

Sleep Problems in Children with Autism Spectrum Disorders

Christine K. Syriopoulou-Delli¹, Grigorios Simos¹ & Andreas Grigoriadis¹

¹ Department of Educational and Social Policy, University of Macedonia, Thessaloniki, Greece

Correspondence: Christine K. Syriopoulou-Delli, Department of Educational and Social Policy, University of Macedonia, Thessaloniki, Greece. E-mail: csyriop@gmail.com

Received: September 29, 2016

Accepted: November 25, 2016

Online Published: November 28, 2016

doi:10.5539/jedp.v7n1p1

URL: <http://dx.doi.org/10.5539/jedp.v7n1p1>

Abstract

This study examines sleep problems of children with Autism Spectrum Disorder (ASD), as reported by their parents. To investigate this issue a total of 35 children with ASD and 35 children of Typical Development (TD) were selected from northern Greece. A structured questionnaire (Williams et al., 2004) was used, a modified version of the questionnaire study conducted by the Kosair Children's Hospital Sleep Center (Gozal, 1998). Results show that children with ASD often experience sleep problems compared to TD individuals and also exhibit frequent awakenings during the night, difficulty in falling asleep, breathing concerns during sleep, morning headaches, sleepwalking, nightmares and fall asleep at school.

Keywords: autism spectrum disorder, sleep problems, children

1. Introduction

According to the DSM-5 (2013) of the American Psychiatric Association, individuals with Autism Spectrum Disorder (ASD) are characterized by restricted interests and repetitive behaviors and a severe delay in social interaction and communication difficulties. Studies demonstrate between 44% and 83% of children with ASD experience sleeping problems (Ferber, 1996; Richdale, 1999). Over the last two decades, a multitude of studies have been conducted concerning the characteristics of the sleep of individuals with ASD, in order to clarify their nature and the possible causes.

Sleep is a normal function, which ensures that a given individual receives the necessary amount of rest to enable him/her to maintain a stable level of alertness and effectiveness during the day. The process of sleep interacts with the process of waking and determines when the person is in a state of alertness and when in a state of sleep (Atkinson et al., 2000). As Glickman (2010) reports, the model of sleep implies the coexistence of two mechanisms that shape the arrangement between sleep and waking: the sleep homeostasis and the circadian pulse (Borbély, 1982; Borbély et al., 1989). This process is reflected in a sequence of five stages, four of which are referred to as periods of Non-Rapid Eye Movement (NREM), while the fifth is referred to as Rapid Eye Movement (REM). Measurement of the eye movements begins at the stage when the individual is still awake, lying down with his/her eyes closed, shortly before he/she enters the state of sleep.

During REM sleep, also known as the dream period, the eyes make very fast movements, the brain is overstimulated and the limbs are loose (Society of Neuroscience, 1996). During sleep, the human brain may present 4-6 periods of REM, usually every half an hour, following a gradual increase in duration as sleep deepens (Society of Neuroscience, 1996). NREM sleep is characterized by muscle relaxation, together with a significant reduction in heart and respiratory rates (Atkinson et al., 2000).

The criteria for the classification and diagnosis of sleep disorders are included in the ICSD-2 (AASM, 2005) and the DSM-5 (APA, 2013). Sleep problems are common in childhood, both in typical developing children and children with developmental disabilities (Polimeni et al., 2005). Studies have demonstrated significant levels of correlation between developmental disorders and sleep problems, ranging from 44% to 83%, regardless of mental level (Krakowiak et al., 2008; Polimeni et al., 2005; Richdale, 1999). Furthermore, the percentages of insomnia (40-80%) in this population are significant (Johnson et al., 2009). Also, the prevalence of sleep disorders in children with ASD is higher than in children with other delays (Goodlin-Jones et al., 2008; Krakowiak et al., 2008) and is not associated with age (Goldman et al., 2012; Maski & Kothare, 2013).

Sleep disturbance often causes discomfort to both children and their parents and can affect the child's functioning during the day (Stores, 1999). In fact, the less nocturnal sleep children with ASD get, the more serious the symptoms of ASD become. To be more precise, their stereotyped behaviors and social skills deteriorate (Schreck et al., 2004). Moreover, repeated awakenings during the night, difficulties in morning awakening, as well as an increase in the duration of the latent period of sleep are the most commonly reported sleep problems (Patzold et al., 1998; Richdale & Prior, 1995; Williams et al., 2004), which result in a shorter total duration of sleep.

Such anomalies suggest that sleep problems may reflect a circadian rhythm in the everyday neurobehavioral and endocrine functions of the individual (Glickman, 2010). The causes, however, of sleep disorders in people with ASD still remain unclear. According to parental testimonies, night waking is a common characteristic of children with ASD, although its frequency is similar to that of TD children (Richdale & Schreck, 2009). However, long-lasting periods of night waking are extremely unusual, as they generally last two or three hours. During this time the child may simply laugh or utter words, wake up screaming or play with items in the room (Malow et al., 2006; Schreck et al., 2004).

The majority of individuals with ASD will experience sleep disorders at some point in their childhood, particularly under the age of eight (Richdale & Prior, 1995). Usually, the interventions that are applied to the sleep problems of children with ASD are behavior-based approaches. Behavioral interventions help both Typical Developing (TD) children (Mindell et al., 2006) and children with ASD (Hall, 1997) to address particular problems related to the initiation and maintenance of sleep. Studies (Didden et al., 1998; Durand, 2002; Durand & Christodulu, 2004; Weiskop et al., 2001; Weiskop et al., 2005) support the application of behavioral methods in controlling the behavior of an individual who is stressed from sleep deprivation. The role of the family is also important in such programs (Weiskop et al., 2001). However, various other studies suggest medication as a means of reducing disturbed behaviors during sleep, particularly the administration of melatonin (Dogde & Wilson, 2001), which is the hormone that helps regulate the circadian sleep-wake cycle.

2. Methods

2.1 Objectives and Hypotheses Tested

The hypotheses tested were the following: a) Do sleep disorders vary with the presence or absence of autism spectrum disorder? b) Is the age of the individual considered to be an important factor in sleep problems (It was hypothesized that the younger a child was, the higher the rates in individual categories of sleep problem would be. In this light, the sample of the two groups was divided into three age groups.)? c) The survey also aimed to examine the medications taken by different individuals and determine whether they affect sleep or the appearance of disorders in the sample. However, the size of the sample to which medication, to overcome sleep problems, was given was limited (n = 3 in 70 individuals), d) Finally, are there gender differences in sleep disorders?

2.2 Sample

This study included 70 parents, 35 children with ASD and 35 of TD children. Of the total number of children, 72.9% (n = 51 children) were boys and 27.1% (n = 19) were girls. To be precise, the sample of the group with ASD consisted of 27 boys (77.1%) and 8 girls (22.9%), whereas the typical population group consisted of 24 boys (68.6%) and 11 girls (31.4 %). The first part of the questionnaire consisted of seven questions concerning the demographics and other personal information of the groups. The survey involved the parents of children aged 4-14 years. The sample was classified into three age categories. Of the total sample, 18.6% (n = 13 children) were aged 0-5 years, 40% (n = 28) were aged 6-11 years, while 41.4% (n = 29) were 12 years or older. Concerning people on the autism spectrum, the percentages were 17.1% (n = 6) aged 0-5 years, 37.1% (n = 13) aged 6-11 years and 45.7% (n = 16) aged 12 years and over, while the percentages for the typical population group were 20% (n = 7) aged 0-5 years, 42.9% (n = 15) aged 6-11 years and finally 37.1% (n = 13) aged 12 years and above (Table 1).

Table 1. Demographic and other characteristics of the sample

	ASD		TD		Total	
	n	%	n	%	n	%
Sex						
Boys	27	77.1	24	68.6	51	72.9
Girls	8	22.9	11	31.4	19	27.1
Age						
0 to 5	6	17.1	7	20.0	13	18.6
6 to 11	13	37.1	15	42.9	28	40.0
12 and above	16	45.7	13	37.1	29	41.4
Other Conditions						
Yes	1	2.9	3	8.6	4	5.7
No	34	97.1	32	91.4	66	94.3
Taking Medicine						
Yes	5	14.3	3	8.6	8	11.4
No	30	85.7	32	91.4	62	88.6
Taking Medicine about Sleep						
Yes	3	8.6	0	0.0	3	4.3
No	32	91.4	35	100.0	67	95.7

2.3 Measures and Procedures

An anonymous questionnaire was completed by the parents with Likert responses. The questionnaire consisted of three parts: a) demographics, b) the quantity of sleep, and c) behavioral problems in sleeping. The largest part of the questionnaire had been used in previous research (Williams et al., 2004), which was a modified version of the questionnaire study conducted by the Kosair Children's Hospital Sleep Center (Gozal, 1998). Parental participation was voluntary. The children who participated in the survey have been diagnosed with ASD and mild or severe mental disability by State-Approved Evaluation Centers in Greece. The sample of TD did not exhibit any mental disorder or disability and served as the control group.

The questionnaire was distributed to parents with children from both groups, with the aid of the headmasters and teachers of children's school units.

2.4 Statistical Analysis

In order to check the consistency of the means of data collection, a reliability analysis was conducted using Cronbach's α . In order to describe the quantitative variables which were involved in the statistical analysis, use was made of average values (mean), standard deviations (standard deviation = SD), minimum-maximum (min-max), and also the tendencies of the third and fourth moments of distribution (skewness and kurtosis). In the case of qualitative data, the description was made by recording the absolute (f) and the relative frequencies (%). To compare quantitative variables with the extraction of the key findings, Student's hypothesis test was used (independent samples t-test). The influence of categorical data on the formation of continuous variables was examined by means of a two-way ANOVA test at a significance level of $\alpha = 5\%$, while the hypothesis of equality of variances was tested by means of the Levene's test. For the processing and statistical analysis of the data, the software package IBM SPSS Statistics 20 was used.

3. Results

3.1 Characteristics of Quantity of Sleep

Table 2 shows the frequencies and relative frequencies of responses, both for the whole sample and for each of the studied groups separately.

Table 2. Descriptive measures of quantitative characteristics of sleep

	ASD		TD		Total	
	n	%	n	%	n	%
<i>Time that nighttime sleep starts</i>						
7-8	1	2.9	0	0.0	1	1.4
8-9	3	8.6	2	5.7	5	7.1
9-10	14	40.0	14	40.0	28	40.0
10-11	12	34.3	16	45.7	28	40.0
11 or more	5	14.3	3	8.6	8	11.4
<i>Number of hours of nighttime sleep</i>						
6-7	11	31.4	2	5.7	13	18.6
8-9	20	57.1	25	71.4	45	64.3
10-11	4	11.4	8	22.9	12	17.1
<i>Number of hours of daytime sleep</i>						
0	21	60.0	16	45.7	37	52.9
1	5	14.3	7	20.0	12	17.1
2-3	4	11.4	11	31.4	15	21.4
5 or more	5	14.3	1	2.9	6	8.6

The above table shows the results of the parental reports concerning the quantitative characteristics of their children's sleep. More precisely, regarding the question about the time of sleep onset, the largest values are for the periods 9-10 p.m. (40%: n = 14) and 10-11 p.m. (40%: n = 14). For the children in the typical population group, 40% were reported to experience onset of sleep from 9-10 p.m. (n = 14) and 45.7% from 10-11 p.m. (n = 16). For the question concerning the evening hours of sleep, 64.3% of children were reported to get 8-9 hours of sleep (n = 45 children). The parents of children with ASD responded that 31.4% of the children (n = 11) slept around 6-7 hours at night, 57.1% (n = 20) 8-9 hours, while only 11.4% (n = 4) slept 10-11 hours. In response to the same question, 71.4% (n = 25) of the parents of TD children replied that their children slept around 8-9 hours at night, while 5.7% (n = 2) reported that their children slept for 6-7 hours and 22.9% (n = 8) gave a response of 10-11 hours. The third question in Table 2 concerns sleeping time during the day: 52.9% (n = 37) of all respondents reported that their child did not sleep at all during the day, while 21.4% (n = 15) responded that their child slept for 2-3 hours. Regarding the subgroups, the values that concern children with ASD are 14.3% (n = 5), which represents one hour of sleep during the day, while 60% (n = 21) of the children do not sleep at all during the day, 11.4% (n = 4) sleep for 2-3 hours and 14.3% (n = 5) for over 5 hours. Of the TD children, 20% (n = 7) sleep one hour during the day, 31.4% (n = 11) about 2-3 hours, 45.7% (n = 16) do not sleep at all, and only 2.9% (n = 1) sleep for over 5 hours.

3.2 Reliability of the Data Collection Instrument

At the beginning of the study, a reliability analysis was carried out for the part of the questionnaire which outlines the children's sleep disorders that are under examination. In Table 3, Cronbach's α scale records the sleep disturbances both for the total number of children in the sample and for each group separately. Values greater than 0.500 may be considered to ensure the cohesion of the individual components and their behavior as constituent members of a group.

Cronbach's α index was $\alpha = 0.866$ for the whole of the sample, $\alpha = 0.870$ for the children with ASD and $\alpha = 0.820$ for the TD group. The conclusion drawn is that the scale that was used has a high internal validity for the study sample.

3.3 Scale Measuring Sleep Disorders

The table below (Table 3) show the distribution of frequencies and relative frequencies for all the responses that were given for each question separately. These form the scale of sleep disorders in the children that were examined. The answers are presented for children with ASD and TD in Table 3, thus providing a first indication of random variation in their sleep disturbances. In this section we take into account the results based on parents' reports of sleep disturbance occurring "often" or "almost always". This section of the questionnaire included 23 categories of sleep disorder (Williams et al., 2004).

More specifically, 10% ($n = 7$ individuals) of parents feel that their TD and children with ASD is often or almost always restless in its sleep, while 11.4% ($n = 8$) feel that their children has difficulty in falling asleep. 11.4% of the children ($n = 8$) are reluctant to sleep in their own bed, 12.9% ($n = 9$) exhibit numerous awakenings during sleep, while 20% ($n = 14$) often or almost always experience difficulty in awakening in the morning. Cases of enuresis at bedtime amount to 8.6% ($n = 6$). 7.1% ($n = 5$) of parents state that their children seem disoriented for a short time after the morning awakening and as many as 7.1% ($n = 5$) observe that their children often or almost always breathes through the mouth during the day. According to the following categories of disorder mentioned in the questionnaire, 8.6% ($n = 6$) of the children grind their teeth (bruxism) during sleep, 7.1% ($n = 5$) snore, 15.7% ($n = 11$) exhibit fear and anxiety, making it impossible to sleep in the dark, 10% ($n = 7$ individuals) seem to be easily disturbed by noise and wake up, while talking in one's sleep also occurs in 8.6% ($n = 6$). Furthermore, 11.4% ($n = 8$) exhibit difficulty in breathing during sleep, 7.1% ($n = 5$) exhibit self-mutilating behavior (head banging) and 11.4% ($n = 8$) frequently or almost always interrupt their sleep to visit the toilet. Indeed, 10% ($n = 7$) of the children have been observed to fall asleep at school, while a further 10% ($n = 7$) of the children have been reported to wake up suddenly from sleep screaming and shouting. Another 10% ($n = 7$) of the parents' responses indicate that their children often or almost always has nightmares, while 8.5% ($n = 6$) report cries during the night, and 11.4% ($n = 8$) morning headaches. Finally, 10% ($n = 7$) of the children have been observed to sleepwalk.

Table 3. Frequencies and relative frequencies of responses of parents in each question for the TD & ASD group

TD frequencies (%)	Sleep disorders	ASD frequencies (%)
2.9%	Restless sleep	17.2%
2.9%	Difficulty falling asleep	20%
8.6%	Unwillingness to fall asleep in own bed	14.3%
0%	Frequent awakenings	25.7%
25.7%	Difficulty arousing	14.3%
2.9%	Enuresis	14.3%
0%	Disoriented waking	14.3%
5.8%	Daytime mouth breathing	8.6%
8.6%	Bruxism	8.6%
5.8%	Snoring	8.6%
20%	Fear of sleeping in dark	11.5%
5.8%	Awakens to noise	14.3%
0%	Vocalizes in sleep	17.2%
0%	Breathing concerns	20%
0%	Head banging	14.3%
8.6%	Gets up to go to bathroom during night	14.3%
2.9%	Wakes up screaming	17.2%
0%	Falls asleep at school	20%

0%	Nightmares	20%
2.9%	Cries during night	14.3%
2.9%	Morning headaches	20%
0%	Sleepwalking	20%
0%	Apnea	0%

17.2% of the parents with ASD children reported ($n = 6$) that their children exhibited restless sleep, 20% ($n = 7$) that they had difficulty in falling asleep, and 14.3% that they were unwilling to sleep in their own bed. 25.7% of parents ($n = 9$) recorded multiple awakenings during the night, 14.3% reported difficulty in awakening in the morning and 14.3% ($n = 5$) reported cases of enuresis during sleep. Another 14.3% ($n = 5$) reported disorientation after morning awakening, 8.6% ($n = 3$) breathing through the mouth during the day, and 8.6% ($n = 3$) reported that their child ground its teeth while asleep (bruxism). The same percentage (8.6%) reported that their child snored in its sleep. Furthermore, 11.5% of children with ASD ($n = 4$) were reported to be afraid to sleep in the dark, 14.3% ($n = 5$) to wake easily due to noise, while 17.1% ($n = 6$) had been observed to vocalize in sleep while sleeping and 20% ($n = 7$) were reported to experience breathing difficulties while sleeping. Finally, 14.3% ($n = 5$) were reported to exhibit self-mutilating behavior (head banging), 14.3% ($n = 5$) to often or almost always interrupt their sleep to visit the toilet, and 17.1% ($n = 6$) to wake up screaming. 20% ($n = 7$) of the parents stated that their child often or almost always had nightmares. 14.3% ($n = 5$) of the children with ASD were reported to cry at night, 20% ($n = 7$) to experience morning headaches and 20% ($n = 7$) to sleepwalk (Table 3).

Table 3, also, presents, as a separate set of data, the responses of parents with TD children regarding the behaviors of their offspring in their sleep. First of all, it may be observed that the values given by parents with TD children are much lower than those given in the responses of parents of children with ASD. The highest values given in the responses of parents of TD children to questions regarding their children's sleep disorders were as follows: 20% ($n = 7$) of the children were afraid to sleep in the dark and 25.7% ($n = 9$) experienced difficulties in morning awakening, a rate that exceeds the 14.3% ($n = 5$) reported for the group of individuals with ASD.

Table 4 provides a strong indication of a variation between the mean sleep disorder of children with ASD and that of children in the typical development group. The mean value of sleep disorders for children with ASD is $M = 1.978$ with a standard deviation of $S.D. = 0.647$, while the mean value for the TD children is $M = 1.595$ (clearly lower than that for the group of children with ASD), with a standard deviation of $S.D. = 0.396$. Compared with the picture that was obtained by comparing the results of Table 3, relating to each question separately, Table 4 provides a clearer indication of the problems that most children with ASD face compared with those in the TD group.

Table 4. Characteristic values of the scale of Sleep Disorder

Sleep Disorder Scale	M*	SD	Minimum Value/Max Value	Skewness	Kurtosis
Total Sample	1.786	0.567	1.00/4.36	1.577	4.974
ASD	1.978	0.647	1.05/4.36	1.401	4.039
TD	1.595	0.396	1.00/2.91	0.961	2.330

Note. * 1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = almost always.

The average score on the measurement scale for sleep disturbance for the whole sample is equal to $M = 1.786$, which corresponds to statements between "never" and "rarely". The minimum value on the measured scale for the sample under study is 1.00 for the statement "never", while the maximum is 4.36, corresponding to the statements between "often" and "almost always". Table 4 shows the third and fourth moments of the scale that is formed, both for the whole sample and for each group separately. To check if the indication of variation in sleep disturbance between TD and with ASD children is confirmed statistically, $\alpha = 5\%$ was used as a significance

level in the Student's statistical hypothesis tests (independent sample t-tests) that were carried out on independent samples, the results of which are presented in Table 5 below.

Table 5. Checking the case of Student's Hypothesis Test for Sleep Disorders (independent samples T-test)

Factors	Levels	Mean*	SD	df	t	p-value
Group	TD	1.59	0.40	56.325	-2.987	0.004
	ASD	1.98	0.65			

Note. * 1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = almost always.

Note. ** = $p < .05$.

As may be observed, the variation in the sleep disturbance scale between the two groups of TD and with ASD children is shown to be statistically significant at a significance level of $\alpha = 5\%$ with $t(56.325) = -2.987$ and $p - \text{value} = 0.004$.

3.4 Effects of Demographic Data

Next, the relationship between the rate of sleep disturbance for TD and with ASD children and demographics (gender, age) were examined. To verify the existence or not of a statistically significant dependence between the factors under study, two models of ANOVA (two-way ANOVA) were used with the global sleep disorders scale as the response and the gender and age of the children in the study group as independent variables. Table 6 shows the results of the ANOVA tests for each factor.

Table 6. Analysis of variation in factors (two-way ANOVA) gender and class studies

Factors	Df	F	p-value
Sleep Disorder			
Constant	1	571.366	0.000*
Group	1	4.597	0.036*
Gender	1	2.183	0.144
Group x gender	1	0.664	0.418
Error	66		
Sleep Disorder			
Constant	1	677.209	0.000*
Group	1	7.729	0.007*
Age	1	0.494	0.613
Group x age	1	1.801	0.173
Error	64		

Note. * = $p < .05$.

The first model that was applied included the following factors: the group to which each child belonged, its gender and its interaction. As is shown in the first part of the table above, at a significance level of $\alpha = 5\%$, only the effect of the group (TD or ASD) to which the child belonged ($p - \text{value} = 0,036$) is statistically significant,

something which is to be expected from the analysis so far, while there is no variation in sleep disorders between boys and girls (p – value = 0.144). The interaction of gender and group does not prove to be statistically significant at the same significance level (p – value = 0.418), which suggests that the degree of sleep disturbance does not vary in each group separately, according to the gender of the child. Similar conclusions can be drawn from the second half of Table 6, for the model with the sleep disorder scale as a dependent variable and the group to which each child belonged, its age and the interaction between the two as factors. The response, at the level of significance $\alpha = 5\%$, is statistically and significantly affected by whether the child has ASD or not (p – value = 0.007) but not by its age (p – value = 0.613). Also, at the same level of significance, the interaction of the two variables does not prove to be statistically significant (p – value = 0.173), which suggests that the degree of sleep disturbance does not vary in any group individually, neither in accordance with the age of the child.

4. Discussion

According to the analysis that was performed, a statistically significant difference ($p < 0.05$) emerges between the reports of parents with children with ASD and those with TD children, based on the measurement of sleep disturbance. Similar studies have highlighted the existence of sleep disorders in children with ASD, as well as differences in the incidence rates of sleep problems among typical development children and children with ASD or other developmental delays (Goodlin-Jones et al., 2008; Krakowiak et al., 2008; Patzold et al., 1998; Richdale & Prior, 1995).

In the present study, the gender and age of the children did not seem to affect the existence of behaviors related to sleep disorders. Regarding age, other surveys have concluded that at some stage in childhood, especially under the age of 8, the majority of children with ASD will experience sleep problems (Richdale & Prior, 1995), while other studies did not find a correlation between sleep problems and age (Goldman et al., 2012). Thus, the results of the surveys conducted so far are contradictory. In this study, although the two samples (ASD and TD) were divided into three distinct age groups (up to 5 years, 6-11 years and 12 years and over), the analysis was restricted to drawing a comparison between the two samples overall. Therefore, it should be stressed that no analysis for each age group was conducted separately.

Some of the most common sleep disorders in this research (multiple night awakenings, difficulty in falling asleep and difficulty in breathing during sleep) are acknowledged by international research (Krakowiak et al., 2008; Williams et al., 2004). At this point, it is worth noting that the results of the present survey indicate a statistically significant difference between the two samples; however, on the basis of the results, it may be concluded that there is no significant difference between the categories of sleep disorder, which occur at varying rates, ranging from 8.6% to 25.7%. Therefore, the rates shown in the sample of individuals with ASD are statistically significant when compared to the sample of TD individuals; however, when compared individually, some of the rates are shown to be on a smaller scale, showing a relative divergence from those in the literature base, although this does not affect the percentage of the overall result, which is produced by the responses to all of the questions together.

The greatest variation between TD and with ASD children was recorded in the multiple night awakenings category, in which 1/4 of the children with ASD observed by parents woke up more than once during the night. In a survey by Williams et al. (2004) the rate was close to 33%. The rates recorded in the other categories amounted to percentages of 20% or less. To be more precise, significant percentages consisted of parasomnic behaviors, with sleepwalking and nightmares reaching rates of 20% in the sample of children with ASD. These percentages, though higher than those for other disorders, are in line with the findings of Schreck and Mulick (2000) and contrast with the low percentages yielded by the studies of Patzold et al. (1998) and Williams et al. (2004).

As for the percentages of disorders in TD children, these ranged from 0% to 25.7%. Among TD children, a percentage was formed by those children experiencing difficulty in morning awakenings, while another percentage consisted of children who were afraid to sleep in a dark room. Also, the percentages formed by the numbers of TD children experiencing difficulty in starting and maintaining sleep—2.9% and 0%, respectively—were regarded as negligible in contrast to the figures suggested by the bibliography, where it is estimated that about 1/3 of children, mainly of preschool age, exhibit night-time awakenings (Ferber, 1995). To conclude, with regard to the findings for the TD children, attention may be drawn to the figure of 8.6% for the percentage of children exhibiting unwillingness to sleep in their own bed (co-sleeping), a behavior that found to be more frequent in previous research than the percentage obtained in this study indicates. The corresponding

percentage for children with ASD (14.3%) was also lower in the present study than the percentages produced by other studies. Intervention programs (Howlin, 1984; Moore, 2004; Reed et al., 2009; Weiskop et al., 2005) are intended to eliminate such behaviors in individuals with ASD. To draw an overall conclusion for the test sample, it may be stated that the parents of TD children believe that their offspring do not experience any disorders that might impair their sleep.

Continuing with the percentages of disorders in individuals with ASD, it may be observed that a percentage of 17.2% ($n = 6$), according to the parents' reports, exhibit restless sleep. The presence of restless sleep is emphasized in sleep evaluation surveys as being a common symptom among the population with ASD (Williams et al., 2004). More specifically, the percentage is 40% and restless sleep is recognized as being the second most common disruptive behavior in children with ASD with respect to sleep. Furthermore, according to the present study, the disorder most frequently reported by the parents of children with ASD occurred in 1 of 4 children with ASD, while according to Krakowiak et al. (2008), the proportion is as high as 1 in 2. Also, 1 in 3 TD children (32%) have at least one problematic sleeping behavior (Krakowiak et al., 2008), while in the present study the sleep problem most frequently reported by the parents of TD children occurs in only 1 in 4 TD children. In the sample of the 35 individuals with ASD, there was no statistically significant number of children receiving medication for sleep problems that might provide a clearer understanding of sleep behaviors during periods of medication.

Considering the age of the children who took part in the survey, larger percentages (11.4% of children with ASD and 20% of TD children) were expected in categories such as those in which children experience fear and refuse to sleep without the existence of a light in their room. Equally small proportions of children with ASD, compared with those in the bibliography, emerge in other categories, such as snoring, the grinding of teeth and systematic inhaling and exhaling through the mouth, where no proportion exceeds 10%. However, a significant proportion of children with ASD 1 in 5 were found to fall asleep at school, either in the "often" or "almost always" category, a proportion that is substantially greater than the approx. 5% found in a similar survey (Williams et al., 2004). As for the percentages obtained for the 23 categories in the sample with ASD tested in this study, conclusions were also drawn in the other categories, with approx. 1 in 5 children—7 individuals with ASD having been observed to mumble in their sleep, either often or almost always, and a similarly high percentage of children—approx. 15% displaying self-mutilating behavior in their sleep. Equally percentages—20% and 14.3% respectively—are formed by the numbers of children with daytime headaches and disoriented morning awakenings, in which children with ASD may appear to be disoriented for a short while after waking.

Concerning the quantitative characteristics of sleep, children with ASD, despite the fact that they displayed a statistically significant difference in the types of sleeping behaviors that were analyzed above, appear to show no differences in the quantity of their sleep. 3 out of 4 children with ASD begin their evening sleep between 9 and 11 p.m., the time at which 80% of TD children retire to bed, while only 14.3% of the population with ASD sleep after 11 p.m. Furthermore, the hours of evening and daily sleep are considered normal and similar to those of TD children. More specifically, 57.1% of the sample with ASD sleep between 8 and 9 hours at night, which corresponds to the percentage arrived at by Williams et al. (2004), while 60% of the ASD sample do not sleep at all during the day. However, a significant proportion of the ASD population—14.3% is shown to sleep unusually long hours—5 or more during the day, when for TD children the same percentage is only 2.9%.

Regarding the limitations, the survey based on parents reports without taking into consideration references from major faces of the children's environment such as doctors, teachers, psychologists who involved with the care and education of children. Furthermore, it is important to stress the fact that the survey was based on the objectivity of parents that take part in and their ability to observe and evaluate the quantity and quality characteristics of sleep behaviours of their children without being, previously, educated in the identification and assessment of distractive sleep behaviors. Significant restriction was also the limited sample which consisted of 70 children aged 4-14 years old.

The above restrictions could be the occasion for further research in order to study thoroughly the childhood sleep disorders in children with ASD and draw safer conclusions. Finally, educating parents on observation, evaluation and treatment of any sleep disorders of their children could contribute to a more objective measurement of sleep problems in children with ASD.

References

- American Academy of Sleep Medicine. (2005). *International classification of sleep disorders* (2nd ed.). Westchester IL, American Academy of Sleep Medicine.
- American Psychiatric Association. (2013). *Diagnostic and Statistical Manual for Mental Disorders* (5th ed.). American Psychiatric Association, Washington, D.C.
- Atkinson, R. L., Atkinson, R. C., Smith, E. E., Bem, D. J., & Nolen-Hoeksema, S. (2000). *Hilgard's introduction to psychology*. Harcourt Brace Jovanovich, New York.
- Borbély, A. A. (1982a). Sleep regulation: Circadian rhythm and homeostasis. In D. Ganten, & D. Pfaff (Eds.), *Current topics in neuroendocrinology. Vol. 1: Sleep. Clinical and experimental aspects* (pp. 83-103). Springer-Verlag, Berlin.
- Borbély, A. A., Achermann, P., Trachsel, L., & Tobler, I. (1989). Sleep initiation and initial sleep intensity: Interactions of homeostatic and circadian mechanisms. *Journal of Biological Rhythms*, 4, 149-160. <https://dx.doi.org/10.1177/074873048900400205>
- Diden, R., Curfs, L. M. G., Simone, P. E., Sikkema, S. P. E., & de Moor, J. (1998). Functional assessment and treatment of sleeping problems with developmentally disabled children: Six case studies. *Journal of Behavior Therapy and Experimental Psychiatry*, 29, 85-97. [https://dx.doi.org/10.1016/S0005-7916\(97\)00038-4](https://dx.doi.org/10.1016/S0005-7916(97)00038-4)
- Dodge, N. N., & Wilson, G. A. (2001). Melatonin for Treatment of Sleep Disorders in Children with Developmental Disabilities. *Journal of Child Neurology*, 16(8), 581-584. <https://dx.doi.org/10.1177/088307380101600808>
- Durand, M. V. (2002). Treating Sleep Terrors in Children with Autism. *Journal of Positive Behavior Interventions*, 4(2), 66-72. <https://dx.doi.org/10.1177/109830070200400201>
- Durand, M. V., & Christodulu, K. V. (2004). Description of a Sleep-Restriction Program to Reduce Bedtime Disturbances and Night Waking. *Journal of Positive Behavior Interventions*, 6(2), 83-91. <https://dx.doi.org/10.1177/10983007040060020301>
- Ferber, R. (1995). Childhood Sleep Disorders. *Neurologic Clinics*, 14(3), 493-511. [https://dx.doi.org/10.1016/S0733-8619\(05\)70271-1](https://dx.doi.org/10.1016/S0733-8619(05)70271-1)
- Glickman, G. (2010). Circadian rhythms and sleep in children with autism. *Neuroscience and Biobehavioral Reviews*, 34, 755-768. <https://dx.doi.org/10.1016/j.neubiorev.2009.11.017>
- Goodlin-Jones, B. L., Sitnick, S. L., Tang, K., Liu, J., & Anders, T. (2008). The Children's Sleep Habits Questionnaire in toddlers and preschool children. *Journal of Development Behavior Pediatrics*, 29(2), 82-88. <https://dx.doi.org/10.1097/DBP.0b013e318163c39a>
- Goldman, S. E., Richdale, A. L., Clemons, T., & Malow, B. A. (2012). Parental sleep concerns in autism spectrum disorders: Variations from childhood to adolescence. *Journal of Autism and Developmental Disorders*, 42, 531-538. <https://dx.doi.org/10.1007/s10803-011-1270-5>
- Gozal, D. (1998). Sleep-disordered breathing and school performance in children. *Pediatrics*, 102, 616-620. <https://dx.doi.org/10.1542/peds.102.3.616>
- Hall, L. (1997). Effective behavioural strategies for the defining characteristics of autism. *Behaviour Change*, 14(3), 139-154. <https://dx.doi.org/10.1017/S0813483900003442>
- Howlin, P. (1984). A brief reform on the elimination of long term sleep problems in a year old autistic boy. *Behavioural Psychotherapy*, 12, 257-260. <https://dx.doi.org/10.1017/S014134730001082X>
- Johnson, K. P., Giannotti, F., & Cortesi, F. (2009). Sleep Patterns in autism spectrum disorders. *Child Adolescence Psychiatry Clinical N. Ann*, 18(4), 917-928. <https://dx.doi.org/10.1016/j.chc.2009.04.001>
- Krakowiak, P., Goodlin-Jones, B., Hertz-Picciotto, I., Croen, L. A., & Hansen, R. L. (2008). Sleep problems in children with autism spectrum disorders, developmental delays, and typical development: A population-based study. *Journal of Sleep Research*, 17, 197-206. <https://dx.doi.org/10.1111/j.1365-2869.2008.00650.x>

- Malow, B. A., Marzec, M. L., McGrew, S. G., Wang, L., Henderson, L. M., & Stone, W. L. (2006). Characterizing Sleep in Children with Autism Spectrum Disorders: A Multidimensional Approach. *Sleep in Children with Autism*, 29(12), 1563-1571.
- Maski, K. P., & Kothare, S. V. (2013). Sleep deprivation and neurobehavioral functioning in children. *International Journal of Psychophysiology*, 89, 259-264. <https://dx.doi.org/10.1016/j.ijpsycho.2013.06.019>
- Mindel, J., Kuh, B., Leei, D. S., & Sadeh A. (2006). Behavioral Treatment of Bedtime Problems and Night Wakings in Infants and Young Children. *Pediatric Sleep*, 29(10), 1263-1276.
- Moore, P. S. (2004). The use of social stories in a psychology service for children with learning disabilities: A case study of a sleep problem. *British Journal of Learning Disabilities*, 32(3), 133-138. <https://dx.doi.org/10.1111/j.1468-3156.2004.00278.x>
- Patzold, L., Richdale, A. L., & Tonge, B. (1998). An investigation into sleep characteristics of children with autism and Asperger's disorder. *Journal of Paediatrics and Child Health*, 34, 528-533. <https://dx.doi.org/10.1046/j.1440-1754.1998.00291.x>
- Polimeni, M. A., Richdale, A. L., & Francis, A. J. P. (2005). A survey of sleep problems in autism, Asperger's disorder and typically developing children. *Journal of Intellectual Disability Research*, 49(4), 260-268. <https://dx.doi.org/10.1111/j.1365-2788.2005.00642.x>
- Reed, H. E., McGrew, S. G., Artibee, K., Surdkya, K., Goldman, S. E., Frank, K., & Malow, B. A. (2009). Parent-based sleep education workshops in autism. *Journal of Child Neurology*, 24(8), 936-945. <https://dx.doi.org/10.1177/0883073808331348>
- Richdale, A. L. (1999). Sleep problems in autism: Prevalence, cause and intervention. *Developmental Medicine and Child Neurology*, 41, 60-66. <https://dx.doi.org/10.1017/S0012162299000122>
- Richdale, A. L., & Prior, M. R. (1995). The sleep-wake rhythm in children with autism. *European Child and Adolescent Psychiatry*, 4(3), 175-186. <https://dx.doi.org/10.1007/BF01980456>
- Richdale, A. L., & Schreck, K. A. (2009). Sleep problems in autism spectrum disorders: Prevalence, nature, & possible biopsychosocial aetiologies. *Sleep Medicine Reviews*, 13, 403-411. <https://dx.doi.org/10.1016/j.smr.2009.02.003>
- Schreck, K. A., & Mulick, J. A. (2000). Parental reports of sleep problems in autism. *Journal of Autism and Developmental Disorders*, 30, 127-135. <https://dx.doi.org/10.1023/A:1005407622050>
- Schreck, K. A., Mulick, J. A., & Smith, A. F. (2004). Sleep problems as possible predictors of intensified symptoms of autism. *Research in Developmental Disabilities*, 25, 57-66. <https://dx.doi.org/10.1016/j.ridd.2003.04.007>
- Society of Neuroscience. (1996). *What do we know on Brain: An Alphabet for Brain and Nervous System* (pp. 30-31). Kastanioti Plc, Athens.
- Stores, G. (1999). Children's sleep disorders: Modern approaches, developmental effects, and children at special risk. *Developmental Medicine & Child Neurology*, 41, 568-573. <https://dx.doi.org/10.1017/S001216229900119X>
- Weiskop, S., Matthews, J., & Richdale, A. (2001). Treatment of sleep problems in a 5-year-old boy with autism using behavioural principles. *Autism*, 5(2), 209-222. <https://dx.doi.org/10.1177/1362361301005002009>
- Weiskop, S., Richdale, A., & Matthews, J. (2005). Behavioural treatment to reduce sleep problems in children with autism or fragile X syndrome. *Developmental Medicine and Child Neurology*, 47, 94-104. <https://dx.doi.org/10.1017/S0012162205000186>
- Williams, P. G., Sears, L. L., & Allard, A. (2004). Sleep problems in children with autism. *Journal of Sleep Research*, 13, 265-268. <https://dx.doi.org/10.1111/j.1365-2869.2004.00405.x>

Copyrights

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).