



**HAL**  
open science

## **Impact of childhood Dravet syndrome on care givers of patients with DS, a major impact on mothers**

Rima Nabbout, Maya Dirani, Théo Teng, Florence Bianic, Monique Martin,  
Rowena Holland, Nicole Chemaly, Nathalie Coque

### ► **To cite this version:**

Rima Nabbout, Maya Dirani, Théo Teng, Florence Bianic, Monique Martin, et al.. Impact of childhood Dravet syndrome on care givers of patients with DS, a major impact on mothers. *Epilepsy & Behavior*, 2020, 108, pp.107094 -. <10.1016/j.yebeh.2020.107094>. <hal-03490935>

**HAL Id: hal-03490935**

**<https://hal.science/hal-03490935v1>**

Submitted on 22 Aug 2022

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons CC BY-NC 4.0 - Attribution - Non-commercial use - International License

## **Impact of childhood Dravet syndrome on care givers of patients with DS, a major impact on mothers**

Rima Nabbout<sup>a,b</sup>, Maya Dirani<sup>a</sup>, Théo Teng<sup>a</sup>, Florence Bianic<sup>c</sup>, Monique Martin<sup>c</sup>, Rowena Holland<sup>d</sup>, Nicole Chemaly<sup>a,b</sup>, Nathalie Coque<sup>e</sup>

<sup>a</sup> Reference centre for rare epilepsies, Department of Pediatric Neurology, Necker Enfants Malades Hospital, Paris Descartes University, Paris, France; <sup>b</sup> Inserm U1163, Imagine institute, Paris, France; <sup>c</sup> Syneos Health Consulting, London, UK; <sup>d</sup> GW Pharma Ltd, Cambridge, UK; <sup>e</sup> Alliance Syndrome de Dravet, France

**Corresponding author:** Rima Nabbout, Department of Paediatric Neurology, Necker Enfants Malades Hospital, Imagine Institute, INSERM 1163, Paris Descartes University, Paris, France. [rima.nabbout@aphp.fr](mailto:rima.nabbout@aphp.fr)

**Paper type:** Original research article

**Word count:** 4,550 words

**Number of tables / figures:** 5 / 4

## **Abstract**

**Background:** The aim of this study was to understand the impact of Dravet syndrome (DS) on patients with Dravet syndrome and their families, with a focus on the social and economic impact on both mothers and fathers.

**Methods:** A French language on-line survey was distributed (October 2014–January 2015) for completion by caregivers of patients aged <18 years with DS. The survey was hosted on the French Dravet Syndrome Alliance website, and the survey link was provided to patients and caregivers during clinics at the Necker Hospital (Paris, France).

**Results:** Survey responses were available for 91 patients (median age 7.6 years; 81.6% *SCN1A* mutation positive). Total seizure frequency was >2 per week for 16.1% of patients, 1–8 per month for 55.2% and <1 per month for 28.7%; tonic-clonic and myoclonic were the most frequent seizure types. Patients showed various degrees of intellectual disability and DS had a high impact on concentration and school learning in 70.1% and 80.5%. In addition, patients showed appetite disorders in 73.6%, sleep disorders in 72.4% and behavior disorders in 62.1%.

Most parents were married (80.5%) with higher rates than the French general population (53.5%). Educational achievement and socio-professional categories for the parents were higher than observed in the French general population, while monthly net income was similar. Preparation of medication was generally done by the mother and father (46.0% of patients) or the mother only (37.9%). Most caregivers reported very low or no difficulty with treatment preparation and low or no risk of error. Parents typically spent <30 minutes per day on treatment preparation and administration and around 4 hours per week for attending therapy appointments. Although most patients and parents were perceived to have good general health, mothers had a worse perception of their own general health than fathers. Compared with fathers, mothers reported a greater impact of caring for a child with DS on their social life, relationships with family and friends, time and energy, and professional life.

**Conclusion:** Families caring for a child with DS experience considerable social and economic impact, with an apparent greater burden of care on the mother than the father.

## **Keywords**

Dravet syndrome; survey; caregiver burden; mothers versus fathers

## **List of abbreviations**

AED, antiepileptic drug; AEEH, state help for patients with educational special needs (*Allocation d'Éducation de l'Enfant Handicapé*); DS, Dravet syndrome; HRQOL, health-related quality of life; IDEA, International Dravet syndrome Epilepsy Action; INSEE, National French institute for statistical and economic studies (*Institut National de la Statistique et des Études Économiques*); IQR, interquartile range; *SCN1A*, sodium channel, voltage-gated, type I, alpha subunit; SE, status epilepticus; SUDEP, sudden unexpected death in epilepsy.

## 1. Introduction

Dravet syndrome (DS) is a rare Developmental and epileptic encephalopathy characterized by pharmaco-resistant epilepsy with a spectrum of cognitive, motor, behavioral and sleep disorders [1]. Patients tend to experience persistent seizures over their lifetime together with a variety of comorbid conditions such as communication, sleep, and orthopedic disorders [2–4]. In addition, patients with DS are at high risk of death, particularly from status epilepticus (SE) or sudden unexpected death in epilepsy (SUDEP) [1,5–7]. Due to the persistence of seizures [5], most parents are highly involved in 24-hour care of their child with DS [8].

Panel discussions among clinical experts and caregivers of children with severe epilepsy have identified that the effects of the child's illness on the caregiver's physical and mental health, social function, and financial resources are important areas of concern [9]. It could be assumed that having a child with DS, a severe epilepsy syndrome, would have a substantial impact on family life. Indeed, evidence collected through on-line surveys [2–4,10] and face-to-face or telephone interviews [8] has highlighted some of the challenges experienced by parents who have a child with DS. Most parents who completed a survey conducted by the International Dravet syndrome Epilepsy Action (IDEA) League affirmed the need for support in managing the ongoing stress of caring for their child [3]. Concerns may evolve over time – from initial anxiety over the diagnosis to stress over seizure control and the emergence of developmental, behavioral, and sleep disorders [8]. A survey conducted in the USA concluded that caring for patients with DS exerts physical, emotional, and time burdens on caregivers [10]. Studies have highlighted the burden of care in families of children with epilepsy [11–15] and, in few cases, the mother seems to take on the role as main caregiver [16,17]. It is not known whether this is also the case in families with a child with DS.

Evaluation of health-related quality of life (HRQOL) using validated instruments may allow identification of the factors that have most negative impact on HRQOL in patients with DS.

One survey showed that early onset of seizures, epilepsy severity (rated by parents using five items from the Epilepsy and Learning Disability Quality of Life Questionnaire), myoclonic seizures, motor disorders, learning difficulties, and behavioral problems are significant predictors of poor HRQOL in patients with DS [18]. Another larger study confirmed that HRQOL is significantly worse in patients with DS compared with both the general population and children with epilepsy and demonstrated lower HRQOL among those patients who experienced more seizures [19]. Although it has been shown that high seizure frequency and severity can impair HRQOL for the patient, the impact of these factors on caregivers and families is not well understood.

Few studies have evaluated the financial burden of DS and available evidence has focused on direct costs, such as inpatient hospitalization and medication. For example, a health-care utilization study conducted in Germany reported that the direct costs of treating patients with DS were above the average European costs for children with other drug-resistant epilepsies [20]. Further analysis using German health insurance data confirmed that the direct costs of treating patients with DS were substantially higher than those of age- and sex-matched insured individuals who did not have epilepsy [21]. A systematic review has indicated that direct costs of treating patients with epilepsy are markedly higher in subgroups with uncontrolled or refractory epilepsy and in those with comorbidities [22], both common features of DS [1]. Treatment of children and adolescents with epilepsy has been reported to be associated with high direct costs due to frequent inpatient admissions and high indirect costs due to productivity losses in mothers [23]. Furthermore, a study in a small population of patients with DS in the USA has indicated that indirect costs resulting from lost productivity, loss of income, and lost leisure time may also be considerable [24].

A review of current literature has identified a need for further research on the humanistic and financial burden of DS on patients and caregivers [7]. The objective of this study was to explore the impact of DS on children and their families, with a focus on their social life and

economic situation. We conducted an in-depth on-line survey of parents and caregivers recruited from a single center in France. As our survey was completed independently by both parents, this provided us with an opportunity to compare the impact of DS on mothers and fathers.

## **2. Material and methods**

### *2.1 Study design*

An on-line survey was distributed between October 2014 and January 2015 to caregivers of children and adolescents aged under 18 years with DS. The survey was jointly developed by the Dravet Syndrome Alliance (France) and the Reference Centre for Rare Epilepsies (France). The survey was hosted on the Dravet Syndrome Alliance website (<http://www.dravet.fr/>) and the link to the survey was provided to patients and caregivers during consultation at Necker Hospital (Paris, France).

The survey was developed in French and aimed to examine the difficulties caused by DS and its impact on day-to-day activities. Five sections covered the following topics: demographical and medical characteristics; preparation and administration of treatment; comorbidities; quality of life of children and parents; and impact on daily life, e.g. social and economic issues. The survey was semi-structured and included both open and closed questions. Ethics board approval was not required because of the anonymous nature of the survey.

For numerical comparison, data relating to the general population or households with children in France were obtained from the Institut National de la Statistique et des Études Économiques (INSEE), Crédoc, and MementoCE websites.

### *2.2 Statistical analysis*

The database was cleaned prior to analysis, including correction of typos. Some variables with more than two possible responses (e.g. yes, several times; yes, once; no, never) were

transformed to binary variables (e.g. yes; no). Any inconsistencies were re-assessed (e.g. date of diagnosis before date of birth). Means or medians were calculated, where appropriate.

A Fisher test was used to test any differences in incidence of comorbidities between current seizure frequency and age categories using a significance level of 5%. For these analyses, seizure frequency was categorized as high (>2 seizures per week), medium (1–8 seizures per month), or low (<1 seizure per month). Age categories were <6 years, 6–<12 years, and 12–18 years.

A multinomial model was derived to investigate the impact of severity of disease, defined by current seizure frequency, on the perception of health of the patient by the caregivers. The model was adjusted for age category, age at diagnosis, the perception of health of the mother, and the presence of *SCN1A* mutation. Data were analyzed using R Version 3.3.3.

### **3. Results**

#### *3.1 Demographics and clinical characteristics*

In total, 91 families fully completed the survey. Four records were excluded from the analysis due to unconfirmed diagnosis of DS (age at first seizure >15 months; n = 2), duplicate record (n = 1), and age at inclusion >18 years (n = 1). Therefore, 87 patients were included in the analyses. The questions were answered thoroughly in most cases.

The age of the patients ranged from 8.5 months to 17.5 years with a median of 7.6 years (**Table 1**). Patients experienced their first seizure at a median age of 5.1 months (interquartile range [IQR]: 4.1 to 7.1 months) and were diagnosed at a median age of 18.3 months (IQR: 11.3 to 31 months). Most patients (81.6%) tested positive for the *SCN1A* mutation. Fourteen patients (16.1%) experienced more than 2 seizures per week, 48 patients (55.2%) experienced between 1 and 8 seizures per month, and the remaining 25 patients (28.7%) experienced seizures less frequently during the last 12 months (**Table 2**). The most frequently reported seizure types were tonic-clonic and myoclonic seizures.

The caregivers, defined as the individual(s) who are providing daily care including medicine preparation were the mother and father together for 46.0% of patients, with the mother only for 37.9%, and the mother, father, and an additional person (childminder, institution staff, or stepfather) for 9.2% (data missing for 6.9%). Most parents were aged between 30 and 49 years (**Table 3**), and the majority were married (**Table 4**). Educational achievement and socio-professional categories for the parents are shown in **Table 3** and family income and city population size are shown in **Table 4**, alongside comparable data for French households with children.

### *3.2 Treatment preparation and administration*

For most patients, treatment preparation and administration were done by the mother (94.3% and 96.6%, respectively) and/or the father (57.5% and 60.9%). Childminders or institution staff were involved in the preparation and administration of treatment for a small proportion of patients (around 10%). Grandparents were occasionally involved in treatment preparation and administration for almost half of patients (50.6% and 41.4%).

Treatment preparation and administration time was evaluated around 30 minutes per day for most parents (91.9% and 90.8%, respectively).

Most caregivers indicated that they had very low or no difficulty with various aspects of treatment preparation (**Fig. 1**). Almost half (40.2%) had been provided with instructions for the preparation of treatment by a specialist (e.g. neurologist, pediatric neurologist), while 40.2% had not received clear instructions and 10.3% responded that they did not need any instruction. Although most caregivers (>70%) did not use any specific methods to avoid errors in treatment preparation, around 25% used pill boxes. The risk of error in medication administration was estimated to be non-existent by 20.7% of caregivers, low by 48.3%, and average by 25.3%, while no caregivers assessed the risk of error to be major.

Almost 40% of caregivers estimated their knowledge about the action of each antiepileptic drug (AED) to be complete, while 58.6% had partial knowledge of the action of each AED.

### *3.3 Beyond seizures*

Overall, 72.4% of patients had sleep disorders, and these were most commonly reported in patients with low seizure frequency. However, no statistically significant correlation was found between sleep disorders and seizure frequency category. A significant correlation was identified between sleep disorders and age category ( $p=0.0042$ ), with a higher incidence in younger patients. Although most patients experienced sleep disorders, only 16.1% were treated with melatonin, and this was mostly given to younger patients. Almost half of this younger group co-sleep with the caregivers, mainly the mother.

Caregivers reported behavior disorders in 62.1% of their children. No statistically significant relationship was found between behavior disorders and seizure frequency or age category. In addition, 70.1% of caregivers reported a negative impact on their child's concentration. Even though behavior disorders and concentration deficits were very common, only a few patients (5.7%) received treatment for this disorder, mostly with methylphenidate.

Appetite disorders were reported in 73.6% of patients, with similar incidence across groups classified by seizure frequency, age, and number of current AEDs.

Respondents were asked to rate the impact of DS on different types of physical activity. DS was considered to have an important impact on significant physical activity for >60% of patients, reducing to 25% for moderate physical activity, 35.6% for walking at least 500 meters, and 20.7% for walking approximately 100 meters.

Considering the age of the patient, personal autonomy with respect to dressing, eating, and washing was highly impacted by DS for 50.6% of patients and slightly limited for 41.4%. A

statistically significant relationship was identified between the impact of DS on personal autonomy and seizure frequency ( $p = 0.087$ ), with greater impact in patients with high seizure frequency. In fact, 64.3% of patients with high seizure frequency rated the impact of DS on personal autonomy to be high.

DS was believed to have a high impact on school learning in 80.5% of patients. This was particularly noted in patients aged >12 years (93.3% vs 80.5% in the total sample); this is interesting given that 47.1% of all patients were cared for in medico-educational institutes and 25.3% were attending normal school with the help of a school care assistant. In addition, 70.1% of caregivers reported that their children had been victims of discrimination and/or rejection due to DS.

### *3.4 Perception of health*

Caregivers were asked to rate their perception of the general health of the patient and themselves using a 5-point Likert scale from excellent to very poor (**Fig. 2**). Most patients and parents were perceived to have good general health. Compared with fathers, mothers had a worse perception of their own general health: 19.5% of mothers vs. 15.3% of fathers rated their own general health as poor or very poor.

The multinomial model shows that the perception of the patient's general health was influenced by seizure frequency, current age and age at diagnosis, mother's general health, and presence of *SCN1A* mutations. The model predicted that a reduction in seizure frequency from high (>2 seizures per week) to low (<1 seizure per month) would reduce the probability of a perception of poor general health from 64% to 12% (**Fig. 3**).

### *3.5 Impact on social life*

More than 50% of parents answered that having a child with DS disturbs their social life and their relationships with family and friends all the time or very often. Fewer mothers than

fathers reported that DS never impacts their social life (3.4% vs 8.3%). Conversely, more mothers than fathers considered that care of their child with DS had an important impact on their time and energy (85.1% vs 49.4%).

Approximately one-fifth (18.4%) of respondents in the survey had not taken a vacation during the last 12 months; most of these families (85%) stated that this was due to their child having DS and the unpredictability of seizures. For the remaining families, more than half went on holiday several times per year and 36.6% at least once per year precising in both cases that the choice of the vacation place is linked to its proximity to a hospital with Pediatric intensive care unit.

### *3.6 Impact on economic situation*

**DS** has a huge impact on the professional life of parents, especially on the mothers (fig.4). Half the mothers reported difficulties in finding or keeping a job due to the disease of their child. Among mothers who were the main caregiver, 33.3% were not working at the time of the survey, while only 31.0% were working full time. More than 50% of mothers had interrupted their work for more than 6 months compared with 7.1% of fathers.

Parents were asked to estimate the time that they spent accompanying their children to different rehabilitation appointments: physiotherapy, psychomotor therapy, occupational therapy, speech therapy, and other rehabilitation programs related to the disease of their child. More than 60% of patients attended therapies; appointments mostly occurred once per week and each lasted 30–45 minutes (**Table 5**). Parents estimated that they spent an average of around 4 hours per week for this purpose.

Some families incurred additional costs resulting from having a child with DS. For example, almost 20% of families had moved to a new house, mostly to relocate closer to a hospital or

medico-educational institute but, in some cases, the family required a home that was better adapted to their child's needs.

#### **4. Discussion**

Findings from our survey present a comprehensive overview of the social and economic impact of DS on patients and families living in France. The survey was completed thoroughly in most cases. Patients included in the survey encompassed a wide age range (8.5 months to 17.5 years) and 81.6% had confirmed mutation in *SCN1A*. Our results confirm that children and adolescents with DS have severe epilepsy characterized by multiple seizure types resistant to therapies; in fact, 60.9% of patients were experiencing at least one tonic-clonic seizure per month. Previous studies have shown that seizure burden is a major determinant of HRQOL for people with epilepsy [18] and that children with DS have lower HRQOL than those with epilepsy [19]. In our survey, patients with high seizure frequency (>2 seizures per week) required more personal care as shown by a high impact on global autonomy. Although most patients were perceived to be in good general health, statistical analysis predicted that a reduction in seizure frequency would substantially reduce the risk of poor general health. Moreover, the high incidence of non-seizures morbidities such as sleep, behavior, and appetite problems indicates that management of the disease is not limited to seizure control. Our findings are in line with other surveys that have reported high incidences of comorbidities in children with DS [25].

Our survey reports a substantial impact of DS on educational possibilities and a great need for special educational path. Almost half of the patients attended a medico-educational institute and a further quarter were not able to attend regular school without full-time assistance from a shadow teacher. Concentration and school learning were impaired in most children. Physical activity was also reduced in many children, but this finding should be interpreted with caution since parents may restrict physical exercise for fear of triggering a seizure.

Consistent with previous studies [2,10], our findings show that parents are highly involved in the care of their child with DS. Importantly, the mother was designated as the sole caregiver in more than one-third of families, while the mother and father together provided care in around half of the families. Mothers were more likely than fathers to be responsible for the preparation and administration of treatment. It is interesting to note that more than 80% of the parents were married, which is substantially higher than the marriage rate in households with children in the French population (53.5%) [26]. Other surveys of families with DS have reported similar marriage rates of 87.5% [8] and 82% [25]. DS appears to be unique among other childhood illnesses in this respect; it has been widely reported that parents of a child with a disability or a chronic disorder are more likely to separate or divorce than the general population, and disability has been cited as one of the factors often involved in marital breakdown [27]. This might be due also to the high socio-economic profile of the population recruited and the bias of population selection from the patients support group.

Caregivers in our survey, particularly mothers, were very well informed and knowledgeable regarding their child's treatment regimen. Their confidence in administering the treatments was shown by the short preparation time and the low perceived level of difficulty and risk of error. However, it should be noted that parents were recruited to the study partly through a patient advocacy group, and the survey population may thus represent a group who are highly motivated, well prepared and engaged, with access to expert help. It has been recognized that many parents of children with DS wish to be informed participants in their child's care and that knowledge is important in helping caregivers to adapt and to develop resilience [3].

Previous studies have reported that having a child with DS has a significant impact on the caregivers' mental and physical health. In a panel discussion, most caregivers talked at length about their significant sleep deprivation and feelings of exhaustion [9]. Caregivers noted that the demands of round-the-clock care made taking care of their own health difficult

[9] and resulted in little time for themselves [2,9]. In terms of HRQOL, EQ-5D general health assessment scores for caregivers were substantially reduced compared with the normal population [10]. While our survey confirmed an important impact of DS on caregivers' health, comparison of responses indicates that there may be a greater impact on mothers compared with fathers. For example, mothers had a poorer perception of their own health compared with fathers and reported that care of their child had greater impact on their time and energy. Mothers were more likely than fathers to have given up their own career to care for their child with DS. Although these findings have not been reported previously in parents of children with DS, there is some evidence that the impact of having a child with epilepsy is greater on the mother than the father. Mothers of children with childhood-onset epilepsy were reported to have poorer quality of life than fathers [13,17] and mothers of young children with epilepsy (aged 1–7 years) were more likely than fathers to be at risk of depression, anxiety, and stress [15]. An earlier study indicated that mothers of children with idiopathic epilepsy sustain a greater burden of care and exhibit higher levels of strain than fathers [11]. Mothers of young children with epilepsy (aged 1–7 years) reported poorer sleep quality than fathers [14], and mothers were more likely than fathers to experience sleep disturbances [12]. It has been suggested that this effect is not sex related (i.e. mothers are less likely to cope) but instead is a consequence of which parent is the primary caregiver [16] as in our group.

The impact of having a child with DS extends to the parents' social life and relationships with family and friends; this finding has been reported in other studies and was confirmed by our survey. Indeed, fewer mothers than fathers reported that DS never impacts their social life. Apart from the reduced time available for parents to socialize, it has also been suggested that the shift in focus towards the child may leave other relationships strained [9]. In a recent European on-line survey, almost all caregivers indicated that caring for a child with DS makes daily activities (90.8%), family relationships (69.9%), and social life (80%) difficult [2]. Siblings were also affected; among patients with DS who had siblings living in the same

household, nearly half (46%) of the siblings had missed leisure opportunities over the past 4 weeks so that the caregiver could take care of the child who had DS [2].

It is interesting that approximately 80% of families in this survey had taken a holiday in the last 12 months and more than half had taken several holidays. These figures are relatively high compared with the general population in France, where only 60% of individuals took a holiday during the last 12 months and only 22% several times per year [28,29]. Caregivers in our survey may be reassured to travel by their knowledge of prehospital protocols and their confidence in administering therapy. Another survey reported that most caregivers (65%) of patients with DS reported that they had taken a holiday, although there was a marked difference across age groups with younger patients less likely to travel [2]. The choice of the holiday in cities having pediatric hospital facilities should be also emphasized as for the facility to have urgent contact with on call child neurologist in our centre on a 24/7 basis.

The indirect costs of serious childhood illness include employment difficulties when one or both parents are unable to work, lost work days due to time taken off for appointments or caregiver responsibilities, and lost productivity at work because of sleep deprivation and fatigue. These factors result in considerable financial burden for many families of children with severe epilepsy [7,24]. Previous surveys have reported that caring for a child with DS influences career choice, impairs productivity, and may result in unemployment, early retirement or dismissal [2,10]. To explore the indirect costs of DS, we compared educational achievement, professional status, and income of the families in our survey with data reported for households with children in the general population in France [26]. Parents of the DS patients included in our survey were more highly educated than the general population. Similarly, among the parents who participated in this study, there were more executives, and higher and middle management professionals than in the general population. However, considering mothers who were the main caregiver, one-third (33.3%) were not working

compared with 26% of mothers in the general population. Conversely, fewer mothers in the survey were working full time than in the general population (31.0% vs almost 50%).

A greater impact on professional life was observed on mothers, for example, more than half of mothers had interrupted their working life for more than 6 months compared with only 7.1% of fathers. A similar discrepancy in the impact on mothers and fathers was reported in a German survey of children and adolescents with epilepsy where 17.4% of mothers and 0.6% of fathers had reduced their working hours or quit work due to their child's epilepsy [23]. Despite higher educational achievement and the expected high income, the income of the families in our survey was similar to that of the general French population, suggesting that care of a child with DS does reduce the potential income of the family. It is possible that mothers, in particular, choose lower income professions and part-time work in order to adapt to their role as caregiver.

Financial support provided by the state to families with a disabled child varies among countries. The French health-care system offers universal health insurance that covers all medical costs and provides a daily allowance for patients with long-term conditions (The Commonwealth Fund). In addition, the Allocation for the Education of a Disabled Child (*Allocation d'Education de l'Enfant Handicapé, AEEH*) is a state benefit that is intended to offset the cost of education and care for a child with a disability aged up to 20 years [30]. The current basic amount of €132.21 per month is supplemented in certain circumstances, for example, if it is necessary for one parent to reduce their working hours or stop working completely to care for the child. Although helpful, this amount is far from being equivalent to the family income if both parents were able to work, especially with advanced career positions. Despite the existence of a supportive health-care system in France, our findings show that families have significant reduced income for the care of their child with DS.

Our survey has several limitations, including potential selection bias of the cohort towards parents who are very involved and experts in the treatment of their child. Indeed, demographic data suggest that the survey population had a higher level of educational achievement and professional status than the general French population.

## **Conclusions**

In conclusion, families caring for a child with DS experience considerable social and economic impact. We show a greater burden of care on the mother than the father resulting in an interrupted working life for most mothers. This universal burden of care has been demonstrated by different studies coming from different countries with different health systems. The burden is complex, related not only to seizures surveillance and medical care but to additional needs of the child and the positioning of the families, mainly mothers, as primary health provider needed for almost every daily task due to intellectual disability, behavior, communication as well as sleep, and eating disorders.

## **Acknowledgments**

The authors would like to thank the caregivers who participated in this study by completing the survey.

## **Disclosures of conflicts of interest**

All authors met the ICMJE authorship criteria. Neither honoraria nor payments were made for authorship.

RN received research grants from EU (Horizons2020, FP7) and from UCB, Eisai, Livanova and GW Pharmaceuticals, has served as a consultant/advisor/lecturer for Novartis, Takeda, Zogenix, Nutricia, Advicenne, Eisai and GW Pharmaceuticals companies and as a study investigator for GW Research Ltd, Advicenne, UCB, Eisai and Zogenix. NO COI for this work  
MD has no COI to declare

NC has served as a lecturer for Nutricia, Novartis, Zogenix, Advicenne, Livanova and GW Pharmaceuticals companies. NO COI for this work

TT served as a lecturer for Nutricia. NO COI for this work

FB has acted as a consultant for GW Pharmaceuticals companies.

MM has acted as a consultant for GW Pharmaceuticals companies.

RH is an employee of GW Pharma Ltd.

NCo has no COI to declare; she is the scientific officer of the Dravet Alliance, France

## **Funding sources**

Editorial and medical writing support was provided to authors by Jennifer Stewart, MSc of Helios Medical Communications, Alderley Park, UK and funded by GW Research Ltd.

## **Ethical publication statement**

We confirm that we have read the Journal's position on issues involved in ethical publication and affirm that this report is consistent with those guidelines.

## References

- [1] Dravet C. The core Dravet syndrome phenotype. *Epilepsia* 2011;52:3–9.  
<https://doi.org/10.1111/j.1528-1167.2011.02994.x>.
- [2] Lagae L, Irwin J, Gibson E, Battersby A. Caregiver impact and health service use in high and low severity Dravet syndrome: a multinational cohort study. *Seizure* 2018;65:72–9. <https://doi.org/10.1016/j.seizure.2018.12.018>.
- [3] Skluzacek JV, Watts KP, Parsy O, Wical B, Camfield P. Dravet syndrome and parent associations: the IDEA League experience with comorbid conditions, mortality, management, adaptation, and grief: Dravet Syndrome and Parent Associations. *Epilepsia* 2011;52:95–101. <https://doi.org/10.1111/j.1528-1167.2011.03012.x>.
- [4] Villas N, Meskis MA, Goodliffe S. Dravet syndrome: characteristics, comorbidities, and caregiver concerns. *Epilepsy Behav* 2017;74:81–6.  
<https://doi.org/10.1016/j.yebeh.2017.06.031>.
- [5] De Liso P, Chemaly N, Laschet J, Barnerias C, Hully M, Leunen D, et al. Patients with Dravet syndrome in the era of stiripentol: a French cohort cross-sectional study. *Epilepsy Res* 2016;125:42–6. <https://doi.org/10.1016/j.eplepsyres.2016.05.012>.
- [6] Wirrell EC. Treatment of Dravet syndrome. *Can J Neurol Sci* 2016;43:S13–8.  
<https://doi.org/10.1017/cjn.2016.249>.
- [7] Jensen MP, Brunklaus A, Dorris L, Zuberi SM, Knupp KG, Galer BS, et al. The humanistic and economic burden of Dravet syndrome on caregivers and families: implications for future research. *Epilepsy Behav* 2017;70:104–9.  
<https://doi.org/10.1016/j.yebeh.2017.02.003>.
- [8] Nolan KJ, Camfield CS, Camfield PR. Coping with Dravet syndrome: parental experiences with a catastrophic epilepsy. *Dev Med Child Neurol* 2006;48:761–5.  
<https://doi.org/10.1017/S0012162206001629>.
- [9] Jensen MP, Liljenquist KS, Bocell F, Gammaitoni AR, Aron CR, Galer BS, et al. Life impact of caregiving for severe childhood epilepsy: results of expert panels and

- caregiver focus groups. *Epilepsy Behav* 2017;74:135–43.  
<https://doi.org/10.1016/j.yebeh.2017.06.012>.
- [10] Campbell JD, Whittington MD, Kim CH, VanderVeen GR, Knupp KG, Gammaitoni A. Assessing the impact of caring for a child with Dravet syndrome: results of a caregiver survey. *Epilepsy Behav* 2018;80:152–6. <https://doi.org/10.1016/j.yebeh.2018.01.003>.
- [11] Ramaglia G, Romeo A, Viri M, Lodi M, Sacchi S, Cioffi G. Impact of idiopathic epilepsy on mothers and fathers: strain, burden of care, worries and perception of vulnerability. *Epilepsia* 2007;48:1810–4. <https://doi.org/10.1111/j.1528-1167.2007.01145.x>.
- [12] Shaki D, Goldbart A, Daniel S, Fraser D, Shorer Z. Pediatric epilepsy and parental sleep quality. *J Clin Sleep Med* 2011;7:502–6. <https://doi.org/10.5664/JCSM.1318>.
- [13] Puka K, Tavares TP, Anderson KK, Ferro MA, Speechley KN. A systematic review of quality of life in parents of children with epilepsy. *Epilepsy Behav* 2018;82:38–45. <https://doi.org/10.1016/j.yebeh.2018.03.008>.
- [14] Reilly C, Atkinson P, Memon A, Jones C, Dabydeen L, Cross JH, et al. Child and parental sleep in young children with epilepsy: A population-based case-control study. *Epilepsia Open* 2018;3:383–91. <https://doi.org/10.1002/epi4.12241>.
- [15] Reilly C, Atkinson P, Memon A, Jones C, Dabydeen L, Das KB, et al. Symptoms of depression, anxiety, and stress in parents of young children with epilepsy: A case controlled population-based study. *Epilepsy Behav* 2018;80:177–83. <https://doi.org/10.1016/j.yebeh.2017.12.020>.
- [16] Ferro MA, Speechley KN. What about dads? An exploratory analysis of depressive symptoms in paternal primary caregivers of children with epilepsy. *Epilepsy Behav* 2012;23:90–1. <https://doi.org/10.1016/j.yebeh.2011.10.004>.
- [17] Koc G, Bek S, Vurucu S, Gokcil Z, Odabasi Z. Maternal and paternal quality of life in children with epilepsy: who is affected more? *Epilepsy Behav* 2019;92:184–90. <https://doi.org/10.1016/j.yebeh.2018.12.029>.

- [18] Brunklaus A, Dorris L, Zuberi SM. Comorbidities and predictors of health-related quality of life in Dravet syndrome. *Epilepsia* 2011;52:1476–82. <https://doi.org/10.1111/j.1528-1167.2011.03129.x>.
- [19] Lagae L, Brambilla I, Mingorance A, Gibson E, Battersby A. Quality of life and comorbidities associated with Dravet syndrome severity: a multinational cohort survey. *Dev Med Child Neurol* 2018;60:63–72. <https://doi.org/10.1111/dmcn.13591>.
- [20] Strzelczyk A, Schubert-Bast S, Reese JP, Rosenow F, Stephani U, Boor R. Evaluation of health-care utilization in patients with Dravet syndrome and on adjunctive treatment with stiripentol and clobazam. *Epilepsy Behav* 2014;34:86–91. <https://doi.org/10.1016/j.yebeh.2014.03.014>.
- [21] Strzelczyk A, Griebel C, Lux W, Rosenow F, Reese J-P. The burden of severely drug-refractory epilepsy: a comparative longitudinal evaluation of mortality, morbidity, resource use, and cost using German health insurance data. *Front Neurol* 2017;8:712. <https://doi.org/10.3389/fneur.2017.00712>.
- [22] Begley CE, Durgin TL. The direct cost of epilepsy in the United States: a systematic review of estimates. *Epilepsia* 2015;56:1376–87. <https://doi.org/10.1111/epi.13084>.
- [23] Riechmann J, Strzelczyk A, Reese JP, Boor R, Stephani U, Langner C, et al. Costs of epilepsy and cost-driving factors in children, adolescents, and their caregivers in Germany. *Epilepsia* 2015;56:1388–97. <https://doi.org/10.1111/epi.13089>.
- [24] Whittington MD, Knupp KG, Vanderveen G, Kim C, Gammaitoni A, Campbell JD. The direct and indirect costs of Dravet Syndrome. *Epilepsy Behav* 2018;80:109–13. <https://doi.org/10.1016/j.yebeh.2017.12.034>.
- [25] Knupp KG, Scarbro S, Wilkening G, Juarez-Colunga E, Kempe A, Dempsey A. Parental perception of comorbidities in children with Dravet syndrome. *Pediatr Neurol* 2017;76:60–5. <https://doi.org/10.1016/j.pediatrneurol.2017.06.008>.
- [26] Institut National de la Statistique et des Études Économiques (INSEE). Logements, individus, activité, mobilités scolaires et professionnelles, migrations résidentielles en 2014. Recensement de la population – Fichier détail 2014.

<https://www.insee.fr/fr/statistiques/2866325?sommaire=2866354#consulter> (accessed August 13, 2019).

[27] handicap.fr. Handicap: parents more isolated than others n.d.

<https://informations.handicap.fr/a-parents-isolement-separation-7588.php> (accessed August 13, 2019).

[28] Hoibian S, Müller J. Collections des rapports. Vacances 2014 : l'éclaircie 2015.

<https://www.credoc.fr/download/pdf/Rapp/R320.pdf> (accessed August 13, 2019).

[29] Mementoce. Les activités sociales et culturelles n.d. [https://www.audit-expertise-](https://www.audit-expertise-cse.fr/wp-content/uploads/2014/03/tourismesocial.pdf)

[cse.fr/wp-content/uploads/2014/03/tourismesocial.pdf](https://www.audit-expertise-cse.fr/wp-content/uploads/2014/03/tourismesocial.pdf) (accessed August 13, 2019).

[30] Service-Public.fr. Allocation d'éducation de l'enfant handicapé (AEEH) n.d.

<https://www.service-public.fr/particuliers/vosdroits/F14809> (accessed August 13, 2019).

## Tables

**Table 1.** Patient characteristics.

	<b>Survey patients</b>
	<b>N = 87</b>
<b>Age (years), median (IQR)</b>	7.57 (5.01–10.00)
<b>Sex, n (%)</b>	
Male	46 (52.9)
Female	41 (47.1)
<b>Age at first seizure (months), median (IQR)</b>	5.12 (4.11–7.08)
<b>Age at diagnosis (months), median (IQR)</b>	18.30 (11.27–31.00)
<b>Time between first seizure and diagnosis (months), median (IQR)</b>	12.68 (6.17–22.55)
<b>Test for mutation (<i>SCN1A</i>), n (%)</b>	
Presence of mutation	71 (81.6)
Absence of mutation	13 (14.9)
Not tested	3 (3.4)

IQR, interquartile range; *SCN1A*, sodium channel, voltage-gated, type I, alpha subunit.

**Table 2.** Seizure frequency for patients at time of survey completion.

<b>Current seizure frequency</b>	<b>Seizure type, % (n) [N = 87]</b>						
	<b>Total</b>	<b>Tonic-clonic</b>	<b>Tonic</b>	<b>Focal or simple partial</b>	<b>Myoclonic</b>	<b>Atypical absence</b>	<b>Other</b>
>2 per week	16.1% (n = 14)	13.8% (n = 12)	5.7% (n = 5)	4.6% (n = 4)	14.9% (n = 13)	10.3% (n = 9)	2.3% (n = 2)
1–8 per month	55.2% (n = 48)	47.1% (n = 41)	16.1% (n = 14)	18.4% (n = 16)	16.1% (n = 14)	14.9% (n = 13)	0.0% (n = 0)
0 or <1 per month	28.7% (n = 25)	39.1% (n = 34)	78.2% (n = 68)	77.0% (n = 67)	69.0% (n = 60)	74.7% (n = 65)	97.7% (n = 85)

**Table 3.** Age, educational level and jobs of mothers and fathers participating in the survey.

	DS survey, % (n)		French population, <sup>a</sup> %	
	Mother (N = 87)	Father (N = 87)	Mother	Father
<b>Age, years</b>				
>30	3.4% (3)	2.3% (2)	11.8%	5.4%
30–39	52.9% (46)	42.5% (37)	27.9%	23.9%
40–49	40.2% (35)	34.5% (30)	32.2%	34.0%
≥50	3.4% (3)	19.5% (17)	28.1%	36.7%
NA	0.0% (0)	1.1% (1)	NA	NA
<b>Degree</b>				
No degree	2.3% (2)	5.7% (5)	14.8%	13.9%
BEPC/CAP/BEP	18.4% (16)	18.4% (16)	27.9%	36.3%
Baccalauréat	8.0% (7)	17.2% (15)	19.9%	17.7%
>Baccalauréat	71.3% (62)	58.6% (51)	37.4%	32.1%
<b>Socio-professional category</b>				
Farmers	0.0% (0)	0.0% (0)	1.5%	0.3%
Craftsmen, traders and general managers	2.3% (2)	5.7% (5)	9.3%	2.7%
Executives and higher intellectual professions	28.7% (25)	40.2% (35)	16.2%	8.7%
Intermediate professions	25.3% (22)	11.5% (10)	16.7%	17.8%
Employees	24.1% (21)	18.4% (16)	13.0%	35.3%

Workers	2.3% (2)	13.8% (12)	27.3%	4.7%
Retirees	5.7% (5)	1.1% (1)	9.6%	7.3%
Other	11.5% (10)	9.2% (8)	6.5%	23.1%

BEP, Brevet d'Études Professionnelles; BEPC, Brevet d'Études de Premier Cycle; CAP, Certificat d'Aptitudes Professionnelles; INSEE, Institut National de la Statistique et des Études Économiques; NA, not available.

<sup>a</sup> Obtained from INSEE website (data for households with children in France).

**Table 4.** Characteristics of parents participating in the survey regarding matrimonial status, income and their location

	DS survey, % (n) (N = 87)	French population, <sup>a</sup> %
<b>Matrimonial status</b>		
Married	80.5% (70)	53.5%
Not married	19.5% (17)	46.5%
NA	1.1% (1)	NA
<b>Monthly net income</b>		
<1,000 €	1.1% (1)	9.0%
1,000–2,500 €	28.7% (25)	18.8%
2,500–5,000 €	47.1% (41)	51.0%
>5,000 €	19.5% (17)	21.1%
NA	3.4% (3)	NA
<b>Location (population size)</b>		
50–400	4.6% (4)	5.5%
400–2,000	24.1% (21)	19.1%
2,000–20,000	33.3% (29)	36.4%
20,000–100,000	23.0% (20)	23.9%
100,000–200,000	5.7% (5)	6.0%
>200,000	9.2% (8)	9.1%

NA, not available.

<sup>a</sup> Obtained from INSEE website (data for households with children in France).

**Table 5.** Time taken by travelling to and attending therapy appointments.

	<b>Type of therapy</b>			
	<b>Physiotherapy (n = 25)</b>	<b>Psychomotor therapy (n = 57)</b>	<b>Occupational therapy (n = 12)</b>	<b>Speech therapy (n = 54)</b>
<b>Frequency of visits, % (n)</b>				
>1 per week	20.0% (5)	12.3% (7)	0.0% (0)	38.9% (21)
1 per week	76.0% (19)	86.0% (49)	75.0% (9)	53.7% (29)
1 per month	4.0% (1)	1.8% (1)	16.7% (2)	7.4% (4)
<1 per month	0.0% (0)	0.0% (0)	8.3% (1)	0.0% (0)
<b>Residential therapy,<sup>a</sup> % (n)</b>	28.0% (7)	59.6% (34)	83.3% (10)	38.9% (21)
<b>Travelling time (mins), median (IQR)</b>	20 (10, 30)	12 (10, 20)	40 (27.5, 60)	15 (10, 20)
<b>Session time (mins), median (IQR)</b>	30 (30, 30)	45 (30, 45)	45 (45, 60)	32.5 (30, 45)
<b>Total time per week (hours), mean</b>	3.9	4.2	4.5	4.2

IQR, interquartile range.

<sup>a</sup> Therapy sessions that took place in the institution where the patient was living (full or part time).

## Figure legends

**Fig. 1.** Evaluation by caregivers (n = 86) of the difficulty of various aspects of treatment preparation and administration.

**Fig. 2.** Perception by mothers (n = 87) and fathers (n = 85) of the general health of their child having DS (as reported by either parent) and themselves.

**Fig. 3.** Multinomial model linking perception of health and seizure frequency.

**Fig. 4.** Impact of caring for a child with DS on the professional life of parents.

Survey questions were as follows:

- Do you have difficulty in keeping or finding a job because of the disease of your DS child (mothers n = 82, fathers n = 84). Response categories: yes/no/other
- Have you ever have had work interruption or sick leave of at least 1 week because of the disease of your DS child (mothers n = 82, fathers n = 83). Response categories: yes, once/yes, several times/no, never (figure shows percentage who replied yes, once or yes, several times)
- Have you asked for an arrangement of your working conditions because of the disease of your DS child (either a tacit agreement or more formally) (mothers n = 81, fathers n = 86). Response categories: yes/no
- Did you stop working for more than 6 months because of the disease of your DS child (mothers n = 85, fathers n = 85). Response categories: yes, but not permanently/yes, permanently/no (figure shows percentage who replied yes, but not permanently or yes, permanently)







