Sleep Medicine 32 (2017) 143–149

Contents lists available at ScienceDirect

Sleep Medicine

journal homepage: www.elsevier.com/locate/sleep

Review Article

# Assessing sleepiness and cataplexy in children and adolescents with narcolepsy: a review of current patient-reported measures

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ARTICLE INFO

*Article history:*
Received 27 May 2016
Received in revised form
23 December 2016
Accepted 26 December 2016
Available online 20 January 2017

*Keywords:*
Narcolepsy
Cataplexy
Sleepiness
Assessment
Children
Adolescents

ABSTRACT

*Objective:* The objective of this study was to review patient-reported outcome measures assessing excessive daytime sleepiness (EDS) or cataplexy in children or adolescents to determine their usefulness and limitations in pediatric narcolepsy assessment.

*Methods:* Searches were performed in Embase and Medline for pediatric measures of EDS and cataplexy that are either patient- or proxy-reported, and searches of http://www.clinicaltrials.gov/ were conducted for studies in narcolepsy that included at least one patient-reported measure. Further review was performed if sleepiness questionnaires (child or proxy-reported), sleep questionnaires that may contain sleepiness questions, proxy-reported child behavior questionnaires, or information on cataplexy measures were mentioned.

*Results:* All self-reported cataplexy questionnaires from among 27 citations were study-specific diaries and were not identifiable as a recognized validated questionnaire. For EDS, 118 of 401 abstracts were further reviewed and the names of 21 questionnaires identified, of which eight questionnaires did not return additional citations of their validation. The Epworth Sleepiness Scale (ESS) or a modified version was the most frequently used measure of EDS. Although all measures were associated with limitations for use in the pediatric population, the ESS has been successfully used in adolescents and was deemed readily amenable to further modification for children.

*Conclusions:* There remains a dearth of validated measures for assessing EDS and cataplexy in children and adolescents with narcolepsy. The need for these measures may be filled by modification or adaptation of existing adult measures; a daily cataplexy diary and the ESS may be readily modified to make them child-friendly with regard to wording and settings, but should still undergo psychometric validation.



## 1. Introduction

Narcolepsy, a chronic neurological disorder, has a prevalence of 0.05% in the United States [1] and is considered an 'orphan' disease. Despite its low prevalence, it is a clinically important condition because there is no cure and disease management is required over the lifetime of the patient. This disease management often begins in childhood or adolescence since narcolepsy has an early onset, generally during the second decade of life, although symptoms can be present in children <10 years of age [2–5]. In addition to specific pediatric issues of obesity and precocious puberty [6], narcolepsy in the pediatric population is associated with impaired academic performance and reduction in social and participatory activities [4], suggesting the need for early recognition and initiation of treatment.

Clinically, narcolepsy is characterized by excessive daytime sleepiness (EDS), cataplexy, hallucinations during onset of sleep or waking, sleep paralysis, and disrupted nighttime sleep, although not all symptoms may be present. Cataplexy and EDS are commonly the primary symptoms targeted for treatment [7]. EDS is present in

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http://dx.doi.org/10.1016/j.sleep.2016.12.020

all narcolepsy patients, is required for diagnosis [8], and is generally the first symptom to occur, often preceding cataplexy by weeks or months [7]. In contrast, although cataplexy is considered pathognomonic for narcolepsy, it is present in approximately 70% of patients [7,8].

Current approaches to the management of narcolepsy are symptomatically driven, with EDS and cataplexy being the main therapeutic targets [9,10]. Published guidelines and best-practice recommendations suggest several pharmacological agents with the choice of therapy dependent not only on the presence of symptoms but also on a variety of patient- and therapy-related factors [9–11]. An important limitation is that these guidelines reflect an adult narcolepsy population [9,10]; thus far, no guidelines specific to the pediatric population have been developed. Nevertheless, management of pediatric patients with narcolepsy has been discussed in several publications [12–14]. However, such management primarily relies on choice of medication and dosing based on empirical data derived from adults because there has also been a lack of published clinical trials evaluating treatments in children and adolescents.

Appropriate long-term management also requires meaningful and regular assessment of treatment effects on frequency and severity of symptoms from the patient's perspective. For assessment of EDS and cataplexy, the Epworth Sleepiness Scale (ESS) [15] and a daily patient cataplexy frequency diary are generally used for these outcomes, respectively, in clinical trials and the clinical setting. However, these measures were designed for the adult population, and may not necessarily be appropriate for a pediatric population. Therefore, the purpose of this review is to identify and review patient-reported outcome (PRO) measures assessing EDS or cataplexy in children or adolescents with the goal of determining the usefulness and limitations of these instruments in pediatric narcolepsy assessment.

## 2. Methods

This review consisted of two parts, of which the first part was a search of the literature for pediatric measures of EDS and cataplexy that were either patient-reported or proxy-reported, ie, parents or caregivers. The second part was a search of PROs used in ongoing clinical trials of narcolepsy based on searches of http://www.clinicaltrials.gov/.

The literature searches were performed in March 2013 in Embase and Medline. For narcolepsy/cataplexy, the terms used were: "(questionnaire MeSH OR questionnaire OR diary OR diaries OR scale) AND (carer OR caregiver OR parent OR proxy OR teacher) AND narcolepsy MeSH" with no limits. The search terms for sleepiness were: "(questionnaire MeSH OR questionnaire OR diary OR diaries OR scale) AND sleepiness" with limits of humans 6–18 years old, abstract, English, and last eight years.

Duplicate abstracts were removed and all abstracts were reviewed and excluded if the population was not pediatric or if there were no relevant questionnaires used in the study as described in the abstract (eg, sleep questionnaires that included only one or two items on sleepiness, study-specific questionnaires that were not documented or validated, name of questionnaire not provided). Articles thought to contain further information on cataplexy measures, or that mentioned a measure that seemed to be a validated questionnaire but did not give its name were ordered and reviewed in detail in order to identify the relevant questionnaires.

For the search of PROs in narcolepsy trials, phase 2, 3, or 4 trials in narcolepsy were identified from http://www.clinicaltrials.gov/ if they included at least one PRO instrument. The search was performed in December 2016. The available information from each trial was reviewed for determination of which PRO measures were included and their appropriateness for use in assessment of sleepiness or cataplexy in pediatric narcolepsy.

## 3. Results and discussion

### 3.1. Literature searches

#### 3.1.1. Cataplexy questionnaires

The literature searches returned 27 abstracts that were evaluated. All self-reported cataplexy questionnaires mentioned were study-specific diaries and were not identifiable as a recognized validated questionnaire. Only one study reported the wording of their specific question, intended for use in adolescents [16]: "how frequently have you experienced episodes of sudden muscle weakness (eg, knee buckling, jaw opening, neck flopping or postural collapse) when you are having fun, excited, angry or laughing?" However, this question was translated in the article from Korean, and the study itself was not specific to narcolepsy.

Most studies that assessed cataplexy measured frequency of attacks, and this was done exclusively through use of the study-specific diaries. Although a few studies measured severity, such assessments were based on an arbitrary scale; for example, "grade 3 is complete loss of posture with fall to the ground, grade 2 is weakness with upright posture being maintained using an external support, such as holding on to a table, grade 1 is momentary weakness without the need to hold on to an object for support, such as head drop or the jaw falling open" [17]. One study described a clinician evaluation of cataplexy changes on a four-point scale (1 = none, 2 = slightly improved, 3 = unchanged, 4 = clearly worsened) [18], and even though it was not clearly stated in the study, this clinician evaluation could be plausibly based on a reading of the daily diary entries.

#### 3.1.2. Sleepiness questionnaires

The search for EDS scales returned 401 abstracts. After excluding non-pediatric articles ($N = 190$), duplicates ($N = 7$), and articles in which there were no relevant questionnaires ($N = 86$), a total of 118 relevant abstracts were kept as reporting the use of a questionnaire assessing sleepiness in pediatric population.

As shown in Table 1, the names of 21 questionnaires that included assessment of sleepiness in the pediatric population were extracted from the relevant articles. Of these questionnaires, the ESS or a modified version of this scale was by far the most frequently used measure of EDS, followed by the Children's Sleep Habits Questionnaire. Further searches on eight of the questionnaires did not return any additional citations of their validation. The measures that were not further identifiable and thus were not considered for subsequent review included the Sleep Disorder Scale for Children [19–21], Children's Report of Sleep Patterns [22], Chronic Sleep Reduction Questionnaire [23], General Sleep Disturbance Scale [24], NIMHANS (National Institute of Mental Health and Neurosciences) Sleep Disorders Questionnaire [25], Sleepiness Scale adapted to Children and Adolescents [26], Sleepiness Scale [27], and the Sleep–Wake Habit Questionnaire [28]. It is possible that for at least some of these measures, mislabeling of the name may account for the inability to identify it.

Of the other 13 measures (Table 2), three were designed primarily for screening: Sleep Disturbance Scale for Children [29], Pediatric Sleep Questionnaire [30], and the BEARS (Bedtime problems, Excessive sleepiness, Awakenings during the night, Regularity of sleep, Snoring) questionnaire [31]. All are parent- or proxy-reported questionnaires and are generally used, respectively, to categorize sleep disorders in children, screen for sleep-related breathing disorders and symptom-complexes, and identify major sleep disorders in children during parent interviews. Additionally,

**Table 1**
Sleepiness questionnaires identified in the literature search for use in the pediatric population.

| Instrument name | Frequency of use |
|---|---|
| Epworth Sleepiness Scale and ESS-modified | 50 |
| Children's Sleep Habits Questionnaire | 24 |
| Pediatric Daytime Sleepiness Scale—subject or caregiver completed | 17 |
| Pediatric Sleep Questionnaire | 14 |
| Karolinska Sleepiness Scale | Six |
| School Sleep Habits Survey | Six |
| Sleep Disorder Scale for Children | Three |
| Adolescent Sleep Hygiene Scale | Two |
| Chronic Sleep Reduction Questionnaire | Two |
| Sleep Disturbance Scale for Children | Three |
| BEARS questionnaire | One |
| Children's Sleep Hygiene Scale | One |
| Children's Report of Sleep Patterns—Sleepiness Scale | One |
| Cleveland Adolescent Sleepiness Questionnaire | One |
| General Sleep Disturbance Scale | One |
| NIMHANS Sleep Disorders Questionnaire | One |
| Pictorial Sleepiness Scale | One |
| Sleepiness Scale adapted to Children and Adolescents | One |
| Sleepiness Scale | One |
| Sleep–Wake Problems Behavior Scale | One |
| Sleep–Wake Habit Questionnaire | One |

BEARS, Bedtime problems, Excessive sleepiness, Awakenings during the night, Regularity of sleep, Snoring; ESS, Epworth Sleepiness Scale; NIMHANS, National Institute of Mental Health and Neurosciences.

the Sleep–Wake Problems Behavior Scale is a subscale of the School Sleep Habits Survey [32], and has little sleepiness-related content.

Overall, only six measures were identified as being worthy of greater consideration with regard to content and relevancy for evaluating sleepiness in narcolepsy. The School Sleep Habits Survey [32] was developed for a wide age range and is multidimensional, but it presents a substantial administration burden resulting from its 63 items. Additionally, it has not been validated or used in narcolepsy and its assessment of only school time limits its ability to capture other situations and daily activities. In contrast, the Cleveland Adolescent Sleepiness Questionnaire [38] has eight questions and a clear format. However, several of its questions relate to difficulty in waking up in the morning, which is not necessarily related to sleepiness, in the sense of an increased daytime sleep propensity. The vague recall period of a "usual week" may also be problematic for interpretation by respondents, and it has neither been validated in narcolepsy nor used in a pediatric narcolepsy population.

The Pediatric Daytime Sleepiness Scale [34] is not restricted to adolescents, thereby enabling assessment in a wider age range. Other advantages include that it has been validated for narcolepsy with good internal consistency (Cronbach's alpha of 0.81), albeit in a Chinese population, and its ability to significantly discriminate narcolepsy from controls and obstructive sleep apnea ($p < 0.001$) [40]. However, this measure also contains items that cover double concepts, and it has a narrow focus with regard to settings (a key item is related to school) and timing (morning). This narrow focus is especially limiting, since it is crucial to evaluate situational sleep propensity in a variety of contexts and settings [41].

The Pictorial Sleepiness Scale [39] has a strong advantage of being short and clear, and its use of pictures makes it adaptable for administration even in very young patients; however, these pictures may also lack cross-cultural validity. Nevertheless, it is unlikely to be suitable for use in narcolepsy because it evaluates the propensity for sleepiness only at a given point rather than assessing situational propensity, and its sensitivity to change has yet to be firmly established. Another short scale is the Karolinska Sleepiness Scale [35], which demonstrates sensitivity to change but, like the Pictorial Sleepiness Scale, only provides an evaluation of sleepiness at a given time point, and has neither been validated nor used for evaluation of EDS in narcolepsy. Additionally, its wording may be too complex for younger children.

The ESS [42] is the most commonly used measure of sleepiness, in the sense of subjectively reported sleep propensity. It consists of only eight questions, and, in addition to its brevity, its evaluation of sleep propensity while engaged in eight different activities and situations means that it can provide an estimate of a general characteristic, ie, the patient's average sleep propensity in daily life [41]. The ESS has been validated in adults with narcolepsy [43,44]. It has also been used to measure changes in 'sleepiness' in the treatment of patients with narcolepsy, for which it also shows test–retest reliability [45]. The adult version of the ESS has been successfully used among adolescents in several large investigations in Canada [46], South Korea [47], and Hong Kong [28]. However, some of its questions may not necessarily be appropriate for a pediatric population, and the wording may be too complex for young children. This complexity has led some investigators to modify the adult ESS for use among adolescents and younger children. For example, Snow et al. [48] simply modified question seven from "sitting quietly after a lunch without alcohol" to "sitting quietly after lunch." Joo et al. [49] modified question three from "sitting inactive in a public place, eg, theatre or meeting" to "sitting inactive at school." Others have changed question eight from "in a car, while stopped for a few minutes in the traffic" to "doing homework or taking a test" [50]. Although each of these changes seemed appropriate from the point of view of face validity, the results from such investigations that used a variety of different versions of the ESS cannot be directly compared. However, its widespread acceptance and ease of use suggest that an appropriately standardized modification of the ESS for a pediatric population may provide an acceptable measure of EDS and is the best candidate measure.

### 3.2. Ongoing clinical trials

From the clinicaltrials.gov database, 24 trials in narcolepsy were identified as of December 2016; ten of these did not include PROs as primary or secondary efficacy endpoints. The 14 trials that did use PROs as efficacy endpoints are shown in Table 3. Among these trials, the ESS was the most common measure for the assessment of EDS, and was used in eight of the 14 studies. Other measures of sleepiness included the Stanford Sleepiness Scale [51] and the Pediatric Daytime Sleepiness Scale [34], each of which was used in one and four trials, respectively. Although the Stanford Sleepiness Scale is a single-item measure that appears to be sensitive to change, it evaluates sleepiness only at a particular time point rather than as an average propensity or associated with specific activities or settings. It may also be inappropriate for use in narcolepsy, especially pediatric narcolepsy, not only because of its lack of validation in this condition, but also because of unclear wording. Furthermore, factor analysis has suggested that the Stanford Sleepiness Scale, despite being a single-item measure, may be multidimensional rather than a unitary construct [52].

Two studies incorporated questionnaires that evaluate sleep quality, the Medical Outcomes Study Sleep Scale [53] and the Pittsburgh Sleep Quality Index [54]. These questionnaires include items that address daytime sleepiness, but they are inadequate for specifically assessing EDS because scoring of the questionnaires does not include sleepiness subscales and the questions themselves do not appropriately reflect the domain of daytime sleepiness. Similarly, one study included the Functional Outcomes of Sleep Questionnaire [55], which, while also including items suggestive of

**Table 2**
Characteristics of patient- or proxy-reported measures identified for potential use for evaluation of excessive daytime sleepiness in pediatric narcolepsy patients.

| Questionnaire | Objective | Population | Number of items | Domains | Scoring | Recall period | Sensitivity to change |
|---|---|---|---|---|---|---|---|
| ESS [15] | To measure a subject's usual level of daytime sleepiness or average sleep propensity | Adult/child for modified version | Eight | Sleepiness (likelihood of falling asleep) | 0–24 (higher scores = greater sleepiness) | "Recent times" | Yes |
| Children's Sleep Habits Questionnaire (parent-reported) [33] | Evaluation of sleep behavior in young children | Children with sleep disorders | 35 | Bedtime resistance; sleep onset delay; sleep duration; sleep anxiety; night awakenings; parasomnias; sleep disordered breathing; daytime sleepiness | Total sleep disturbance score of 33 items (higher scores indicate more sleep problems) | Past week | – |
| Pediatric Daytime Sleepiness Scale [34] | To evaluate daytime sleepiness in a pediatric population | Children 5–15 years old | Eight | Daytime sleepiness | 0–32 (higher scores = greater sleepiness) | None | Yes |
| Pediatric Sleep Questionnaire (parent-reported) [30] | To screen for sleep-related breathing disorders and symptom-complexes | Children 2–18 years old | 69 | Snoring; sleep-related breathing disorders; excessive daytime sleepiness; inattention/hyperactive behavior | 22-Item sleep-related breathing disorders score; not clear if other domain scores | Unknown | – |
| Karolinska Sleepiness Scale [35] | To measure sleepiness at a specific time point | General population | One | Sleepiness | 1–9 (higher scores = greater sleepiness) | None | Yes |
| School Sleep Habits Survey [32] | To assess the sleep/wake habits and typical daytime functioning of high-school students | Children 9–19 years old | 63 | Sleep schedule regularity; school performance; daytime sleepiness; behavior problems; depressive mood; bed times, rise times, and total sleep times | Domain scores | Previous two weeks unless otherwise specified | – |
| ASHS [36] and CSHS (parent-reported) [37] | ASHS: to assess behaviors that may inhibit or facilitate sleep in adolescents; CSHS: measure of activities surrounding sleep in children | Adolescents (ASHS) and children aged 2–8 years (CSHS) | 28 items on ASHS, and 17 items on CSHS | ASHS: physiological; cognitive; emotional; sleep environment; substances; sleep stability (although unclear, another article stated sleep inhibiting and sleep facilitating practices) CSHS: activities surrounding sleep; bedtime routines; stable bedtime and wake time | Global and subscale scoring; all scores range from 1 to 6 (higher scores indicate better sleep hygiene) | One month | – |
| Sleep Disturbance Scale for Children (parent-reported) [29] | To categorize sleep disorders in children | Children 6–15 years old | 26 | Initiating and maintaining sleep; sleep breathing disorders; disorders of arousal/nightmares; sleep/wake transition disorders; disorders of excessive somnolence; sleep hyperhidrosis | 26–130 (higher scores = greater disturbance) | Six months | – |
| BEARS questionnaire (proxy-reported) [31] | Screening tool for major sleep disorders in children | Children 2–18 years old | Five | Bedtime problems; excessive sleepiness; awakenings during the night; regularity of sleep; snoring | None | None | – |
| Cleveland Adolescent Sleepiness Questionnaire [38] | Measurement of sleepiness | Children 11–17 years old | 16 | Degree of sleepiness; degree of alertness | 16–80 (higher scores = greater sleepiness) | None | Yes |
| Pictorial Sleepiness Scale [39] | Measurement of perceived sleepiness at a given moment | Adults and children | One | Sleepiness | None | None | Yes |
| Sleep–Wake Problems Behavior Scale (subscale of the School Sleep Habits Survey) [32] | To evaluate irregular sleep habits | Adolescents | Ten | Irregular sleep habits; prolonged sleep latency; difficulties waking up in the morning. | 10–50 (higher scores reflect more sleep-related problems) | Two weeks | – |

ASHS, Adolescent Sleep Hygiene Scale; BEARS, Bedtime problems, Excessive sleepiness, Awakenings during the night, Regularity of sleep, Snoring; CSHS, Children's Sleep Hygiene Scale; ESS, Epworth Sleepiness Scale.

**Table 3**
Patient-reported outcomes used for efficacy endpoints in ongoing or completed randomized, controlled trials listed in the clinicaltrials.gov database.

| Product/sponsor (ClinicalTrials.gov identifier) | Phase/comparator | Conditions | Pediatric population | PRO primary efficacy endpoints | PRO secondary efficacy endpoints |
|---|---|---|---|---|---|
| Sublingual flumazenil/Emory University (NCT01183312) [56] | 1–2/placebo | Hypersomnia; narcolepsy without cataplexy | No | – | Stanford Sleepiness Scale |
| PF-03654746/Pfizer (NCT01006122) | Two/placebo | Excessive daytime sleepiness associated with narcolepsy | No | – | ESS<br>Medical Outcomes Study Sleep Scale<br>SF-36<br>Patient diaries for cataplexy<br>Brief Fatigue Inventory |
| ADX-N05/Aerial BioPharma (NCT01681121) [57] | Two/placebo | Narcolepsy | No | – | ESS<br>PGI-C |
| ADX-N05/Aerial BioPharma (NCT01485770) [58] | Two/placebo | Narcolepsy | No | – | ESS |
| Clarithromycin/Emory University (NCT01146600) [59] | Two/placebo | Hypersomnia; narcolepsy | No | – | ESS<br>Functional Outcomes of Sleep Questionnaire<br>SF-36<br>Pittsburgh Sleep Quality Index |
| Modafinil/Cephalon (NCT00107848) | Three/none | Narcolepsy; obstructive sleep apnea | Yes, ages 6–16 years | – | PDSS<br>Child Behavior Checklist for ages 6–18 years |
| Pitolisant/Bioprojet (NCT01067222) [60] | Three/modafinil and placebo | Narcolepsy with or without cataplexy | No | ESS | Patient diary (number and duration of diurnal sleep and sleepiness episodes; number of cataplexy attacks) |
| Modafinil/Cephalon and Teva Pharmaceutical Industries (NCT00107796) | Three/placebo | Narcolepsy | Yes, ages 6–16 years | – | PDSS |
| Pitolisant/Bioprojet (NCT01399606) | Three/none | Narcolepsy | No | – | ESS |
| Pitolisant/Bioprojet (NCT01638403) | Three/Provigil and placebo | Narcolepsy | No | ESS | Five Dimension EuroQol<br>Patient's global opinion of the effect of treatment<br>Patient daily diary (number and duration of diurnal involuntary sleep attacks and episodes of severe sleepiness; number of total and partial cataplexy attacks; number of hallucinations; number of sleep paralysis episodes; number and duration of nocturnal awakening and total duration of nocturnal sleep time) |
| Armodafinil/Cephalon (NCT00228566) | Three/none | Excessive daytime sleepiness associated with narcolepsy or obstructive sleep apnea/ hypopnea syndrome | No | PGI-C | – |
| Pitolisant/Bioprojet (NCT01067235) | Three/add-on modafinil vs placebo add-on modafinil | Narcolepsy with cataplexy | No | Patient diary for cataplexy attacks | ESS<br>Patient sleep diary (number and duration of diurnal sleep and sleepiness episodes) |
| Modafinil/Cephalon and Teva Pharmaceutical Industries (NCT00214968) | Three/none | Excessive daytime sleepiness associated with narcolepsy or obstructive sleep apnea/ hypopnea syndrome | Yes, ages 6–16 years | – | PDSS |
| Pitolisant/Bioprojet (NCT02611687) | 2/placebo | Narcolepsy with or without cataplexy | Yes, ages 6 to <18 years | PDSS<br>Patient diary for cataplexy attacks | |

ESS, Epworth Sleepiness Scale; PDSS, Pediatric Daytime Sleepiness Scale; PGI-C, Patient Global Impression of Change; PRO, patient-reported outcome; SF-36, Short-Form Health Survey (36 items).

daytime sleepiness, focuses on function rather than the propensity for sleepiness. These measures are also unlikely to be appropriate for a pediatric population without extensive modification for language and settings.

Assessment of EDS through the use of daily diaries was also mentioned in three trials, although the details of how such information would be captured in a diary (ie, time and settings) were not stated (Table 3). While diaries could provide a useful method of recording daytime sleepiness on a daily basis, there would need to be some standardization to ensure consistency and accuracy, especially for assessment of this outcome in a pediatric population. It should also be noted that the three trials that reported using the Pediatric Daytime Sleepiness Scale were the only clinical trials in pediatric narcolepsy listed in the database (Table 3). Although the Pediatric Daytime Sleepiness Scale may be limited by its narrow focus, it has been the most commonly used method so far for assessing EDS in pediatric narcolepsy patients.

Relative to EDS, cataplexy was less frequently assessed, and in fact was only mentioned as an outcome in three of the trials (Table 3). When assessed, cataplexy was always measured through use of a patient diary to record the number of attacks. Of note, the severity of attacks was not mentioned in any of the trials or studies reviewed, and this may be due to a lack of an ability to determine how severity of cataplexy attacks can or should be measured because cataplexy is often heterogeneous in its presentation.

## 4. Conclusions

This review confirms not only the paucity of validated measures available for assessing EDS and cataplexy in children and adolescents with narcolepsy, but also the lack of formal clinical trials evaluating therapeutic approaches for the management of narcolepsy in pediatric patients. The results of searches suggest that the need for developing such measures may be filled by modification or adaptation of existing measures that are currently used in adults. Since the need for a cataplexy measure is unique to narcolepsy, and cataplexy is currently assessed in adults using a daily diary, adaptation of a diary format to more clearly define how to recognize cataplexy using child-friendly language may present the most appropriate approach for assessing this symptom. In contrast, EDS is also a characteristic of other conditions, and is not specific for narcolepsy. Of available measures of EDS, the ESS is the most widely used and has been validated in adults with narcolepsy. Thus, although other pediatric EDS measures are available, the ESS may represent a measure that can be readily modified and standardized to make it child friendly. The main benefit would be the use of a well-documented measure of EDS across the whole age range, from young children to adolescents, and to adults of all ages. This could overcome the problem of having multiple different modified versions of the ESS that are currently in use. Johns [61] has proposed a modified version of the ESS for children and adolescents, called the ESS-CHAD. Additional development of the ESS-CHAD based on a qualitative study, as well as development of a cataplexy diary for use in a pediatric population will be reported in a manuscript that is in development, although further validation of both measures is needed.

## Acknowledgements

This literature review was funded by Jazz Pharmaceuticals, Inc. Under the direction of the authors, E. Jay Bienen, PhD, of The Curry Rockefeller Group, LLC (CRG), provided medical writing assistance for this publication. Editorial assistance in formatting, proofreading, copy editing, and fact checking was also provided by CRG. Jazz Pharmaceuticals, Inc., provided funding to CRG for support in the writing and editing of this publication.

## Conflict of interest

Dr Benmedjahed and Dr Lambert are employees of Mapi, a consulting company commissioned by Jazz Pharmaceuticals, Inc., for this study. Dr Wang is an employee of Jazz Pharmaceuticals, Inc., who in the course of this employment has received stock options exercisable for, and other stock awards of, ordinary shares of Jazz Pharmaceuticals plc. Dr Evans and Mr Hwang are employees of Endpoint Outcomes, a consulting company commissioned by Jazz Pharmaceuticals, Inc., for this study. Dr Black is a part-time employee of Jazz Pharmaceuticals, Inc., and stockholder of Jazz Pharmaceuticals plc. Dr Johns owns the copyright to the Epworth Sleepiness Scale (ESS) and has received license fees from corporations and government agencies. His participation in this investigation was without financial considerations by Jazz Pharmaceuticals, Inc.

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: http://dx.doi.org/10.1016/j.sleep.2016.12.020.

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