nationality of the respondents was mostly Spanish (95.9%). The relationship that these people have with the child or adolescent in 84.6% is maternal, in 12.9% paternal, in 1.5% of siblings and the rest with percentages of 1%, other relationships such as grandparents, uncles, neighbors' and/or guardians.

2.2. Instruments

Recipients rated their children's anxiety using the Spanish version of the State-Trait Anxiety Inventory for Children (STAIC) test [47,48]. This test also demonstrated adequate psychometric properties [49]. The STAIC was composed of 40 items which are equally divided in two main dimensions: trait and state anxiety. The state anxiety scale tried to clarify "how the child feels at a given moment". The trait anxiety scale measured "how the child feels in general," exploring relatively stable differences in propensity to anxiety. Parents answered the questionnaire with their children's information for the current study. Original items were modified by including "Your child…" at the beginning of each item. For instance: "your child feels calm", "your child feels restless". Response options were 7-point Likert scales, in which 1 = "strongly disagree" and 7 = "strongly agree". For this study, the reliability of the instrument was adequate, presenting values of α=0.894 for trait anxiety; and α=0.907 for state anxiety.

BEARS was used as a brief sleep habits disturbances screening test with 9 items [50]. This test was completed by parents/guardians answering questions such as "their child seems to be tired or

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drowsy" or "their child wakes up several times during the night". Each item had 7 response options, in which 1 = totally disagree and 7 = totally agree. Regarding the reliability and internal consistency, the scale presented a Cronbach alpha's coefficient of 0.732 [51].

The BRIEF-2 (parent-report form) test was used to assess executive behavior [52]. It consisted of nine scales made up of 63 items with three possible response options (always, sometimes or never). From these domains, ten items of the emotional regulation subscale were selected, which included emotional control and cognitive flexibility as dimensions. It was decided to carry out a brief screening selecting these items of the parent version since they were directly related to the objectives of the present study. Six of these items of emotional control, and four items of cognitive flexibility were used. For the present sample, these items showed adequate reliability through Cronbach's alpha and McDonald's omega coefficients: α=0.902, ω=0.901 for the emotional regulation subscale, α=0.877, ω=0.881 for emotional control, and α=0.832, ω=0.830 for cognitive flexibility

2.3. Procedure

The current study was authorized by the ethics committee of the University of Alicante. Families were informed about the objectives of the study and researchers indicated that participation was completely confidential, anonymous, and voluntary. Parents who agreed to participate in the study were sent a link to the evaluation protocol configured on the Google Form platform. Participation in the study was requested through social media groups, using a snowball sampling strategy. To protect the confidentiality and anonymity of the data, codes were assigned to identify the participants following a pseudonymization process. The research was conducted following the guidelines of the Declaration of Helsinki and the European Union of Good Clinical Practice Standards.

2.4. Data analysis plan

Preliminary analyses. Prior to conducting the primary statistical analyses in line with the study's aims, descriptive statistics (i.e., means, standard deviations, skewness, and kurtosis) of participants' trait/state anxiety, sleep habits, executive functions, emotional regulation and cognitive flexibility. To examine bivariate correlations among trait/state anxiety, sleep habits, executive functions, emotional regulation and cognitive flexibility, a correlation matrix was created. According to Hernández-Lalinde et al. [53], the interpretation of the Pearson correlation coefficient (PCC) was: $0.00 < r < 0.10$ for null correlations; $0.11 < r < 0.30$ for weak correlations; $0.31 < r < 0.50$ for moderate correlations; and $0.51 < r < 1.00$ for strong correlations.

Hierarchical regression analyses. Four hierarchical regressions were run to examine the role of trait/state anxiety, and executive functions variables as predictors of sleep habits disturbances. In Model 1, trait anxiety was included as predictor. Model 2 included trait and state anxiety as predictors. Model 3 then included trait and state anxiety, and cognitive rigidity. And Model 4 included trait/state anxiety, cognitive rigidity, and emotional regulation as predictors.

Mediational models. Figure 1 shows four mediational models, which were developed using the PROCESS macro [54] to examine the direct and indirect effects of emotional regulation, cognitive flexibility on sleep habits, using 5,000 bootstrap samples. Bootstrapping is a non-parametric method for assessing indirect effects [55,56]. Bootstrapping provides the most powerful and reasonable method of obtaining confidence limits for specific indirect effects under most conditions [57]. In the first two models, emotional regulation (model 1) and cognitive flexibility (model 2) were specified to lead to trait anxiety which was then specified to lead sleep habits. In the other two models, emotional regulation (model 3) and cognitive flexibility (model 4) were specified to lead to state anxiety which was then specified to lead sleep habits.

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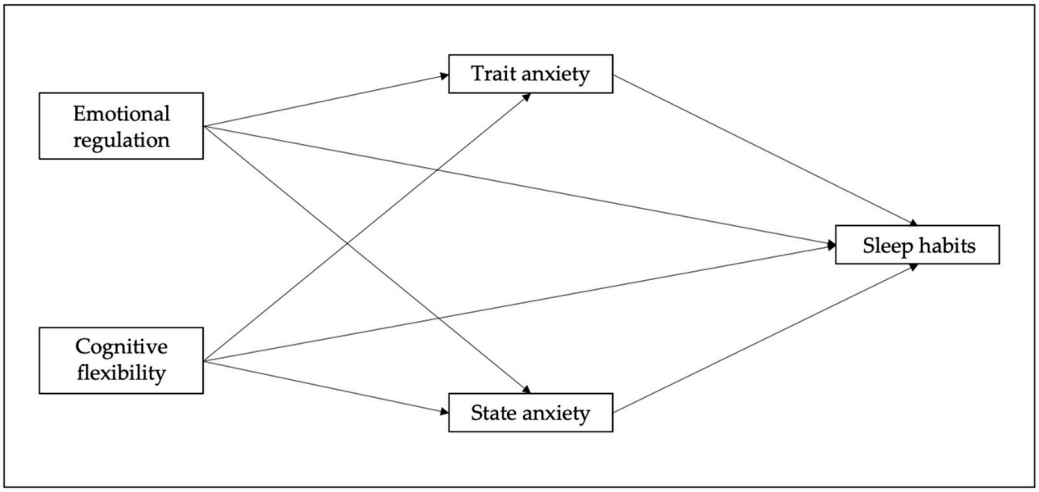

Figure 1. Research mediational models of the present study.

Analyses were performed using SPSS version 28.0 (SPSS, Inc., Chicago, IL, USA). The level of significance was set at $p<0.05$.

3. Results

3.1. Descriptive and correlation analysis between trait and state anxiety, executive functions and sleep disturbances.

Table 1 shows the descriptive analysis results and the relationship among the study variables. Specifically, both state and trait anxiety demonstrate a positive, moderate and significant correlation with sleep habits disturbances. Moreover, state and trait anxiety are importantly associated with executive dysfunctions, especially, with emotional dysregulation and cognitive rigidity. Sleep habits disturbances have also pointed out positive, moderate and significant correlations with the executive dysfunctions global index, emotional dysregulation and cognitive rigidity (Table 1).

Table 1. Means, standard deviations, skewness, kurtosis and correlations (confidence intervals) among the study variables.

Variables	M (SD)	Skw	Kurt	1.	2.	3.	4.	5.	6.
1. Trait anxiety	33.57 (7.49)	0.34	-0.40	-					
2. State anxiety	34.99 (8.72)	0.48	-0.37	0.654*** [0.616, 0.689]	-				
3. Sleep habits disturbances	13.17 (3.65)	0.74	-0.14	0.423*** [0.369, 0.474]	0.422*** [0.368, 0.472]	-			
4. Executive dysfunctioning global index	41.84 (16.63)	0.21	-0.85	0.488*** [0.438, 0.534]	0.559*** [0.514, 0.601]	0.375*** [0.319, 0.428]	-		
5. Emotional control problems	21.86 (10.01)	0.16	-1.09	0.481*** [0.430, 0.528]	0.529*** [0.481, 0.573]	0.356*** [0.299, 0.410]	0.921*** [0.911, 0.930]	-	
6. Cognitive rigidity	13.49 (6.55)	0.35	-0.85	0.416*** [0.362, 0.467]	0.491*** [0.441, 0.537]	0.315*** [0.257, 0.371]	0.866*** [0.849, 0.881]	0.653*** [0.615, 0.688]	-

Note. M = Mean, SD = Standard deviation, Skw = Skewness, Kurt = Kurtosis. *Correlation is significant at the 0.05 level (2-tailed); **Correlation is significant at the 0.01 level (2-tailed); ***Correlation is significant at the 0.001 level (2-tailed).

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3.2. State/trait anxiety, and executive dysfunctions as predictors of sleep habits disturbances.

Table 2 shows the regression models in which trait/state anxiety, emotional dysregulation, and cognitive rigidity are considered as predictors of sleep habits disturbances. Although cognitive rigidity appears to be a significant predictor of sleep habits disturbances, that variable is not significant when emotional dysregulation is introduced in the regression model. Trait/state anxiety remains as a significant predictor of sleep habits disturbances in all models.

Table 2. Regression analyses of sociodemographic, state/trait anxiety, and executive functioning variables as predictors of sleep habits disturbances.

Variable	Sleep habits disturbances				
	Model 1				
	B	SE	β	p	95% CI
Trait anxiety	0.203	0.015	0.415	<0.001	[0.357, 0.473]
	$F(1) = 188.50$, $R^2 = 0.187$, $\Delta R^2 = 0.167$, $p < 0.001$				
	Model 2				
	B	SE	β	p	95% CI
Trait anxiety	0.128	0.019	0.263	<0.001	[0.188, 0.337]
State anxiety	0.100	0.017	0.238	<0.001	[0.163, 0.313]
	$F(2) = 116.18$, $R^2 = 0.219$, $\Delta R^2 = 0.032$, $p < 0.001$				
	Model 3				
	B	SE	β	p	95% CI
Trait anxiety	0.120	0.019	0.246	<0.001	[0.171, 0.321]
State anxiety	0.079	0.017	0.189	<0.001	[0.110, 0.268]
Cognitive rigidity	0.048	0.020	0.087	0.015	[0.017, 0.156]
	$F(3) = 84.06$, $R^2 = 0.230$, $\Delta R^2 = 0.005$, $p = 0.015$				
	Model 4				
	B	SE	β	p	95% CI
Trait anxiety	0.112	0.019	0.229	<0.001	[0.153, 0.304]
State anxiety	0.071	0.017	0.168	<0.001	[0.088, 0.249]
Cognitive rigidity	0.019	0.022	0.034	0.403	[-0.045, 0.113]
Emotional control problems	0.041	0.015	0.112	0.006	[0.033, 0.192]
	$F(4) = 65.50$, $R^2 = 0.236$, $\Delta R^2 = 0.006$, $p = 0.006$				

Note. Significant differences were considered when $p < 0.05$.

3.3. The mediating role of the anxiety between executive functions and sleep disturbances.

Four mediational models were built to explore the mediation effects of anxiety in the relationship between executive functioning dimensions (emotional regulation and cognitive flexibility) and sleep habits, controlling children's age, parents' marital status, and parents' educational level. Emotional regulation and cognitive flexibility have been entered in the model as independent variables, trait/state anxiety as mediators, and sleep habits have been evaluated as a dependent variable.

Figures 2 and 3 show the mediational effects of trait/state anxiety, in which emotional regulation predicts sleep habits (B=0.143, SE=0.013, 95% CI [0.03-0.08], p<0.001), trait anxiety (B=0.481, SE=0.021, 95% CI [0.32-0.40], p<0.001), and state anxiety (B=0.529, SE=0.024, 95% CI [0.41-0.51], p<0.001). Regarding the mediation variables, sleep habits are predicted by trait (B=0.224, SE=0.019, 95% CI [0.07-0.15], p<0.001) and state (B=0.199, SE=0.017, 95% CI [0.05-0.12], p<0.001) anxiety. Moreover, the analyses of the indirect effect of trait and state anxiety show significant mediations (indirect effect of trait anxiety: B=0.107, SE=0.019, 95% CI [0.07-0.15], p<0.001); indirect effect of state anxiety: B=0.106, SE=0.021, 95% CI [0.07-0.15], p<0.001).

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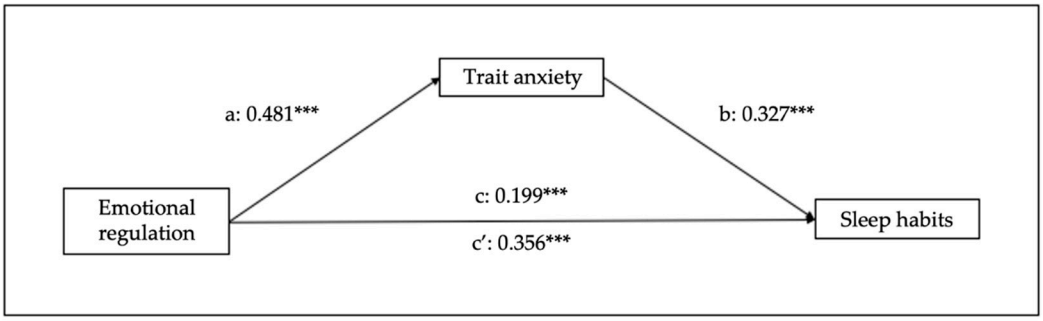

Figure 2. Results of regression analysis for the mediation effects of emotional regulation on sleep habits mediated by trait anxiety. Standardized regression coefficients.

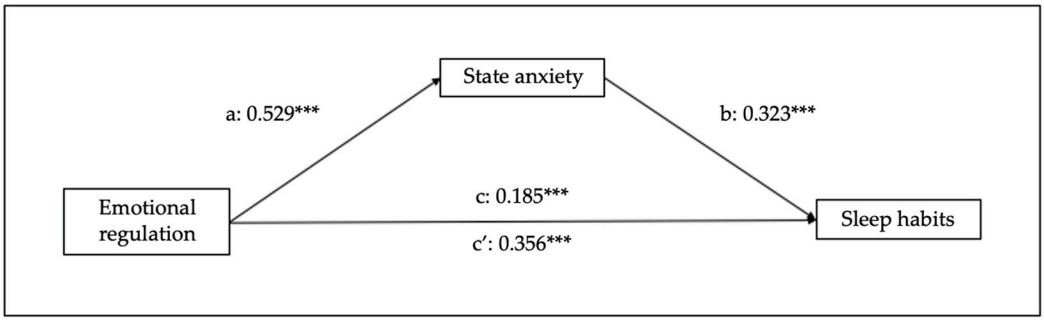

Figure 3. Results of regression analysis for the mediation effects of emotional regulation on sleep habits mediated by state anxiety. Standardized regression coefficients.

Finally, in relation to the other mediational models, cognitive flexibility predicts sleep habits (B=0.190, SE=0.019, 95% CI [0.15-0.23], p<0.001), trait anxiety (B=0.473, SE=0.037, 95% CI [0.40-0.54], p<0.001), and state anxiety (B=0.668, SE=0.041, 95% CI[0.59-0.75], p<0.001). Regarding the mediation variables, sleep habits are predicted by trait (B=0.213, SE=0.015, 95% CI [0.18-0.24], p<0.001) and state (B=0.178, SE=0.013, 95% CI [0.15-0.20], p<0.001) anxiety. Moreover, the analysis of the indirect effect of trait and state anxiety show significant mediations (indirect effect of trait anxiety: B=0.082, SE=0.01, 95% CI [0.06-0.10], p<0.001); indirect effect of state anxiety: B=0.096, SE=0.012, 95% CI [0.07-0.12], p<0.001) (see Figures 4 and 5).

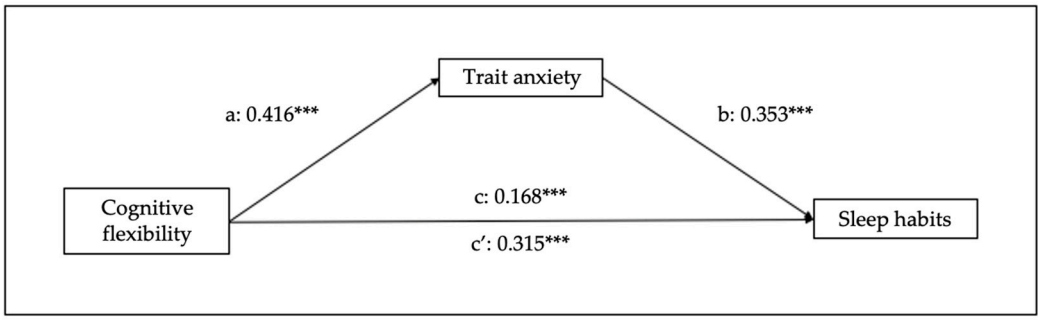

Figure 4. Results of regression analysis for the mediation effects of cognitive flexibility on sleep habits mediated by trait anxiety. Standardized regression coefficients.

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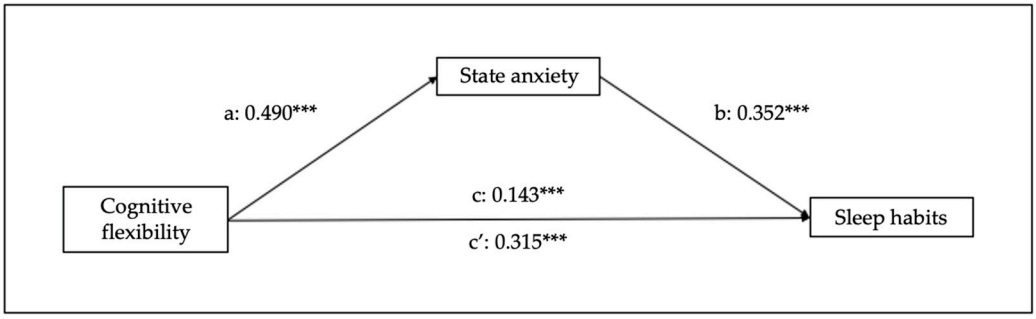

Figure 5. Results of regression analysis for the mediation effects of cognitive flexibility on sleep habits mediated by state anxiety. Standardized regression coefficients.

4. Discussion

Sleep and executive functions are influenced by child development factors. Several researchers have assessed the effect of sleep on EF, especially, the management of emotions. However, there is a scarce number of studies focusing on the impact of emotional regulation on sleep habits. The present study aimed to analyze the influence of EF (emotional regulation and cognitive flexibility) on the sleep habits, considering the mediating role of trait/state anxiety in children and adolescents through the parents' perception. We therefore set the following objectives: (1) analyzing the relationship among sleep habits, trait/state anxiety, and EF (emotional regulation and cognitive flexibility); (2) exploring the influence of the trait/state anxiety, the emotional regulation and the cognitive flexibility on the sleep habits; and (3) examining the mediating role of state/trait anxiety in the relationship between the EF (emotional regulation and cognitive flexibility) and sleep habits.

In respect of the relationship among the variables measured, findings revealed moderate-strong and positive correlations. That is, the higher trait/state anxiety, the higher sleep habits disturbances and alterations in EF. These results are consistent with previous research studies, in which they highlighted that the increasing level of anxiety could be related to the appearance of sleep habits disturbances [41,42,58]. It is known for a long time the relationship between these two variables. In fact, some studies have suggested that anxiety and sleep are strictly related and affect each other in a two-way manner [59]. Moreover, other recent studies have stated the direct association of the levels of anxiety with alterations in emotional regulation and cognitive flexibility [33–36]. Further, based on the results of previous scientific studies, sleep habits disturbances seem to be linked to a higher level of difficulty in controlling EF, especially, emotional regulation and cognitive flexibility [20–22,60].

Regarding the findings observed of the multiple regressions created, trait/state anxiety appear to be significant in all models. This is coherent with other investigations, in which they identified anxiety as a predictor of the fluctuation of sleep habits in children and adolescents [41,61]. Moreover, emotional regulation also showed an influence on sleep habits. As a matter of fact, recent literature has suggested further consideration of the management of emotions to fully understand sleep habits [22,44]. Furthermore, the results have demonstrated the importance of the mediating role of anxiety in the relationship between EF (emotional regulation and cognitive flexibility) and sleep habits. These findings are also consistent with other research studies, in which anxiety has played an essential role in this relationship measured [34,35]. Previous studies from different countries have supported the association between sleep and emotional problems in children [62]. It has been also indicated that children may present different sleep problems associated with emotional problems [63,64].

5. Strength, limitations, and future research

The current study's findings could help the scientific and clinical community further understand the need to examine the mechanisms associated with the relationship between emotional regulation and sleep habits. These results also allow professionals and the rest of society to identify and prevent sleep disturbances related to maladaptive emotional strategies. However, although this research comprises a great sample of participants and rich data analysis, which let us explain the performance

of the variables measured, it is not without limitations that we are aware of. This study was carried out from the perspective of parents. As the questionnaires were sent via social networks to parents, despite parental observation being known as one the most reliable methods to assess children's behaviors, that could be a reason for some biases for the results [65,66]. Measures are vulnerable to recall bias and findings should be therefore interpreted with caution.

In regard to the BEARS, although it is a suitable data source for sleep habits, which contains some validated measures, it does not include all the dimensions we would have liked to explore. For example, information on sleep quality, such as subjective sleep quality or possible pharmacological treatments for altered sleep quality were not available. This could differentiate the sleep habits and quality.

As for the future research lines, it is essential to carry out investigations in which children are the direct participants. This could avoid some difficulties in exploring their behavior and parents' biases. Additionally, analyzing the similarities and differences between sex or age groups would provide the scientific community with interesting data about the manifestation of the variables measured between males and females, and also across the age. Further, another crucial issue to deal with is to explore other protection and vulnerability factors of the sleep habits through a latent variable analysis, in which other psychosocial factors could be considered to better understand children and adolescents' behavior.

6. Conclusions

The present study sheds light on the significance of employing effective emotional regulation strategies and managing anxiety in order to promote healthy sleep habits. It is evident that higher levels of anxiety are associated with increased disruptions in the sleep patterns of children and adolescents, with anxiety and emotional regulation emerging as influential factors, as reported by parents. Furthermore, emotional regulation and cognitive flexibility can be considered protective factors for overall health habits, including sleep. In light of these findings, it is imperative for healthcare professionals to prioritize the identification and evaluation of potential sleep-related issues in children and adolescents. This is particularly crucial as anxiety-inducing environments, such as school, family, and work settings, can have detrimental effects on sleep habits and executive functioning. Therefore, it becomes essential to enhance the utilization of emotional and cognitive strategies to facilitate the regulation of sleep habits effectively.

It is important to recognize that the promotion of adequate sleep habits is a multidimensional task that requires a comprehensive approach. By addressing emotional regulation and cognitive flexibility, professionals can help individuals develop the necessary skills to regulate their sleep patterns more effectively. This includes the identification of triggers that may disrupt sleep, the implementation of relaxation techniques, and the establishment of consistent bedtime routines. Additionally, providing education and support to parents and caregivers is vital in ensuring a conducive sleep environment and reinforcing positive sleep habits.

By integrating emotional and cognitive strategies into sleep interventions, the overall well-being and executive performance of children and adolescents can be significantly improved. The recognition of the intricate relationship between emotions, anxiety, and sleep habits underscores the need for a holistic approach that considers the interplay of various factors. Ultimately, fostering healthy sleep habits early on can have long-lasting benefits, contributing to optimal development and overall quality of life.

Author Contributions: For research articles with several authors, a short paragraph specifying their individual contributions must be provided. The following statements should be used "Conceptualization, B.C.-L., R.L.-C. and I.N.-S.; methodology, B.C.-L., R.L.-C. and I.N.-S.; formal analysis, B.C.-L.; investigation, B.C.-L., J.C.V., R.L.-C. and I.N.-S.; data curation, B.C.-L.; writing—original draft preparation, B.C.-L., J.C.V., R.L.-C. and I.N.-S.; writing—review and editing, B.C.-L., R.J.-R., R.L.-C. and I.N.-S.; supervision, R.L.-C. and I.N.-S. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee and Vice-Rectorate for Research and Knowledge Transfer of the University of Alicante (UA-2020-05-12).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: All data generated or analyzed during this study are included in this published article. The availability of data must be personally requested to the corresponding author at ignasi.navarro@ua.es

Conflicts of Interest: The authors declare no conflict of interest.

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