

Sleep disorders in children with Angelman syndrome: Parental concerns and priorities

Angelman syndrome is a rare genetic syndrome, in which sleep disturbances are reported for 20 to 80% of individuals (Williams et al., 2006). This interview study delineated parental perceptions of sleep problems experienced by children with Angelman syndrome and the impact on parental sleep quality, health and wellbeing. The nature of desired interventions was also explored. Semi-structured interviews were completed with parents of 50 children, aged 16 months to 15 years with Angelman syndrome who experienced current or historic sleep problems; predominantly night waking and settling problems. Parents were concerned by the impact of their child's sleep quality upon their own ability to function during the day. The importance of considering parental experiences was evidenced by variability in coping e.g. despite the persistence of sleep problems 20% of parents did not feel the need for any additional support. Amongst a range of types of further support desired, 27% cited further support with a behavioural intervention, and information about the trajectory of sleep problems in Angelman syndrome (18%). The results suggest that behavioural interventions supporting both children and parents in improving their sleep quality and well-being, and longitudinal research into sleep problems should be prioritised.

1. Introduction

A recent review of studies of children with intellectual disabilities with a range of aetiologies reported prevalence rates of sleep disturbances ranging from 54% to 99%, (Tietze, et al. 2012), which is higher than the prevalence rate of approximately 25% reported for typically developing school aged children (Owens, 2007). A recent meta-analysis showed that average total sleep time for individuals with intellectual disabilities is 23 minutes shorter than that of typically developing individuals, and that 93% of individuals with an intellectual disability have poorer sleep quality according to proxy reported or directly assessed sleep

quality (Anonymised for peer review, in review). Emerging literature suggests that the nature of sleep disorder in people with intellectual disability is associated with the aetiology of intellectual disability.

One example of a known genetic aetiology associated sleep disturbances is Angelman syndrome; caused by abnormality in the expression of the UBE3A gene on the 15q11.2-q13 chromosome (Peters et al., 2004). Angelman syndrome affects between 1 in 10,000 and 1 in 40,000 individuals (Clayton-Smith & Laan, 2003). The physical and behavioural features consistently associated with Angelman syndrome include: ataxic gait, increased smiling and repetitive arm movements and limited or non-existent use of verbal language (Williams, 2005). Other characteristics present in over 80% of individuals include microcephaly, seizures, and abnormal EEG (Williams, 2005).

1.1. Sleep in children with Angelman syndrome

Diagnostic clinical criteria for Angelman syndrome indicates sleep disturbances are an associated feature of Angelman syndrome; affecting between 20 to 80% of individuals (Williams et al., 2006). Studies using parental report have demonstrated that children with Angelman syndrome experience poorer quality sleep than their typically developing peers, with significantly reduced total duration of sleep, higher number of night-wakings and a longer sleep-onset time (Bruni et al., 2004). Prevalence rates for night waking range from 49% to 100% of children, with a decrease in waking observed with increasing age (Pelc, Cheron, Boyd & Bernard, 2008). When quantifying the severity of night waking to three or more times a week and lasting over several minutes, the prevalence was 37% of individuals aged 3-44 years (Didden, Korzilius, Smits, & Curfs 2004). The prevalence of settling problems across studies was wide, ranging from 2-91% (Bruni et al., 2004; Didden et al., 2004; Pelc, et al., 2008; Summers, Allison, Lynch, & Sandier 1995; Walz, Beebe, Byar &

Dykens, 2005). The wide ranging prevalence rates of sleep problems based upon questionnaires may be attributed to the lack of a standardised definition of sleep disturbance. From a clinical perspective, it is important to capture information on sleep problems without assumptions about the likely impact of problems or the priorities of carers. For example, despite a reduced total sleep time to an average five to six hours in children with Angelman syndrome (Clayton-Smith, 1993, as cited in Pelc, et al., 2008), daytime sleepiness is reported for between 14 and 25% of children only (Bruni et al., 2004; Walz, Beebe, Byar & Dykens, 2005). Based on these findings, children may not necessarily have decreased daytime alertness as a result of their impaired nocturnal sleep. However, all these studies have relied upon questionnaire measures, and have not considered parents' perspectives of the impact of children's sleep quality on their broader daily functioning. As a) the reported prevalence rates of daytime sleepiness are much lower than those for sleep disturbance in AS, and b) few studies have examined the impact of children's sleep disturbance on daytime functioning, further research is needed to infer whether children with AS experience "sleep debt", according to parent report which could impact negatively on children's functioning during the day. A bottom up approach could be used to explore both parents' perceived severity of the impact of the children's sleep quality upon children and the nature of the impact of children's sleep quality upon parents.

Understanding parents' perspectives on the impact of sleep problems on the child is important, as the consequences of sleep debt for children with AS may not be recorded as daytime sleepiness when operationalised by sleep questionnaires. In addition, questionnaire studies do not take into account parents' perceptions of whether of sleep disturbances are perceived as problematic and the impact that they may have upon children. The identification

of parents' perception of impact of sleep quality upon children could also be compared to parents' perceived impact of children's sleep quality upon parents themselves.

1.2 Impact of children's sleep disturbance upon parents

The relationship between poorer sleep quality in children with Angelman syndrome and detrimental effects on parents have been identified in two studies. Longer sleep latency onset for the children (longer time taken to fall asleep once in bed) was associated with more symptoms of insomnia and higher levels of daytime sleepiness for parents (Goldman, Bichell, Surdyka, & Malow, 2012). The frequency and duration of night-time waking in children with Angelman syndrome has also been associated with disturbed sleep for their mothers (Burrow, 2007).

More broadly 47% of parents of children with intellectual disabilities have reported daytime fatigue and 28% reported experiencing irritability as a result of their child's sleep disturbances (Didden, Korzilius, van Aperlo, van Overloop, & de Vries, 2002). However, whilst in one study parents have indicated that their own sleep has been disrupted as a result of their child's sleep, 42% of these parents did not consider their child to have a sleep problem (Robinson & Richdale, 2004). A similar discrepancy was found by Didden et al. (2002) where 35% of parents whose child met the criteria for a severe sleep problem on a questionnaire did not report their child to have a sleep problem. No studies have compared the severity of the impact of children's sleep disturbance in families of children with Angelman syndrome to families of children with intellectual disabilities of heterogeneous origin, or the relationship between the perception of the presence of a sleep problem and the impact upon families of children with Angelman syndrome specifically. Robinson & Richdale (2004) found that children with a profound level of intellectual disability were significantly more likely to experience sleep problems (63.6%) compared with children with

moderate and mild levels of intellectual disability, where rates of sleep disturbances are reported as 30.4% and 33.9% respectively. Subsequently sleep disturbances experienced by children with a profound intellectual disability were reported as more stressful for parents than sleep disturbances experienced by children with mild and moderate levels of intellectual disability (Richdale & Baker, 2014).

The disparity between both parental perception of the presence of sleep problems and the acknowledgement of their impact upon parents (e.g. Didden et al., 2002; Robinson & Richdale, 2004) calls for reflection upon the agenda of research into sleep in children with Angelman syndrome, to ensure that it appropriately captures families' experiences. It is important to consider parents' perspectives of the degree of disturbance they experience as a result of their child's sleep, and to be able to quantify this impact in relation to parents' identification of whether or not they consider their child with Angelman syndrome to have a sleep problem.

1.3 Interventions used by families

A study involving caregivers of 103 children and adults with Angelman revealed only 33% of families had received support for their child's sleep disturbance (Didden et al., 2004). Pharmacological interventions were most often reported (23%), followed by education (11%) and psychological interventions such as behavioural interventions (6%). However, psychological interventions, whilst advised the least frequently, were the most effective according to caregivers (43% rated as effective versus 24% for sleep medication). Whilst this study included a large sample of families, it is important to understand the types of interventions that families currently use with children more specifically and then what further support parents would like from professionals with regard to managing their child's sleep problems. In addition to understanding current and desired input and strategies for sleep that

parents use, parents' perceived acceptability of an intervention is an important consideration for researchers and clinicians when developing suitable interventions with good compliance rates. Two studies researching parents' opinions of interventions for sleep in children neurodevelopmental disorders found that the majority of parents preferred a behavioural intervention, or rated it as more satisfactory, as opposed to a pharmacological intervention, but parents did not differ in their perceived acceptability between the use of a behavioural intervention versus the use of melatonin (Keenan, Wild, McArthur, & Espie, 2007; Robinson & Richdale, 2004). Understanding parents' current strategies and desired input to improve their child's sleep, and their experiences of the efficacy of different strategies will ensure that appropriate support is accessible to parents, suitably meets their expectations and is within their capabilities to increase feasibility of its successful implementation (Stores, 2014).

1.4 Using suitable methodology to understand families' concerns and priorities for addressing their child's sleep disturbance

It is particularly important to ensure that parent's concerns are represented in the literature in addition to the categorisation of sleep disorders according to predefined clinically useful criteria through questionnaire studies (Britten, 1995). Given the research suggesting the wide ranging impact of sleep problems on children with intellectual disabilities and their families, to ensure that support for families is targeted, a hierarchy of the most problematic aspects of their child's sleep quality could be established. The only interview study to date identifying a hierarchy of concerns of parents of children with intellectual disabilities revealed parents were significantly more concerned about the detrimental impact of sleep disturbance on their child over the impact on the rest of the family when comparing visual analogue scales of severity (Cotton & Richdale, 2006).

The current research study provides a novel approach to studying sleep quality in children with Angelman syndrome using structured interviews with parents, enabling a bottom-up approach to describing children's quality, its impact and the management strategies that parents use. Capturing the specific concerns of parents using a structured interview would ensure that the rationale for the development of interventions at a later date to improve sleep outcomes for children with Angelman syndrome is parent-led, which is imperative, as no research into parents' opinions on the strategies they currently use and what additional support they might need has yet been conducted.

This interview used a combination of interviewer selected codes from a pre-determined list during the interview and post-interview development of new codes to ensure that data were appropriately coded. This study was designed to provide an innovative approach to generating data whilst ensuring that the interview was concise and standardised across multiple interviewers for data to be gathered in a large sample of parents or carers of children with Angelman syndrome. The study had the following aims:

1. To describe the nature of sleep problems considered most problematic for parents
2. To explore the impact of children's sleep quality on both children and the rest of the family and to identify a hierarchy of the most stressful impact of children's sleep
3. To describe management strategies used by parents and parent reported efficacy
4. To explore the priorities parents have for future support

2. Method:

2.1. Participants

Parents attending the Foundation for Angelman Syndrome Therapeutics Conference in Chicago were invited to an interview about their child's sleep. Parents were sent information about the study via the Foundation prior to the conference. Fifty parents/

caregivers of children aged 16 months to 15 years (30 females, 20 males), with a mean age of 7.02 years ($SD= 4.00$ years) completed an interview. Night-time care was shared by two caregivers for 30 families and one family indicated that the mother had primary responsibility for night-time care (19 missing responses). Overnight respite care was currently received by seven families. One family had previously been in receipt of respite care. Number of nights of respite ranged from two nights a year to four times per month. The majority of families were resident in the USA (82%), but other countries of residence included the United Kingdom, Canada, Gibraltar and Australia.

2.2. Measures

The structured interview schedule was developed through a series of pilot interviews with parents of children with disabilities (five families with a child with Tuberous Sclerosis Complex, two with autism spectrum disorder). The interview was refined to ensure that it was possible to complete in approximately 20 minutes. Interviewers asked the questions in the same order, although if parents provided information related to a later question the parents' answer was noted under the relevant question section. The interview schedule covered parents' description of any perceived sleep problems that their child may currently have or had experienced previously (if no current sleep problem), and what factors may contribute to increased or reduced sleep quality. This question was open ended, and the interviewers were instructed not to provide parents with pre-identified codes to ensure that only sleep disturbances that parents perceived as problematic were stated. More detailed questions about settling difficulties, night waking and parental response to these behaviours were also included. These included the direct closed questions of whether or not their child woke during the night or had difficulty settling to sleep. The interview was also concerned with parents' perceived impact of any sleep problems on their child and the rest of family- using open questions, to rank the most stressful impacts of their child's sleep quality and what

strategies parents had tried to improve their child's sleep and what their priorities were for the future (open question). For most questions, parents could endorse more than one response. The interview used open questions predominantly and the interviewer took notes throughout the interview. Either a five point Likert score was used by parents or the interviewer selected a predetermined code (e.g. for impact upon parents question, predetermined codes included: stress, sleep deprivation, relationship difficulties, daytime fatigue, problems coping at work, affecting physical health and difficulty concentrating whilst driving). For questions without predefined categories or if the parents' answer did not match any of the predetermined codes new codes were developed to generate data (see section 2.4). Additional elements were also included after pilot (specifically questions about respite, impact on child and a 5 point Likert rating scale for impact of sleep on children and the rest of the family). See supplementary material for interview schedule questions.

2.3. Procedure

Interviews were conducted with families attending the Foundation for Angelman Syndrome Therapeutics Conference in Chicago. Families with a child with or without a perceived sleep problem were invited to take part. For some interviews, both parents were present. In these cases, the parent determined as the primary caregiver was identified at the start of the interview. For the question about the impact on partner, if present, the partner responded to this question, otherwise primary caregivers only responded. Interview data were assigned pre-defined codes on the interview response sheet by the interviewer. Due to the number of parents interviewed, seven interviewers were needed, including the primary author. The six additional interviewers received training in the delivery of the interview and all had previous experience of conducting interviews. The interview data were entered into a

survey host then exported to the Statistical Package for the Social Sciences version 22.¹ This study received approval from Science, Technology, Engineering and Mathematical ethical review committee at the (anonymised for peer review).

2.4. Analysis:

Directed content analysis (Hsieh & Shannon, 2005) was used, whereby a flexible approach to data analysis permitted predetermined codes for questions to be developed from the literature to facilitate quantitative analysis of data. Codes were assigned to the data by the interviewer during the course of the interview and new codes for data that did not fit predetermined codes were developed once data were collated. Two questions: what strategies parents used and what support parents received with their child's sleep quality, did not have any predetermined codes and codes were derived after the data were collated. A frequency analysis of the parent's primary concerns based upon the ranking determined by the interviewer with the parent was conducted to identify the 'most stressful or most difficult aspect of their child's sleep'. A frequency analysis was conducted with the parent's single priority for change and on all of the helpful and unhelpful strategies to identify the number of parents who had endorsed each strategy.

2.4.1. Agreement:

The percentage of inter-interviewer agreement of coding with the primary author was established using audio recordings for a minimum of 20% of each of six other researchers' interviews². The mean raw positive agreement value for 17 questions with pre-defined categories was 35% (range .0-100%) and 86% for raw negative agreement (range 0-100%);

¹ Due to the limited availability of the interviews, some interviews were entered by the primary author with help from audio recordings where answers were missing or handwriting was illegible. Where notes were made but no category was selected for a question, the primary author selected the category considered most appropriate. Where notes indicated an inappropriate code was selected by the interviewer e.g. if the answer cuddling child was given in response to the question 'What is your response to night waking' but was written in the resettling without engagement box, the code was changed to resettling child with engagement.

² Due to missing recordings inter-rater reliability only 11% of the interviews for the sixth interviewer were re-coded by the primary author.

positive agreement occurred when the original interviewer and the primary author assigned of the same code to the data, and due to the possibility of selecting multiple codes, negative agreement was used to assess whether the original interviewer and the primary author agreed that a code was not applicable to the data. An independent researcher coded the initial data to check reliability further with the codes developed and assigned by the primary author. Where disagreement occurred a consensus on the most appropriate code name or assignment was reached by discussion between the primary author and the independent researcher.

3. Results:

3.1. The nature of sleep problems considered most problematic for parents

The sample included children with current sleep problems (45 families) and only historic problems (5 families). To address the first aim, to describe the nature of sleep problems, the number of times each sleep problem was reported was calculated. The data reported in Table 1 reveal that the most reported current sleep problems according to parents included night-time waking followed by settling problems. The majority of sleep problems were reported to be present from birth or develop within the first two years of the child's life. When stratified by age, the frequency of current parent reported night waking problems (to include only wakes when ill and awake all night) was 77% for children aged three years and under, 73% for children aged 4-11 years and 71% for children aged 12 to 15 years.

Table 1

Number of children stratified by age with sleep problems indicated by parents

	Aged 16 months to three n=13		Aged 4-11 years n=30		Aged 12- 15 years n=7		Total n (%)	
	C	H	C	H	C	H	Current	Historic
Waking	9	1	20	7	5	1	34 (68)	9 (18)
Only wakes when ill	0	0	2	0	0	0	2 (4)	0 (0)
(Waking then) awake all night	1	0	0	1	0	0	1 (2)	2 (1)
Settling	6	0	9	2	3	3	18 (36)	5 (10)
Decreased sleep duration	2	0	6	3	0	2	8 (16)	5 (10)
Early morning waking	1	0	3	0	0	0	4 (8)	0 (0)
Sleep association with parents/co-sleeping	1	1	2	0	1	1	4 (8)	2 (4)
Bedtime resistance	0	0	2	0	1	0	3 (6)	0 (0)
Escaping house	0	0	0	1	0	0	0 (0)	1 (2)
Toileting issues	0	0	2	0	0	0	2 (4)	0 (0)
Parasomnias	0	0	1	0	1	0	2 (4)	0 (0)
Sleep apnoea	0	0	1	0	0	0	1 (2)	0 (0)
New environments/noise sensitivity	3	0	1	0	1	0	5 (10)	0 (0)
Daytime sleepiness	1	0	0	0	0	0	1 (2)	0 (0)
Any reported sleep problem	13	1	27	3	6	1	45 (90)	5 (10)

C: Current problem H: Historic problem

When asked directly, 94 % of parents indicated that their child woke or had woken during the night historically. Most children (54% n=27) usually only woke once in the night, but 30% of children (n=15) woke three or more times during the night. The data in Table 2 demonstrate that the most commonly reported reason for waking was due to discomfort such as needing their pad changed, or being hungry or thirsty, but also that parents were often unsure as to what has caused their child to wake.

Table 2

Parent perception of reason for waking

Reason for waking	Number of families N=50
	% (n)
Discomfort	34 (17)
Unknown reason	22 (11)
Seizures	18 (9)
Environmental noise/light levels	16 (8)
Pain/medical reason	14 (7)
Parent attention/play	12 (6)
Myoclonic jerk	6 (3)
Assumed part of Angelman syndrome condition	4 (2)

When asked directly if their child was reluctant to get into bed or settle to sleep, 56% of parents (n=28) agreed. The most commonly reported problems were tantrums such as crying or whining (22% of total sample of 50 families) and at least one form of challenging behaviour to include aggression, destructive behaviour and self-injury (22%, n=11).

3.2.1. Impact of child's sleep quality upon the child

A frequency analysis was conducted on the coded data to address the second aim of the study; exploring the impact of child's sleep quality upon the child, primary caregiver and partner. Eighty percent of families indicated that their child's sleep problems had at some point impacted upon their child (n=40). Daytime sleepiness was the most commonly reported

impact (52% of parents, n=26), followed by behaviour problems (33%, n= 17) and difficulty coping at school (36%, n=18) and physical health being affected (26%, n=13).

3.2.2. Impact of child's sleep quality upon primary caregiver and partner

Ninety four percent (n=47) of primary caregivers indicated that their child's sleep problems had at some point impacted upon themselves. As can be seen in Figure 1, these impacts included daytime fatigue and sleep deprivation, the most commonly reported impacts by 70% (n= 35) and 64% (n=32) of primary caregivers respectively, followed by stress (58%, n=29), and difficulties coping at work (42%, n= 21). Seventy-eight percent of respondents indicated that their child's sleep quality impacted upon the rest of the family, to include partners (n=39). Figure 1 shows that partners most commonly reported stress, irritability or mental health problems as a result of their child's sleep problems (30%, n=15), followed by sleep deprivation and fatigue (both 32%, n=16).

Forty two percent of parents monitored their child at night, the most frequently cited reason was to monitor their child's medical condition (seizures, oxygen and glucose levels, 24% of total number of families, n=12), followed by checking whether their child was asleep (24%, n=12) and whether child needs toileting or was uncomfortable (14%, n=7). The act of monitoring their child at night impacted upon the sleep of 22% (n=11) of parents and 8% (n=4) of the children's sleep.

[Insert figure 1 about here]

3.2.3. Overall aspect of their child's quality that is the most stressful for parents

To address the final aspect of the second aim of the study, exploring parents' perception of the most stressful or most difficult aspect of their child's sleep quality, the impacts rated as most stressful were collated to derive a percentage of the total sample.

The most stressful impact was the effect upon parents (42% of parents, n=21) followed by the impact upon their child's health and functioning (18%, n=9) and child's behaviour (18%, n=9). Eight percent of parents (n=4) stated that the unpredictability of their child's sleeping patterns or uncertainty over what was causing the sleep problem (8%, n=4) was the most stressful, whilst 4% (n=2) of parents stated that they had no concerns about the impact of their child's sleep quality, and 2% (1 parent) stated that unhelpful responses from doctors were the most stressful. Parents indicated a significantly higher impact rating of their child's sleep quality for themselves as caregivers (mean= 3.32, SD 1.28) compared with for their children (mean = 2.87, SD= 1.22) on 5 point Likert scale, $Z=-2.51$, $p=.012$.

3.3 Description of strategies used by parents and parent reported efficacy

3.3.1 In response to night waking

In order to address the first aspect of the third aim of the study; parents' response to night waking, the frequency of use of each response was reported. Parents indicated that 72% (n=36) of children called out or cried to let parents know that they were awake and then demanded parents' attention or wanted to play with toys that required parents' input (68%, n=34).

The majority of parents (70 %, n=35) resettled their child with engagement, i.e. gave the child attention in response to their waking. Parents also ensured that children's pads were changed if necessary and retrieved a misplaced dummy or bottle. Fewer parents had tried ignoring (18%, n=9) or resettling their child whilst minimising the attention given to them (16%, n=8).

3.3.2 In response to bedtime resistance

Parents would often give children attention in an attempt to settle them to sleep e.g. by lying in bed with children (n=21) or reduce attention or engagement (n=7).

3.3.3 Range of and parent perceived efficacy of strategies

Where multiple medications were taken in combination with melatonin, the helpfulness of the total drug combination was presented, as certain drugs, particularly anti-epilepsy drugs, may impact upon sleep quality and somnolence (Shvarts & Chung, 2013). The majority (68%, n=34) of parents had tried both medication and behavioural techniques to improve their child's sleep quality. Eight percent of parents (n=4) had only tried medication to improve their child's sleep, whilst 10% (n=5) used medication in combination with improving the environment or other options (see Table 4) compared with 6% (n=3) who had used solely behavioural interventions. Four percent of parents (n=2) stated that they had tried both improving the environment and behavioural techniques, whilst one parent stated that they had only tried improving the child's sleeping environment. One family reported using no strategies to support their child's sleep. Table 4 shows a breakdown of parents' opinions of specific strategies in each category.

Table 4

Strategies used and parental perceived efficiency

	n used	Helpful	Not helpful- % (n)	Inconsistent/unsure	Only helpful
	% of total sample (n)	% (n) of parents who used strategy	of parents who used strategy	% (n) of parents who used strategy	to fall asleep
Melatonin only (1)*	30 (15)	80 (12)	20 (3)	0	0
Melatonin combination†	46 (23)	57 (13)	17 (4)	9 (2)	17 (4)
Trazadone + clonidine	2 (1)	Trazadone	0	Clonidine	0
Epilome	2 (1)	100 (1)	0	0	0
Clonazepam + levetiracetam	2 (1)	Levetiracetam	Clonazepam	0	0
Medications Clonidine	2 (1)	100 (1)	0	0	0
Timed ignoring/reducing attention	12 (6)	67 (4)	33 (2)	0	0
Giving child attention	12 (6)	50 (3)	50 (3)	0	0

		N used	Helpful	Not helpful- % (n)	Inconsistent/unsure	Only helpful
		% of total sample (n)	% (n) of parents who used strategy	of parents who used strategy	% (n) of parents who used strategy	to fall asleep
Behavioural strategies	Giving child attention helpful but now reliant for sleep	6 (3)	100 (3)	0	0	0
	Routine (2)*	36 (18)	94 (17)	6 (1)	0	0
	Delayed bedtime	4 (2)	100 (2)	0	0	0
	Use of pressure	8 (4)	50 (2)	25 (1)	25 (1)	0
	Increasing child's communicative ability	2 (1)	100 (1)	0	0	0
	Behaviour plan helpful but not feasible	2 (1)	100 (1)	0	0	0
	Sleep association with object- now reliant for sleep	2 (1)	100 (1)	0	0	0
	Ensuring child is hydrated or fed	6 (3)	67(2)	0	33 (1)	0
	Transition to own room	2 (1)	100 (1)	0	0	0
	Sleeping in parent's room	2 (1)	100 (1)	0	0	0

		N used	Helpful	Not helpful- % (n)	Inconsistent/unsure	Only helpful
		% of total sample (n)	% (n) of parents who used strategy	of parents who used strategy	% (n) of parents who used strategy	to fall asleep
Improving environment	Increasing daytime activity levels	4 (2)	50 (1)	50 (1)	0	0
	Measures to keep child safe (5)*	4 (2)	50 (1)	50 (1)	0	0
	White noise/noise (2)*	20 (10)	100 (10)	0	0	0
	Improving comfort (5)*	0	0	0	0	0
	Weighted blanket (2)*	6 (3)	100 (3)	0	0	0
	Reducing stimulation in the bedroom (2)*	2 (1)	100 (1)		0	0
	Bath salts/essential oil massage (1)*	2 (1)	0	100 (1)	0	0
	Door no longer locked	2 (1)	100 (1)	0	0	0
Other	Gluten free diet (1)*	2 (1)	100 (1)	0	0	0
	Low glycemic diet	2 (1)	100 (1)	0	0	0

Note. * Numbers in parentheses represent responses with missing perception of efficacy. Drug names included in efficacy columns if different perception of efficacy was reported for drugs in a drug combination.

† Melatonin combination= Melatonin in combination with a range of drugs to include: Diazepam, topiramate, gabapentin, passiflora, trazadone, ziprasidone, clorazepate, levetiracetam, natural sources of melatonin, antihistamine, clonidine, 5HTP, lansoprazole, risperidone, benodiazapine (unspecified), promethazine, paracetamol and codeine combination

3.3.3.1 Medication

From Table 4 it can be noted that the majority of families (78%, n=39) used melatonin alone or in combination with another medication to improve children's sleep quality. Parents had mixed opinions of the efficacy of melatonin to improve their child's overall sleep quality, 66% of families (n=25) who used it found melatonin helpful alone or in combination versus 18% of families (n=7) finding it not helpful, only helpful for child to fall asleep as opposed to reducing night wakings (11%, n=4) or unsure if helpful (5%, n=2).

3.3.3.2. Behavioural strategies and improving the environment

It can be noted that parents differed as to whether they found giving attention as a helpful strategy (three families, or 50% of those who used it) versus unhelpful or now as a contingency for sleep onset (three families). The antithetic strategy of ignoring the child or limiting attention at night also divided opinion. A Chronotherapy technique found to be helpful by two families was delaying children's bedtime so that they were more tired at bedtime. A range of techniques to improve the child's sleep environment were used, with the use of white noise rated as helpful by all 10 families who used it (for whom efficiency data were available).

3.3.4 Parents experience of contact with professionals

Sixty-four percent of parents (n=32) stated that they had seen a professional either in primary care and/or in a hospital clinic about their child's sleep. Thirty-eight percent (n=12) of these parents stated that their contact with professionals was helpful with regard to their child's sleep, whilst 25% (n=8) stated that these visits were not helpful and one parent (3%) stated that their contact with professionals was partially helpful but had not addressed sleep

disturbance caused by pain (34%, n=11, missing responses for opinion of contact with professionals). A chi-squared analysis was performed to investigate any interaction between seeing a professional and taking melatonin for sleep. Seeing a professional did significantly increase the likelihood of children taking melatonin ($\chi^2 1, 8.26, p = .004$; OR= 7.73 CI 95% 1.71-34.97).

3.4 Priorities parents have for future support

A frequency analysis was conducted on the coded data to address the fourth aim of the study; exploring parents' priorities for change. Table 5 reports the description of parents' priorities when asked if 'What sort of information or input from professionals would be most helpful right now?' and the percentage of parents whose children experienced current sleep problems who stated the same priority. Support in implementing a behaviour intervention was the most widely cited by parents, however 20% of parents stated that the management of their child's sleep quality did not require additional input.

Table 5

Parents of children with current sleep problem's priorities for further support from professionals

Parents' priorities	N=44*
	% (n)
Support/information to develop a behavioural intervention	27 (12)
No further input needed	20 (9)
Information about sleep physiology/trajectory	18 (8)
Child having more efficient sleep	9 (4)
Better understanding of pain/underlying medical condition	7 (3)
Better information and choice about medication	5 (2)
Unsure	5 (2)
Positive engagement with professionals	2 (1)
Support in monitoring child's sleep	2 (1)
Improving communication	2 (1)
Support from other parents	2 (1)

* 1 missing response

4. Discussion

This study described parental report of sleep problems in children with Angelman syndrome. These data were established by interviewing parents of children with Angelman syndrome about their child's sleep quality in the largest sample of parents of children with intellectual disabilities to date. The study is further enhanced by using a bottom-up approach to describe the strategies used by parents, parent reported efficacy, priorities parents have for further support from professionals and the parental perception of the most difficult or stressful aspect of their child's sleep, as opposed to relying on imposing professionals' predefined concepts of sleep problems.

All families reported their child to have experienced either current or historic sleep problems, which is concordant with the high prevalence rate of sleep disturbances reported by previous studies, especially when a broad definition of sleep problem is applied. The most frequently reported current sleep problems by parents were night waking (74%), followed by settling problems (36%). Problems were present since birth or started between birth and one year of age for the majority of families, which is an age common for many infants to experience sleep problems (Galland, Taylor, Elder, & Herbison, 2012). The persistence of these problems beyond the developmental period where sleep problems are expected characterises sleep problems in children with Angelman syndrome relative to typically developing children. Consistent with previous research, this study found that parent report of children's sleep problems indicated that night waking problems are more common in Angelman syndrome than settling problems (see Pelc et al., 2008). Through not imposing sleep disturbance categories upon families, this study highlights the importance of understanding parents' concerns about children's sleep in the context of tailoring intervention to sleep problems as parents' perceive them as opposed whether or not sleep disturbance occurs.

The single most frequently cited stressful impact of their child's disturbed sleep was on parents own ability to function during the day (42% of parents), which is in contrast to the findings of Cotton and Richdale's (2006) study; who found the greatest concern was the impact of children's sleep disturbance upon their child as opposed to the parent. It is possible that parents reported a greater impact of their child's sleep disturbances upon themselves as these interview data suggest that the majority of children seek out parent attention when they awake during the night, thus potentially increasing the proportion of the night that the parent is awake for. The majority of parents then resettled their child by providing them with the attention that they sought, thus creating a cycle of positive reinforcement for waking (see Wiggs, 2009). It is interesting to note that when asked directly about their perception of the reason for their child's waking, far more parents indicated that their child woke due to discomfort, as a result of being hungry or thirsty or needing their pad changed, as oppose to seeking attention. It is therefore possible that children had learnt that when waking as a result of needing their physical needs attended to, parents' social engagement with the children created a learned association with waking and the availability of parent attention.

A large majority of parents had tried medication to aid their child's sleep, with 68% of parents stating that they had tried behavioural strategies to improve their child's sleep quality in combination with medication. Sixty six percent of the parents who stated that they used melatonin alone or in combination reported that it was helpful in improving their child's sleep quality. Thirty four percent also stated that maintaining a routine was helpful in improving their child's sleep. However, as the question of whether your child has a bedtime routine was not posed, it is possible that the number of parents using a routine was underreported. The majority of parents had seen a professional concerning their child's sleep quality (64%). Compared with Didden et al.'s study in 2004, in which only 33% of families in the current study were using some form of intervention to support their child's sleep, far more families

used an intervention to support their child's sleep and received support from a professional. This difference may be accounted for by approximately a ten year gap between when both studies were conducted, and comparing families resident primarily in the United States versus The Netherlands. A greater proportion of parents used medication and reported it to be effective, hence an acceptable treatment in supporting their child's sleep in the current study relative to previous studies (see Didden et al., 2004; Keenan, et al., 2007; Robinson & Richdale, 2004).

The findings of this study suggest that parents are optimistic about the support options available to them for their child's sleep, with only 5 % of parents interviewed stating that they were unsure what could help. Researchers and clinicians should take note that the most reported additional input that parents wanted to access was information and support in developing a behavioural intervention for their child (27% of parents), as opposed to further information about medication (5%). It would be interesting to identify which interventions (behavioural or medication) parents tried as a first line of treatment. In contrast, 20% of parents did not feel that they required any further outside input to assist with their child's sleep. It is possible that parents felt self-sufficient in managing their child's sleep disturbance; one family described themselves as having gone so long without support that they could not think what would be helpful, and another stated that they were able to do their own research. However, it is important to note that the sample of families interviewed may have reflected a group of very proactive parents who had travelled an extensive distance, in some cases from different continents, to attend the conference where the interviews took place. On the whole parents did not desire more support to improve their own sleep quality and well-being. It is possible that parents perceived that improving children's sleep quality as the first line solution to improving their own sleep quality, as empirical evidence does support an improvement in parental sleep quality after intervention (Wiggs & Stores, 2001).

Therefore the serious impact upon parents of caring for a child with a sleep disturbance and what could be done to minimise this impact upon parents need to be taken into account when designing interventions for these families.

A strength of this study was that it highlighted parent's perceived efficacy of strategies, in particular it should be noted that a traditional behavioural intervention technique for sleep such as limiting attention once child is settling to sleep or during the night was not found to be helpful by all parents. Conversely, of all the parents who actively stated they provided their child with attention in response to their disturbed sleep, half of these parents thought this was helpful, versus half who did not. Further research could probe into parents' definitions of helpful, such as helpful to get their child back off to sleep, or as a helpful strategy to minimise sleep disruption for both the child and parent.

Whilst previous studies have measured children's current sleep quality and outcome measures using parental report, the body of research does not account for future concerns that parents may have. One of the novel contributions of the present study is the acknowledgement of parents' worries about the future, which professionals need to be mindful of when supporting parents and in considering what information to provide to parents as 18% of parents wanted more information about the physiological processes underpinning their child's sleep quality and information about the developmental trajectory of sleep quality in Angelman syndrome. Parents' desire to understand more about how their child's sleep quality might change as they age provides a strong rationale for further research into longitudinal sleep trajectories in children with Angelman syndrome. A similar number of parents in this study (at least 25% of parents who had contact with professionals about their child's sleep) reported that their contact with professionals concerning their child's sleep was not helpful. It is imperative that professionals receive adequate information about how best to support families of children with Angelman syndrome and therefore further research into the

possible aetiologies of sleep problems in Angelman syndrome is required. Future research could use actigraphy to examine the severity of sleep problems identified by parents.

4.1. Limitations

The findings of this study need to be considered in the context of the methodology of this study. As the interviewers sought to ask the questions in a way which did not lead parents with the coding options on the script, it is possible that parents selectively reported information about their child's sleep quality or intervention to improve their child's sleep. It is also possible that parents had different definitions of what was meant by 'helpful' when evaluating the strategies that they had used. Therefore, these findings should be considered as exploratory and as a rationale for developing future behavioural interventions for sleep disturbances in children with Angelman syndrome. It is particularly important to consider the wide age range of children referred to in this study, as one quarter of children were aged three years or under. In the typically developing population, 25% of parents of children aged three years and under reported a small or a serious sleep problem (Sadeh, Mindell, Luedtke, Wiegand, 2009). In contrast, only 4% parents children aged 4-12 years reported a sleep problem in another study (Schreck, Mulick & Rojah, 2005). A large representation of children aged three and under could in the present study may have biased the proportion of children with parent reported sleep problems. However, unlike the 21% difference between Sadeh et al.'s and Schreck et al.' study, only a 6% increase in night waking problems was found for children aged three and under compared with children aged 12-15 years, therefore it could be argued that the large number of children aged three and under did not adversely bias the findings. The findings from this study refer to parental perception of sleep problems

in a sample of children with AS, and should therefore not be extrapolated to infer the prevalence of sleep disturbances for children with AS, particularly as data on health factors that may impact upon sleep quality such as seizures (see Conant et al., 2009; Thibert et al., 2009) were not collected in this study.

4.2. Conclusion

In summary, this study has demonstrated that the majority of parents of children with Angelman syndrome do have concerns about their child's sleep quality, which is impaired as a result of night-time waking, and to a lesser extent due to settling problems. The majority of parents' concerns related to the impact on of their child's poor sleep quality on their own well-being, possibly as a result of a cycle of positive reinforcement of attention during night-time wakings being maintained. The vast majority of the parents used medication in combination with behavioural strategies or strategies to improve their child's sleeping environment, and had found the current strategy they were using to be helpful. Professionals should consider parents' experience of caring for a child with Angelman syndrome and a sleep problem when devising guidelines for intervention and information, particularly supporting parents to implement behavioural interventions and conducting research into and providing information about the trajectory of sleep problems in Angelman syndrome.

Acknowledgements:

We are grateful to the Foundation for Angelman Syndrome Therapeutics and all the families for supporting this study. This project was funded by Cerebra. Thanks go to Amanda Chassuel, Lieke Van Heumen, Diana Lemos, Darnell Motley and Gail Werblood for their

assistance with the data collection and to Lucy Wright, Hannah Ramshaw, Miriam Chauhdry and Hayley Denyer for their assistance with the reliability coding. We thank Dr Caroline Richards for her helpful comments on this manuscript.

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