Journal of Intellectual Disability Research

VOLUME 49 PART 4 pp 260–268 APRIL 2005

A survey of sleep problems in autism, Asperger's disorder and typically developing children

M. A. Polimeni, A. L. Richdale & A. J. P. Francis

Psychology & Disability Studies, School of Health Sciences, RMIT University, Bundoora, Australia

Based on Parental Questionnaires

Abstract

Background Sleep problems are common in typically developing (TD) children and in children with autism, however, less is known about the sleep of children with Asperger's disorder (AD). The aim of this study was to compare sleep patterns of children with autism and AD to a TD group of children.

Methods Sixty-six parents of TD children, 53 parents of children with autism, and 52 parents of children with AD completed a survey on their child's sleep patterns, the nature and severity of any sleep problems and success of any treatment attempted.

Results The results showed high prevalence of sleep problems with significantly more problems reported in the autism and AD groups (TD = 50%, autism = 73%, AD = 73%), with no significant differences between groups on severity or type of sleep problem. Children with AD were significantly more likely to be sluggish and disoriented after waking and had a higher Behavioral Evaluation of Disorders of Sleep (BEDS) total score compared to the other two groups. The autism and AD groups reported significantly better treatment success for medication compared to the TD group. The autism group reported significantly better success for behavioural treatment compared to the AD group.

Conclusions In conclusion, children with AD may have more symptoms of sleep disturbance, and different types of sleep problems than children with autism. As this is the first study to compare autism and AD and to survey treatment outcomes, further research is needed to validate these findings.

Keywords Asperger's disorder, autism, behavioural treatment, children, medication, sleep problem

Introduction

Autism and Asperger's disorder (AD) are pervasive developmental disorders involving both deviance and delay in social development and behaviour. In autism, language and communication development are also deviant and delayed, whereas in AD the history of language development is normal, although pragmatics remains an area of difficulty. About 75% of children with autism have a cognitive delay whereas children with AD do not (American Psychiatric Association 2000). In autism, a common additional difficulty is the high prevalence of sleep problems, but there is little information concerning sleep in AD (Richdale 2001).

Correspondence: Melinda Polimeni, Psychology & Disability Studies, School of Health Sciences, RMIT University, PO Box 71, Bundoora, Victoria, Australia, 3083 (e-mail: s9809728@student.rmit.edu.au).

Sleep problems are common during childhood, particularly in younger children and in children with developmental disabilities (DDs). As well as causing the parent and child significant distress at bedtime and during the night, sleep problems can also impact significantly on the daytime functioning of the child (Stores 2001), including behavioural disturbances, drowsiness, and learning problems (Sheldon 2001; Paavonen *et al.* 2002).

Prevalence rates for sleep problems in children with a DD vary from 13% to 86% (Didden & Sigafoos 2001) and are significantly higher than those found in typically developing (TD) children (Richdale *et al.* 2000). The most common sleep problems occurring in all children are difficulties initiating and maintaining sleep (Didden & Sigafoos 2001; Sheldon 2001). Sleep problems have been found to persist for long periods in both TD children (Smedje *et al.* 2001) and children with a DD (Quine 1991; Richdale *et al.* 2000).

Children with autism exhibit among the highest rates of sleep problems (Richdale 1999); on average two-thirds of these children experience sleep difficulties (Richdale 2001). Sleep problems include irregularity in sleep–wake patterns, night and early morning waking, and behavioural problems at bedtime, including unusual bedtime routines and settling difficulties (Richdale 2001). Rates of sleep problems differ from that in age- and IQ-matched control children (Patzold *et al.* 1998). Additionally, studies suggest that rapid eye movement (REM) sleep abnormalities are present in some children with autism, although this requires further exploration (Richdale 2001). Despite the high rate of sleep difficulties in autism, treatment studies remain rare (Schreck & Mulick 2000).

Less is known about sleep in children with AD, but evidence suggests there is also a high rate of sleeping difficulties, some of which may differ from those found in autism (Richdale 2001). Patzold *et al.* (1998) found that a small group of children with AD had qualitatively similar sleep patterns to the children with autism. However, other research indicates that individuals with AD may have specific sleep problems not typically seen in those with autism including increased Stage 1 sleep, absence of dreaming and periodic limb movements (Bergeron *et al.* 1997; Godbout *et al.* 1998; Godbout *et al.* 2000). Kleine-Levin syndrome, which consists of recurring periods of hypersomnia, behavioural and mood disturbance, has also been reported in two case studies of adolescent males with AD (Berthier *et al.* 1992). Given that all studies contained less than 10 individuals with AD and many of the individuals were adolescents or adults, further conclusions about sleep in children with AD and any similarities or differences with autism cannot be drawn. Treatment for sleep problems in either group remains largely unexplored.

The aim of this study was to compare sleep patterns in AD, autism, and TD children. A second aim was to explore treatments used for sleep problems and examine treatment outcomes in these groups. It was predicted that children with autism and with AD would exhibit a greater frequency and severity of sleep problems compared to the TD group; that sleep problems in AD would differ from those in the autism and TD groups; and that TD children would report better treatment outcomes than children with AD or autism.

Method

Participants

TD children were recruited by general advertisement placed in a local newspaper and around RMIT University campuses via notice boards and newsletters. Children with autism and AD were recruited through a range of associations for children with these disabilities in Victoria, Queensland, South Australia and Tasmania. Sixty-six parents of TD children, 53 parents of children with autism, and 52 parents of children with AD completed and returned the survey. Children's diagnoses were reported by parents.

Materials

The sleep survey contained questions requiring parents to tick the relevant box or write a brief statement. The survey was similar to one recently reported by Robinson & Richdale (2004). The survey contained questions regarding child demographics including age, diagnosis, gender, and current medication. Three questions pertained to child sleep patterns including average hours of sleep per night, sleep location, and whether the parent believed their child had a sleep problem (yes/no). If parents answered yes to this question, they were asked to respond to a further six questions regarding type of sleep problem (set-

tling, night waking, early morning waking), severity (mild, moderate or severe), duration of sleep problem, whether their own sleep was disturbed because of the child's sleep problem (yes/no) and whether their child had been formally diagnosed with a sleep disorder. Parents also listed any treatments they had sought to remedy their child's sleep problem, and rated the success of the treatment on a 7-cm visual analogue scale anchored with the statements *Not very successful* and *Very successful*.

Parents also completed the Behavioral Evaluation of Disorders of Sleep (BEDS) (Schreck *et al.* 2003) which is designed to evaluate sleep patterns and sleep problems in children. Data are also available for children with autism (Schreck & Mulick 2000). The BEDS yields four factor scores: Factor 1 (expressive sleep disturbance) refers to observable behaviours of sleep disturbance such as screaming during sleep, and sleep walking; Factor 2 (sensitivity to the environment) refers to environmental factors which may be contributing to sleep problems; Factor 3 (disoriented awakening) relates to the child being sluggish or disoriented when they wake; and Factor 4 (Apnea/Bruxism) refers to difficulty breathing during sleep and teeth grinding. A fifth factor relating to sleep facilitators and referring to whether a child needs medication or pacifier to fall asleep, was eliminated from the final scale, but may be useful for children with a disability and was therefore included in the analyses. A total sleep problem score can also be calculated.

Procedure

The study was approved by the RMIT University Human Research Ethics Committee. All advertisements asked for parents of children aged 2 years and older to volunteer to complete a survey on sleep patterns. The survey was either attached to, or advertised in the regular newsletter of State autism and AD associations, and TD parents responded to advertisements placed on University campuses and in a local newspaper, therefore return rates could not be calculated. Parents responding to an advertisement were mailed a survey to be returned to the first author (MP) via mail.

Data analysis

All categorical data from the survey were examined using chi-square analysis. Analysis of variance procedures with Tukey-Kramer post hoc tests were employed to examine noncategorical data. A small amount of data were missing, and this varied for each item of the survey. Therefore, percentages reported and statistical analyses are based on the number of participants who responded to the relevant item.

Results

The TD group consisted of 39 males and 27 females, the autism group consisted of 41 males and 12 females and the AD group consisted of 42 males and eight females. The TD group had a significantly higher proportion of females compared to the autism and AD groups [χ^2 (N = 169) = 9.82, P = 0.007]. A single factor between subjects analysis of variance revealed that there was a significant difference in age between the groups, with the AD group being significantly older than both the TD group and the autism group (Table 1). Therefore, in the remaining analy-

Table 1 Descriptive statistics for age and hours sleep per night across groups

	TD (n = 66)	Autism (n = 53)	AD (n = 52)
Mean age (years)	6.0 (3.1) Range = 2–11	6.5 (2.7) Range = 2–16	9.3* (3.1) Range = 4–17
Mean hours sleep per night	9.3 (1.8) Range = 6–13	8.9 (1.5) Range = 5–11.5	8.9 (1.4) Range = 5–11.5

*Statistically significant difference, P < 0.001.
TD, typically developing; AD, Asperger's disorder.

ses, age was entered as a covariate and was not found to contribute significantly to any of the results.

Sleep characteristics and sleep problems

No differences were found between the groups on hours sleep per night (Table 1). Fifty per cent of the parents in the TD group reported that their child had some kind of sleep problem compared with 73% in both the autism and AD groups. This difference was significant, with the TD group reporting significantly fewer sleep problems than the other two groups [χ^2 (N = 171) = 9.618, P = 0.018]. There was no significant difference between the groups regarding the number of sleep problems reported, with all three groups reporting 1.2 sleep problems on average. There were no differences in severity ratings of sleep problems between the groups (Table 2). Of the parents who reported their child had a sleep problem in the TD group, 65% (n = 21) reported that their own sleep was disturbed because of their child's sleep problem compared to 80% (n = 29) and 68% (n = 26) in the autism and AD groups, respectively.

Table 2 Parent percentage severity ratings of their child's sleep problem

	Sleep problem severity		
Group	**Mild**	**Moderate**	**Severe**
TD	23% (n = 7)	42% (n = 14)	30% (n = 9)
Autism	22% (n = 8)	57% (n = 22)	17% (n = 6)
AD	25% (n = 9)	39.5% (n = 15)	33% (n = 12)

TD, typically developing; AD, Asperger's disorder.

There were no significant differences between the groups on this item. There was no relationship between whether parent sleep was being disrupted and severity ratings.

The parents in the AD group reported longer duration of sleep problems than the other two groups, however, there was no significant difference between the groups on duration of sleep problems after age was controlled for. There was no significant difference between the groups on settling problems, night waking, early morning waking problems or cosleeping (Table 3).

There was a significant difference between the three groups on the disoriented waking factor of the BEDS [F (2, 77) = 4.145, P = 0.020]. Post hoc tests revealed that the AD group had significantly higher scores on this factor than the TD group. This indicates that the AD group was more likely to be sluggish, have slow reactions and speech, and to be disoriented upon waking. There were no significant group differences for the other BEDS factors. Nevertheless, the TD group had the lowest average scores on all BEDS factors. There was a significant difference between the groups on the BEDS total score [F (2, 81) = 6.305, P = 0.003]. Post hoc tests indicated that the AD group had significantly higher BEDS total scores than both the TD and the autism groups. This indicates higher overall symptoms of sleep disturbance in the AD group. Table 4 shows descriptive statistics for BEDS factors and total BEDS score across the three groups. Means of BEDS factors for each group were compared to BEDS normative data. For BEDS factors 1, 2 and 3 means for the TD and autism groups indicated normal levels of sleep disturbances, whilst the means for the AD group indicated mild sleep disturbance on these three factors. For factor 4, the TD and AD group means were within

Table 3 Percentage of parents reporting settling, night waking, early morning waking, and cosleeping across the groups.

	Sleep problem			
Group	**Settling**	**Night waking**	**Early morning waking**	**Cosleeping**
TD	72% (n = 26)	53% (n = 19)	14% (n = 5)	25% (n = 12)
Autism	69% (n = 27)	51% (n = 20)	38.5% (n = 15)	29% (n = 9)
AD	68% (n = 32)	45% (n = 21)	25.5% (n = 12)	36% (n = 5)

TD, typically developing; AD, Asperger's disorder.

Table 4 Means and standard deviations of normative scores, BEDS factor scores and BEDS total scores across the three groups

	TD ($n = 37$)	Autism ($n = 29$)	AD ($n = 14$)	Norms
Factor 1: EA	3.78 (5.41) normal	4.48 (5.9) normal	7.84 (6.54) mild	1.57 (3.39)
Factor 2: SE	5.71 (4.04) normal	6.53 (5.49) normal	8.38 (4.70) mild	4.31 (3.84)
Factor 3: DA	4.47 (3.69) normal	6.1 (4.29) normal	8.07 (4.40)* mild	4.15 (3.28)
Factor 4: AB	1.39 (1.92) mild	1.89 (1.8) moderate	1.07 (1.7) mild	0.22 (0.74)
Factor 5: SF	1.07 (2.52) mild	1.62 (2.49) mild	2.38 (3.3) moderate	0.13 (0.85)
BEDS Total	73.48 (30.11) normal	79.53 (38.78) normal	116.85 (51.75)** moderate	59 (28.23)

EA, expressive awakening; SE, sensitivity to the environment; DA, disoriented waking; AB, apnea/bruxism; SF, sleep facilitators.
*statistically significant difference $P < 0.05$, **statistically significant difference $P < 0.01$; TD, typically developing; AD, Asperger's disorder; BEDS, Behavioral Evaluation of Disorders of Sleep.
Normal = within 1 standard deviation of normative mean; mild = more than 1 standard deviation above normative mean; moderate = more than 2 standard deviations above normative mean; severe = more than 3 standard deviations above normative mean.

the normal range, whereas the autism group mean indicated moderate levels of sleep disturbance. For factor 5, means for both the TD and autism groups showed mild levels of sleep disturbance, while the mean for the AD group indicated moderate degrees of sleep disturbance. For BEDS total score, means for TD and autism groups were within the normal range, however, the score for the AD group was within the moderate range of sleep disturbance.

Current medication

Table 5 lists the number of children taking different types of medication across the three groups. There was a significant difference regarding the number of medications taken by children in each group, with the autism and AD groups taking significantly more medication than the TD group [F (2, 168) = 11.81, $P < 0.001$]. Taking medication was not associated with the presence of a sleep problem in any of the three groups.

Treatment outcomes for sleep problems

Overall 34.7% ($n = 42$) of parents had sought treatment to alleviate their child's sleep problem. Treatments fell into four categories: behavioural intervention, medication, herbal treatment, and a mixed group of other treatments. The percentage of parents in each clinical group seeking one of these first three treatments for their child's sleep, and the average success ratings reported by parents (where 0 cm = no success and 7 cm = high success) are listed in Table 6.

There were no differences between groups regarding whether parents had sought treatment or not (Table 6). Of those parents who had sought treatment, 29% of parents in the TD group, 17.4% of parents in the autism group, and 38.9% of parents in the AD group had attempted some other kind of treatment (besides behavioural, medication or herbal) for their child's sleep problem. These other treatments included chiropractic treatment ($n = 1$), aromatherapy ($n = 5$), restricted diet ($n = 1$) and biofeedback ($n = 1$). Because of the variety of other treatments and the small numbers, the success ratings of these other treatments were not analysed separately, however, the average success ratings of these treatments was 1.5 (SD = 1.6). Of the parents who indicated that their child had a sleep problem, 87% of parents in the TD group indicated that they would be interested in participating in a treatment program for their child's sleep problem, compared to 78% of parents in the autism group and 77% of parents in

Table 5 Current medication taken by children across the three groups

Drug	TD ($n = 66$)	Autism ($n = 53$)	AD ($n = 52$)	Total
Dextroamphetamine[a]	1	5	9	15
Methylphenidate[a]	0	0	4	4
Fluoxetine hydrochloride[b]	1	2	2	5
Fluvoxamine[b]	0	1	0	1
Setraline[b]	0	0	2	2
Paroxetine[b]	0	0	1	1
Amitriptyline[c]	0	2	1	3
Clomipramine[c]	0	1	0	1
Resperidone[d]	0	1	0	1
Diazepam[e]	0	0	1	1
Carbamazepine[f]	0	1	2	3
Baclofen[g]	0	0	1	1
Clonidine[h]	0	2	6	8
Promethazine[i]	0	2	0	2
Melatonin[j]	0	2	1	3
Dietary supplements	1	2	2	5
Other	4	3	3	10

[a]Central nervous system stimulant; [b]Antidpressant-Selective Serotonin Re-uptake Inhibitor (SSRI); [c]Antidepressant-Tricyclic (TCA); [d]Atypical antipsychotic; [e]Benzodiazepine; [f]Anticonvulsant; [g]Muscle relaxant; [h]Hypotensive; [i]Antihistamine; [j]Chronobiotic.
TD, typically developing; AD, Asperger's disorder.

Table 6 Interventions attempted and their average success ratings across groups

	Treatment						
	Behavioural		Medication		Herbal		
Group	Attempted	Success (cm)	Attempted	Success (cm)	Attempted	Success (cm)	Never sought
TD	21% ($n = 7$)	2.0 (Range = 0–4)	60% ($n = 20$)	1.54 (Range = 0–6)	6% ($n = 2$)	1.0 (Range = 0–2)	39% ($n = 13$)
autism	28% ($n = 11$)	3.1 (Range = 0–7)	50% ($n = 19$)	3.95 (Range = 0–7)	15% ($n = 6$)	2.40 (Range = 0–7)	50% ($n = 19$)
AD	37% ($n = 14$)	1.2 (Range = 0–4.5)	43% ($n = 16$)	3.96 (Range = 0–7)	32% ($n = 12$)	1.30 (Range = 0–5.5)	29% ($n = 11$)

TD, typically developing; AD, Asperger's disorder.

the AD group. The differences between the groups for this item were not significant.

Behavioural intervention was reported to be significantly more successful in the autism group than in the AD group [F (2, 32) = 3.978, $P = 0.029$]. Medication was rated as more successful by parents in the autism group and the AD group than by parents in the TD group [F (2, 39) = 5.045, $P = 0.011$]. The TD group were taking significantly more promethazine (a nonprescription antihistamine) [$\chi^2(N = 118) = 26.273, P = 0.003$]. This suggests that medication may be more effective for treating sleep problems in children with autism and AD than in children who are TD. Medications taken by children

Table 7 Previous Medication taken by children across the three groups to treat sleep problems

Drug	TD ($n = 35$)	Autism ($n = 40$)	AD ($n = 46$)
Clonidine[h]	2	4	8
Promethazine[i]	11	3	4
Trimeprazine[i]	5	5	0
Melatonin[j]	0	3	1
Other	2	2	2
Total	20	15	15

[h]Hypotensive; [i]Antihistamine; [j]Chronobiotic.
TD, typically developing; AD, Asperger's disorder.

across the three groups in an attempt to alleviate sleep problems are reported in Table 7. There were no significant differences between groups on parent ratings of success of herbal treatment.

Discussion

The major aim of this study was to compare sleep patterns of children with autism and AD to TD children. The hypothesis that children with autism and AD would have more sleep problems than TD children was supported with 73% of parents in the autism and AD groups reporting that their child had a sleep problem, compared to 50% in the TD group. However, it is also clear from these figures that sleep problems were highly prevalent in all three groups. The hypothesis that children with autism and AD would have significantly more severe sleep problems than the TD group, as rated by parents, was not supported. There were no statistically significant differences between severity ratings among the groups, with the autism group tending to have fewer children with sleep problems rated as severe. This finding is interesting given that the AD group were found to have significantly higher symptoms of sleep disturbance as indicated by the BEDS total score and more disoriented waking, compared to the other two groups.

Although there were no differences between the groups on duration of sleep problems, there was a higher proportion of older children in the AD group. It is possible that this is because of a sampling bias. However, this may also be because of children with AD being diagnosed later than children with autism. As children with AD do not have language or cognitive delays, a diagnosis may not be made until the child is older (American Psychiatric Association 2000; Gillberg 2002). Alternatively, this result may be because sleep problems in children with AD persist into late childhood and early adolescence. Further research should examine these possibilities by investigating sleep problems in individuals with AD at different ages (cross-sectional) and across the lifespan (longitudinal).

The hypothesis that TD children would report better treatment outcomes than children with autism and AD was not supported. Medication was rated as being significantly more successful in the autism and AD groups than in the TD group. This result may be because of the children with autism and AD more often taking clonidine than TD children who almost all took promethazine (phenergan) or trimeprazine (vallergan). These nonprescription medications do not require the supervision of a doctor and therefore may not be used appropriately by parents. Promethazine and trimeprazine can also produce paradoxical effects in many children (Owens *et al.* 2003), which may have contributed to lower treatment success ratings. These findings reflect those reported by Owens *et al.* (2003) who found that the use of both prescription and nonprescription medication to treat sleep problems was a relatively common practice. Owens *et al.* (2003) also found that pervasive developmental disorders was one of the top five conditions for which paediatricians prescribe medication for children's sleep problems. However, few of these medications have any empirical evidence, or clinical guidelines, for use in paediatric populations.

For attempted behavioural intervention, there were no differences between the TD, autism and AD groups, however, behavioural intervention was reported to be significantly more successful for the autism children than the AD children. This may be because of the children in the autism group being younger on average than children in the AD group. It may be that behavioural programs and applied behaviour analysis are most beneficial for children at younger ages. Therefore, the autism group may have benefited more from behavioural intervention for sleep than the AD group. Parents of children with autism may also be more experienced at conducting

behavioural intervention, resulting in behavioural treatments for sleep problems being reported as more successful in the autism group. Another explanation for this finding is that children with autism may have sleep problems that are more amenable to behavioural intervention.

It may also be that the sleep problems seen in children with AD are different to those seen in autism. The AD group had significantly higher scores on the Disoriented Waking factor of the BEDS, indicating that the AD group is more sluggish, have slower reactions and speech after waking, and can be disoriented on waking. Children with AD also had significantly higher BEDS total scores. These results may be because of the excessive daytime sleepiness associated with Kleine-Levin syndrome which has been reported in adolescents with AD (Berthier *et al.* 1992). Another reason for this result may be related to older children in the AD group. Daytime sleepiness has been found to increase during adolescence because of a delayed sleep phase pattern that occurs during this period (Kahn *et al.* 1996; Thorleifsdottir *et al.* 2002).

However, children with AD have also been found to have a number of abnormalities in sleep patterns including disturbances to REM sleep, longer sleep latencies, more night waking, increased stage 1 sleep (light sleep) and less slow wave sleep (deep sleep) (Bergeron *et al.* 1997; Godbout *et al.* 1998). These factors could also contribute to children with AD feeling less rested and sleepy when woken in the morning, as they may be experiencing poorer sleep quality. These factors would also contribute to children with AD having generally more disturbances to their sleep, which may account for higher BEDS total scores. Future research should further explore these findings.

Overall, although there was a very high prevalence of sleep problems reported across the groups, many parents had never sought treatment. This may be because of the belief that children grow out of sleep problems, or that sleep problems are caused by the child's disability and therefore cannot be treated. The majority of parents of TD children with a sleep problem indicated that they would be interested in taking part in a treatment program for their child's sleep problem (87%). This was lower for the autism and AD groups with about 75% of parents in each group expressing interest in such a program. This difference may be because of parents of children with autism or AD being less concerned with sleep problems compared to other behavioural or learning problems that their child may have.

There are a number of limitations associated with collecting self-report survey data. For example, the relatively high prevalence of sleep problems obtained could potentially reflect a sampling bias. Although we advertised for participants to complete a survey on children's sleep patterns and not sleep problems per se, it is possible that parents who had a child with a sleep problem were more likely to complete the survey, resulting in an over-estimation of the prevalence of sleep problems in this sample. However, similar prevalence rates have been reported previously in children with autism (Johnson 1996; Richdale 2001). Nonetheless, there is no reason to suspect that there was any systematic bias within the obtained sample which would preclude valid comparisons being made across the three participant groups as to the nature and severity of sleep problems, or treatment success. The high prevalence rates reported in the current sample allow more confident statistical comparisons of children's sleep to be made than might have otherwise been possible with lower rates of sleep problems. Future studies utilizing rigorous population sampling methods are indicated to further clarify the epidemiology of sleep problems in these groups.

It was not possible to confirm the diagnoses of the children and the number of AD children for whom there was BEDS data was relatively small. There was also a lack of detail about the treatments attempted such as dosage of medication, type of behavioural intervention or type of herbal treatment undertaken. Nevertheless, there is a lack of data examining and contrasting sleep patterns and treatment outcomes in these groups, and these preliminary data provide valuable information on sleep problems as well as treatment outcomes.

In conclusion sleep problems were common in these children who were TD or who had an autism spectrum disorder. Results indicate that children with AD have sleep problems that are more resistant to behavioural treatment, and they have more disoriented waking and more symptoms of sleep disturbance compared to children with autism and TD children. As this is the first study to survey treatment outcomes for sleep problems in these populations,

further research should examine the differences in sleep patterns between children with AD and autism, and evaluate the effectiveness of currently used treatments for sleep problems.

References

American Psychiatric Association (2000) *Diagnostic and Statistical Manual of Mental Disorders*, 4th Edn. text revision. Author, Washington DC.

Bergeron C., Godbout R., Mottron L. & Stop E. (1997) Sleep and dreaming in Asperger's syndrome. *Sleep Research* **26**, 541.

Berthier M. L., Santamaria J., Encabo H. & Tolosa E. S. (1992) Recurrent hypersomnia in two adolescent males with Asperger's syndrome. *Journal of the American Academy of Child and Adolescent Psychiatry* **31**, 735–8.

Didden R. & Sigafoos J. (2001) A review of the nature and treatment of sleep disorders in individuals with developmental disabilities. *Research in Developmental Disabilities* **22**, 255–72.

Gillberg C. (2002) *A Guide to Asperger's Syndrome*. Cambridge University Press, Cambridge.

Godbout R., Bergeron C., Limonges E., Stip E. & Mottron L. (2000) A laboratory study of sleep in Asperger's syndrome. *Neuroreport* **11**, 127–30.

Godbout R., Bergeron C., Stip E. & Mottron L. (1998) A laboratory study of sleep and dreaming in a case of Asperger's syndrome. *Dreaming* **8**, 75–88.

Johnson C. R. (1996) Sleep problems in children with mental retardation and autism. *Sleep Disorders* **5**, 673–83.

Kahn A., Dan B., Grosswasser J., Franco P. & Sottiaux M. (1996) Normal sleep architecture in infants and young children. *Journal of Clinical Neuropsychology* **13**, 184–97.

Owens J. A., Rosen C. L. & Mindell J. A. (2003) Medication use in the treatment of pediatric insomnia: results of a survey of community-based pediatricians. *Pediatrics* **111**, 628–35.

Paavonen E. J., Almqvist F., Tamminen T., Moilanen J., Piha J., Rasanen E. & Aronen E. T. (2002) Poor sleep and psychiatric symptoms at school: an epidemiological study. *European Child and Adolescent Psychiatry* **11**, 10–7.

Patzold L., Richdale A. & Tonge B. (1998) An investigation into sleep characteristics of children with autism and Asperger's disorder. *Journal of Paediatrics and Child Health* **34**, 528–33.

Quine L. (1991) Sleep problems in children with metal handicap. *Journal of Mental Deficiency Research* **35**, 269–90.

Richdale A. (1999) Sleep problems in autism: prevalence, cause and intervention. *Developmental Medicine and Child Neurology* **41**, 60–6.

Richdale A. L. (2001) Sleep in autism and Asperger's syndrome. In: *Sleep Disturbance in Children and Adolescents with Disorders of Development: Its Significance and Management* (eds G. Stores & L. Wiggs), pp. 181–191. Mac Keith Press, London.

Richdale A., Gavidia-Payne S., Francis A. & Cotton S. (2000) Stress, behaviour, and sleep problems in children with an intellectual disability. *Journal of Intellectual and Developmental Disability* **25**, 147–61.

Robinson A. M. & Richdale A. L. (2004) Sleep problems in children with an intellectual disability: parental perceptions of sleep problems, and views of treatment outcomes. *Child Care, Health and Development* **30**, 139–50.

Schreck K. A. & Mulick J. A. (2000) Parental reports of sleep problems in autism. *Journal of Autism and Developmental Disorders* **30**, 127–35.

Schreck K. A., Mulick J. A. & Rojan J. (2003) Development of the behavioral evaluation of disorders of sleep. *Journal of Child and Family Studies* **12**, 349–59.

Sheldon S. H. (2001) Insomnia in children. *Current Treatment Options in Neurology* **3**, 37–50.

Smedje H., Broman J. E. & Hetta J. (2001) Short-term prospective study of sleep disturbances in 5–8-year-old children. *Acta Paediatrica* **90**, 1456–63.

Stores G. (2001) *A Clinical Guide to Sleep Disorders in Children and Adolescents*. Cambridge University Press, Cambridge.

Thorleifsdottir B., Bjornsson J. K., Benediktsdottir B., Gislason T. & Kristbjarnarson H. (2002) Sleep and sleep habits from childhood to young adulthood over a 10-year-period. *Journal of Psychosomatic Research* **53**, 529–37.

Accepted 16 March 2004