



Parent reported health related quality of life (HRQoL) and behaviour in young people with epilepsy before and two years after epilepsy surgery

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ABSTRACT

Purpose: The aim of this study was to compare parent-reported Health Related Quality of Life (HRQoL) and behaviour of young people before (baseline) and two years after paediatric epilepsy surgery (follow-up).

Methods: The parents of 107 children who underwent epilepsy surgery completed surveys focussing on different aspects of child HRQoL and behaviour at baseline and follow-up. Parents of children with multiple disabilities ($n = 27$) completed five additional questions focussing on child HRQoL. Changes in scores between baseline and follow-up were compared using Wilcoxon signed-rank tests. Factors associated with changes in scores were analyzed using linear regression.

Results: HRQoL and behaviour were significantly improved at follow-up ($p < 0.001$). HRQoL was also significantly improved for children with multiple disabilities ($p = 0.003$). Factors independently associated with improvement in HRQoL on multivariable analysis were lower baseline scores ($p < 0.001$), seizure-free status ($p < 0.001$) and improvement in behaviour ($p = 0.022$). Factors independently associated with improvement in behaviour were higher baseline difficulties ($p < 0.001$), reduction in antiepileptic drug (AED) usage, ($p < 0.001$), seizure-free status ($p = 0.04$), younger age ($p = 0.03$), and improvements in HRQoL ($p = 0.028$).

Conclusion: Parent rated HRQoL and behaviour had improved two years after epilepsy surgery. Seizure freedom was associated with both improvements in HRQoL and behaviour. Additionally, a reduction in AED usage contributed to reduced behavioural difficulties. All children undergoing epilepsy surgery should undergo assessment of HRQoL and behaviour at baseline and follow-up.

1. Introduction

Epilepsy in children is often associated with emotional and behavioural difficulties [1,2] which have a negative impact on the child's education [3] and family functioning [4], leading to reduced Health Related Quality of Life (HRQoL). Emotional and behavioral difficulties in childhood have a very significant negative impact on a child's functioning including on the child's education and social difficulties leading to significant deficits in the child's HRQoL [5,6]. Emotional and behavioural difficulties in children with epilepsy have been shown to be greater in magnitude than in other non-neurological chronic conditions [7] and often have a greater impact on HRQoL than the seizures [8–10]. Therefore, considering child behavioural and emotional needs in tandem with treating seizures is important when considering the impact

of epilepsy on child HRQoL.

According to the World Health Organization (WHO) the measurement of health and the effects of health care must include not only an indication of changes in the frequency and severity of diseases, but also an estimation of wellbeing and this can be assessed by measuring the improvement in the quality of life related to health care or HRQoL (<https://www.who.int/healthinfo/survey/whoqol-qualityoflife/en/> Accessed October 15th 2019). In the context of the current study HRQoL refers to how epilepsy impacts on physical, social and psychological aspects of wellbeing and functioning in line with a number of definitions of HRQoL [11–13] or quality of life in the context of chronic health conditions.

Childhood-onset epilepsy often has a long-term negative impact on HRQoL due to reduced life opportunities including in education and

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employment [14]. Comparisons with other paediatric chronic conditions in childhood indicate that epilepsy is associated with a lower HRQoL compared with asthma, diabetes and cerebral palsy [15]. Increasingly, improving HRQoL rather than just reducing seizures, is seen as the principal goal in the management of epilepsy in children [9,15]. Thus, considering HRQoL when evaluating treatments for epilepsy in children is important.

Surgery in children with epilepsy is successful with respect to seizure reduction or freedom provided candidates are selected appropriately [16]. However, children who are candidates for epilepsy surgery usually have a high rate of behavioural and emotional difficulties as measured by both parental rating scales [17] and clinical diagnoses [18,19]. Thus, assessing behaviour and emotional functioning before and after surgery and its impact on HRQoL is important when considering the broad psychosocial impact of surgery on children with epilepsy.

A systematic review and meta-analysis have shown that HRQoL after paediatric epilepsy surgery improves compared with pre-surgical functioning but also compared with controls with drug resistant epilepsy who have not undergone surgery [20]. Additionally, a systematic review of behaviour and emotions before and after paediatric epilepsy surgery as measured by parental rating scales shows that behaviour and emotions improved in the majority of studies where it was considered [21]. However, the majority of studies have had small sample sizes and the studies have focussed predominantly on seizure freedom in relation to contributors to improved HRQoL and behaviour. Other factors like behavioural and emotional difficulties and use of antiepileptic drugs (AEDs) may have a negative effect on HRQoL. Therefore, it is important to consider these factors as well, when assessing HRQoL before and after epilepsy surgery, which can aid presurgery counselling.

We have previously shown that parent reported symptoms of ADHD had improved two years after epilepsy surgery in a sample of children who underwent surgery in Gothenburg [22]. The purpose of the current study was to compare parental ratings of HRQoL and behaviour before and two years after epilepsy surgery in the same population. An additional aim was to consider a wide range of potential factors including epilepsy related factors, surgery related factors and child cognition associated with changes in parental ratings of HRQoL and behaviour.

2. Method

We have previously reported on this group of children [22]. In summary, the study sample comprised all young people (≤ 19 years) who underwent epilepsy surgery from 1995 to 2014 at Sahlgrenska University Hospital in Gothenburg. Information was collected longitudinally for each patient and included baseline information about epilepsy history, preoperative seizure types, mean monthly seizure frequency during the year preceding the presurgical investigation, AEDs, preoperative investigations, psychosocial data, surgical data and histopathologic diagnoses. Eligibility criteria were that the children underwent surgery as part of the epilepsy surgery programme at Queen Silvia Children's Hospital in Gothenburg. Children were excluded if they were not resident in Sweden at the time of surgery. Cognitive functioning or type of surgery were not exclusion criteria.

2.1. Outcome measures

Parents of participating children completed surveys including questions focussing on child behaviour and HRQoL at the time of pre-surgical evaluation (baseline) and two years postoperatively (follow-up). The questionnaires were in paper form, distributed by the epilepsy nurse and were self-administered at the hospital.

2.1.1. HRQoL measure

The parental survey included questions focussing on a range of aspects of HRQoL. The parents of all children completed nine questions

(see supplement 1). These nine questions were originally included in a survey from the Wellcome study of Epilepsy (personal correspondence Ann Jacoby August 15th 2019). This survey was first used in a study of quality of life outcomes in children with epileptic syndromes taking lamotrigine [23]. Items were subsequently adapted for inclusion in the Epilepsy and Learning Disabilities Quality of Life (ELDQOL) Scale [24]. The nine questions were based on a four-point Likert scale with the exception of two questions which were based on a five-point Likert scale. The nine questions were summed to give a total quality of life score (minimum 9 and maximum 38). Higher scores mean better quality of life on the nine-item quality of life scale.

Additionally, all parents were asked if their child had multiple disabilities including motor impairments and difficulties understanding language (see supplement 1). If parents answered affirmatively to this question, they were asked to complete an additional five questions focussing on aspects of HRQoL (see supplement 1). These additional questions were all based on a four-point Likert scale and had also been in the original Wellcome survey and the first four questions were also included in the ELDQOL Scale. The five questions were summed to give a total HRQoL for children with multiple disabilities (minimum 5 and maximum 20). Higher scores indicated better HRQoL on the five-item quality life scale.

2.1.2. Survey of behavioural-emotional functioning

The survey focussing on behaviour and emotions contained 14 questions (see supplement 2). Each question was based on a four-point Likert scale; Always, Often, Sometimes, Rarely/Never and were also taken from the Wellcome survey and were subsequently included in the ELDQOL [16] with some slight modifications (see supplement 2). Higher scores meant more behavioural/emotional problems. Scores on the 14 items were summed to give a total score (minimum 4 and maximum 56).

2.2. Child characteristics

Information about all the children before surgery and two years after was also collected, including age at surgery, gender, age of seizure onset, seizure frequency, use of AEDs, cognitive functioning, type of surgery and laterality of surgery.

Seizure outcome was graded as seizure-free (seizure-free with or without auras during last year of follow-up, International League Against Epilepsy [ILAE] Class I and II) [25], $\geq 75\%$ reduction, 50–74% reduction, 0–49% reduction in seizure frequency or increased seizure frequency. For patients who were not seizure-free at the two-year follow-up, the mean monthly seizure frequency in the last year of follow-up was reported. For the purposes of this study, two categories were compared: seizure-free vs non seizure-free.

2.3. Ethics

The study was approved by the University of Gothenburg Regional Board of Medical Ethics (Dnr 450-95) and informed consent was obtained from all parents.

2.4. Statistical analysis

Mean (M) scores are reported for the nine-item HRQoL scale, the five-item HRQoL scale for children with multiple disabilities and the 14-item behaviour scale at baseline and at follow-up. In addition, the number of children whose scores changed on each of the HRQoL items is reported on. Changes in the three survey total scores between baseline and follow-up were tested using Wilcoxon signed rank tests.

Standardized Response Mean (SRM) were calculated as the difference between mean values divided by the standard deviation of change scores. SRM magnitude were interpreted against the criteria suggested by Cohen for effect sizes: trivial ($0 < 0.2$), small (≥ 0.2 to < 0.5),

moderate (≥ 0.5 to < 0.8), and large (≥ 0.8) [26].

Linear regression analysis was used to identify factors associated with changes (Δ) in scores on the nine-item HRQoL and 14-item behaviour survey. The predictors in the model for the HRQoL scale were gender, age at time of epilepsy surgery in years, age of epilepsy onset in years, seizure outcome status (seizure-free vs. non seizure-free), baseline FSIQ, change in FSIQ, change in AEDs, surgery type (temporal lobe vs other), surgery type (frontal lobe vs. other), lateralisation (left vs. right), change in behaviour and presurgery HRQoL (i.e. score on nine-item scale at baseline). The predictors in the model for behaviour were the same except for baseline HRQoL was not included but baseline behaviour was included. Additionally, change in HRQoL was included as a predictor.

All predictors were first tested in a univariable manner. Multivariable analysis was then carried out via backward regression with all predictors entered into the model to identify factors independently associated with the outcome variables. Residual analyses revealed that assumptions for the linear regression model were met. The alpha level for all analyses was $p < 0.05$. All analyses were conducted using IBM SPSS version 25 (Chicago, IL, U.S.A.).

3. Results

137 children were operated on including two children who underwent epilepsy surgery on two separate occasions longer than two years apart. The parents of nine children did not fill in the surveys at baseline or follow-up. Nine parents filled in the survey at baseline but not at follow-up and six parents filled in the survey at follow-up but had not filled in the survey at baseline. One child had died before the 2-year follow up and five children were of adult age at follow-up and were not seen for follow-up at the paediatric department. The remaining 107 parents completed the surveys before surgery and at the two-year follow-up. In the case of reoperations within two years, we took the survey two years after the most recent operation.

There was not a significant difference between those who completed surveys and those who did not for seizure outcomes ($p = 0.220$), change in AEDs ($p = 0.253$), child age ($p = 0.096$), age of epilepsy onset ($p = 0.858$), child gender ($p = 0.092$) or change in child IQ ($p = 0.292$) [15].

Table 1 shows the data on the 107 children whose parents completed surveys at baseline and follow-up.

3.1. Scores on HRQoL and behaviour surveys

Table 2 shows the mean scores on all surveys at baseline and follow-up for the HRQoL and behaviour scales

3.1.1. Nine-item HRQoL scale

Cronbachs alpha – a measure of internal consistency was 0.860 at baseline and was 0.863 at 2-year follow up for the nine-item survey. Values between 0.70 and 0.90 have been suggested as acceptable [26] indicating adequate internal consistency for the nine item measure.

There was a significant improvement in the total score between baseline and follow-up ($p < 0.001$) (SRM = 1.09). 82% ($n = 79$) had an improved score, 7% ($n = 7$) had no change and 10% ($n = 10$) had worse HRQoL at follow-up. Fig. 1 illustrates the distribution of scores at baseline and 2-year follow-up for the question on quality of life. The distribution of scores for the other eight questions are shown in supplement 3.

3.1.2. Five-item HRQoL scale

Cronbachs alpha was 0.756 at baseline and was 0.741 at the 2-year follow-up indicating again adequate internal consistency for the five-item measure. There was a significant improvement in the total score between baseline and follow-up ($p = 0.003$) (SRM = 0.67) indicating better HRQoL at follow-up. 63% ($n = 17$) had an improved score, 19%

Table 1

Data on the children whose parents completed surveys before and two years after (follow-up) epilepsy surgery ($n = 107$).

Gender (male/female)	52/55
Age at surgery in years - mean (range) (SD) - parent reported	9.7 (1.5-19) (4.8)
Age at epilepsy onset in years - mean (range) (SD)	3.9 (0-17) (4.2)
Total AEDs before - mean (range) (SD)	2.3 (0-5) (1.1)
No AED	1
Monotherapy	27
Polytherapy	79
Total AEDs after - mean (range)	1.7(0-4) (1.1)
No AED	17
Monotherapy	25
Polytherapy	63
Missing	2
Type of surgery	
Temporal lobe resection	38
Frontal lobe resection	19
Parietal lobe resection	9
Occipital Lobe resection	4
Multilobar resection	1
Hemispherotomy	9
Disconnection of hamartoma	6
Corpus callosotomy	18
Multiple subpial transection	2
Insula	1
Cognitive functioning at baseline	
IQ ≥ 70	53
IQ 50-69	18
IQ < 50	36
Cerebral palsy	20
Seizure outcome at 2-year follow up	
Seizure-free	48
$\geq 75\%$ reduction in seizure frequency	22
50-74% reduction in seizure frequency	12
0-49% reduction in seizure frequency	19
Increased seizure frequency	5
Missing	1

Adapted from Reilly et al. [22].

Table 2

Mean score on HRQoL and behaviour surveys.

Survey	Baseline			2-year follow-up			
	Mean	SD	Range	Mean	SD	Range	p
HRQoL - 9 item scale*	21.71	5.76	9-38	29.01	6.04	14-38	< 0.001
HRQoL - 5 item scale**	12.39	3.48	6-19	14.65	3.19	8-20	0.003
Behaviour scale***	29.77	7.30	15-53	26.20	6.15	15-40	< 0.001

* 106 responded at baseline and 97 at follow-up (96 had both before and after).

** 36 responded at baseline and 43 at follow-up (27 had both before and after).

*** 105 responded before and 102 at follow-up (96 had both before and after data).

($n = 5$) had no change and 19% ($n = 5$) had worse HRQoL at follow-up. The distribution of scores for the five questions are shown in supplement 4.

3.1.3. Survey of behavioural-emotional functioning

Cronbachs alpha at baseline was 0.870 at baseline and was 0.848 at follow-up after surgery indicating adequate internal consistency for the 14-item measure. There was a significant improvement in the total score between baseline and follow-up ($p < 0.001$) (SRM = 0.59) indicating improved behavioural and emotional functioning at follow-up. 73% ($n = 73$) had an improved score, 2% ($n = 2$) had no change and 25% ($n = 25$) had worse behaviour at follow-up. There was an improvement at follow-up for all 14 questions see Fig. 2.

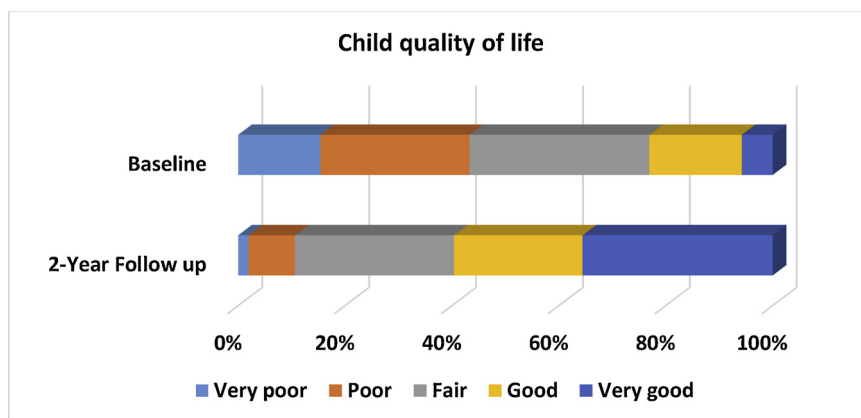


Fig. 1. Child quality of life ratings at baseline and at two year follow-up.

3.2. Regression analysis

The results of regression analysis considering factors associated with change in HRQoL on the nine-item HRQoL scale are shown in Table 3.

The factors significantly independently associated with improvement in HRQoL at follow-up were baseline HRQoL, seizure outcome and change in behaviour. Lower HRQoL at baseline was significantly associated with greater improvement in HRQoL at follow-up ($p < 0.001$). Seizure freedom was also associated with a greater improvement in HRQoL ($p < 0.001$). Additionally, reduced behaviour and emotional difficulties were also associated with an improvement in HRQoL ($p = 0.022$).

The results of regression analysis considering factors associated with change in behaviour-emotional functioning on the 14-item scale are in Table 4.

The factors significantly associated with change in behaviour and emotions at follow-up were behaviour and emotions at baseline, change in AEDs, child age, seizure outcomes and change in HRQoL. Children with the greatest amount of emotional and behavioural difficulties at baseline experienced the greatest reduction at follow-up ($p < 0.001$). A greater reduction in AEDs was associated with a greater reduction in behavioural difficulties ($p = 0.005$). Younger children had greater

reduction in behavioural difficulties ($p = 0.006$). Seizure freedom was also associated with a greater improvement in behaviour ($p = 0.010$). Additionally, increases in HRQoL were also associated with reduction in behavioural difficulties ($p = 0.028$).

4. Discussion

This is one of the largest studies to date to consider both HRQoL [20] and behaviour [21] before and at follow-up after paediatric epilepsy surgery. Additionally, the study includes children across the full range of intellectual functioning and considers a wide range of possible contributory factors to changes in HRQoL and behaviour. The reported improvements in both HRQoL and behaviour add to the literature suggesting that epilepsy surgery can have positive effects beyond seizure freedom or reduction. Whilst seizure freedom was associated with improvements in both HRQoL and behaviour in line with previous research, the finding that a reduction in AEDs was associated with improvements in behaviour highlights the potential contribution of AED burden to behavioural concerns in these children. The significant association between improved behavioural-emotional functioning and improved HRQoL highlights the need to always consider behaviour and emotions in children referred for epilepsy surgery.

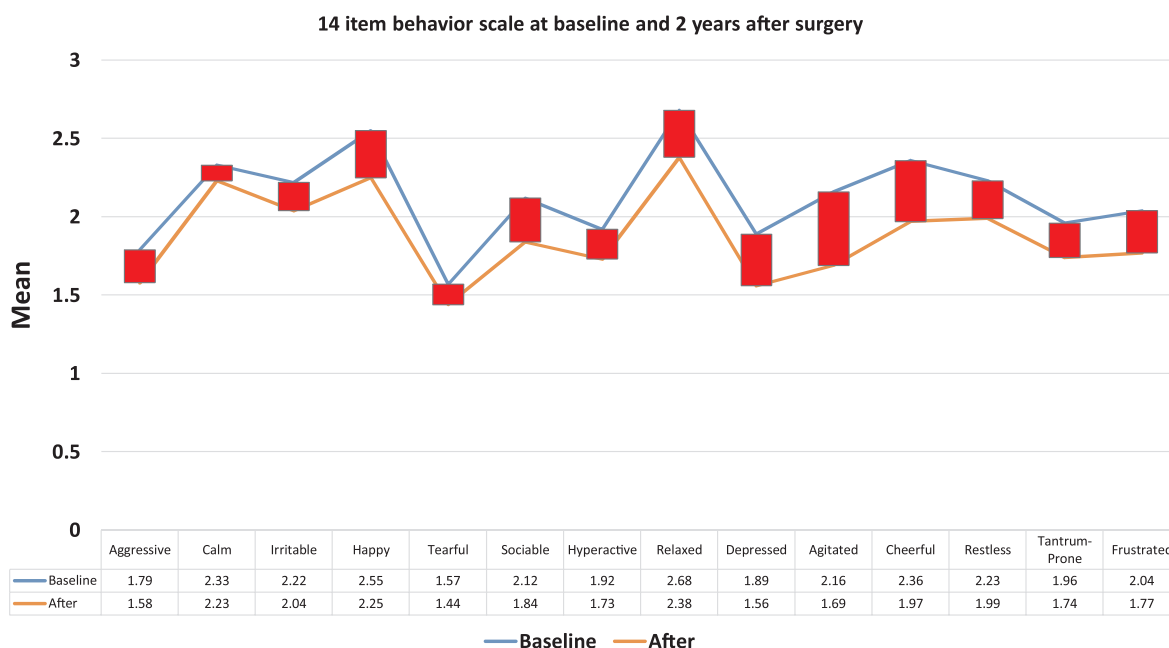


Fig. 2. Scores on items on measure of behavior and emotions before surgery and at 2-year follow up.

Table 3
Regression analysis of factors associated with change in HRQoL on 9-item scale.

	Univariable regression	p	Multivariable regression	p
Gender	7.766 (-3.177 to 1.901)	0.619	NA	NA
Age at surgery	0.025 (-0.253 to 0.304)	0.858	NA	NA
Age of epilepsy onset	0.118 (-0.195 to 0.431)	0.455	NA	NA
Change in IQ	-0.028 (-0.129 to 0.074)	0.591	NA	NA
Baseline IQ	-0.004 (-0.049 to 0.041)	0.859	NA	NA
Change in AEDs	-1.179 (-2.233 to -0.124)	0.029	-0.813 (-1.750 to 0.123)	0.088
Seizure outcome	-5.831 (-8.108 to -3.553)	< 0.001	-6.102 (-8.518 to -3.686)	< 0.001
Temporal vs. rest	0.391 (-2.284 to 3.066)	0.772	NA	NA
Frontal vs. rest	-2.247 (-5.403 to 0.910)	0.161	-2.049 (-4.355 to 0.258)	0.81
Laterality	2.579 (-0.263 to 5.420)	0.075	NA	NA
Change in behavior	-0.351 (-0.562 to -0.140)	0.001	-0.198 (-0.366 to -0.030)	0.022
Baseline HRQoL	-0.538 (-0.737 to -0.339)	< 0.001	-0.657 (-0.834 to -0.497)	< 0.001

NA as not in final model.

The improvement in HRQoL noted in this study echoes the findings of a recent systematic review and meta-analysis [20]. Furthermore, it highlights the need to look beyond core symptoms and consider a child's wellbeing when evaluating the effects of health care on chronic conditions such as epilepsy. The finding that children with multiple disabilities also experienced improved HRQoL is in line with a Canadian study of 111 children where the 24 children with intellectual disability achieved similar improvements in HRQoL after epilepsy surgery compared with those without intellectual disability [27]. These findings highlight that low intellectual functioning should not be seen as a barrier to epilepsy surgery and that children regardless of cognitive ability can have quality of life gains as a result of epilepsy surgery. Seizure freedom was associated with improved HRQoL at follow-up consistent with the majority of previous studies [20]. The significant independent association between improvement in HRQoL and improved behaviour emphasizes the close link between behaviour and HRQoL in children with epilepsy highlighted in previous observational studies [8–10] and in a previous cohort study focussing on long term HRQoL after paediatric epilepsy surgery [28]. Children with the lowest HRQoL at baseline showed the greatest improvement in HRQoL at follow-up underlining that improvements were greatest for those most in need. HRQoL is a key outcome for children with chronic medical conditions like epilepsy, and improvements in HRQoL are likely to lead to better social, educational and vocational outcomes [14]. Given the close relationship between child HRQoL and parental HRQoL [29], improvements in child HRQoL are also likely to impact positively on parental HRQoL.

The improvements in behaviour reported by parents at follow-up in the current study have also been noted in the majority of other studies [21] including the only randomized control trial of epilepsy surgery in children [30]. The positive changes in behaviour occurred across all items in the survey, highlighting that improvements were not confined

to either internalizing or externalizing behaviours. These improvements in parent reported behaviour have not been found in studies which have considered clinical diagnoses of behaviour before and after surgery [18,19,31] suggesting that improvements while noticed by parents are not significant enough to warrant a change in clinical diagnosis. The significant association between improved behaviour and seizure freedom has also been found in three of four previous studies where it has been considered [21] and also in the previous study in this group of children which focussed specifically on ADHD symptoms [22]. The significant independent association between a reduction in AEDs and improved behaviour at follow-up echoes the finding that improved IQ scores are associated with AED reduction and withdrawal after paediatric epilepsy surgery independent of other determinants of outcome [32] and the finding that early AED withdrawal after surgery does not affect seizure outcome [33]. These findings highlight the need for regular reviews of AED regimes after surgery [33]. The association between age and behavioural difficulties indicates that younger children are likely to show greater improvements in behaviour and has been found in a previous study of long-term behavioural outcomes in children who have undergone epilepsy surgery [34]. It may be that younger children have more potential for improvements due to less established patterns of behavioural difficulties. Improved behavioural and emotional functioning is also likely to lead to better functioning in school because of the often negative impact of behavioural-emotional problems on school performance in children with epilepsy [3]. Moreover, parental mental health difficulties are significantly associated with child behavioral difficulties [35] and thus improved child behaviour may have a positive impact on parental mental health.

4.1. Implications for practice and future research

The potential for improvements in HRQoL and behaviour and their

Table 4
Regression analysis of factors associated with change in behavior.

Factor	Univariable regression	p	Multivariable regression	p
Gender	0.100 (-2.335 to 2.535)	0.935	NA	NA
Age at surgery	-0.195 (-0.455 to 0.064)	0.139	-0.316 (-0.540 to -0.090)	0.006
Age of epilepsy onset	-0.244 (-0.553 to 0.085)	0.153	NA	NA
Change in IQ	0.015 (-0.081 to 0.111)	0.761	NA	NA
Baseline IQ	-0.021 (-0.062 to 0.020)	0.304	NA	NA
Change in AEDs	-0.186 (-1.247 to 0.874)	0.728	-1.351 (-2.288 to -0.414)	0.005
Seizure outcome	3.542 (1.227 to 5.857)	0.003	3.301 (0.822 to 5.781)	0.010
Temporal vs. rest	0.609 (-1.925 to 3.143)	0.634	NA	NA
Frontal vs. rest	-1.066 (-4.163 to 2.030)	0.496	NA	NA
Laterality	-4.408 (-7.082 to -1.734)	0.002	-1.782 (-3.864 to 0.300)	0.092
Behavior at baseline	-0.490 (-0.621 to -0.359)	< 0.001	-0.587 (-0.377 to -0.022)	< 0.001
Change in HRQoL	-0.305 (-0.488 to -0.122)	0.001	-0.200 (-0.377 to -0.022)	0.028

N/A as not in final model.

close relationship highlights the need for assessments before surgery and at follow-up. In considering the potential benefits of epilepsy surgery parents and young people should be made aware that benefits may go beyond seizure freedom or reduction even for children with significant cognitive and motor impairments. The need to regularly review AEDs after successful epilepsy surgery is important given the potential improvements in behaviour accruing from a reduction in AEDs.

Few studies of behaviour and emotions or HRQoL have focussed on child self-report and understanding the views of the young people themselves is important in order to better understand the wide-ranging impact of paediatric epilepsy surgery. Additionally, asking teachers about child functioning in school can also enhance understanding of how surgery may impact on HRQoL and behaviour. Studies employing qualitative methods including interviews and/or focus groups with parents and children can also enhance our understanding of how behaviour and HRQoL evolve as a result of surgery. It is also important to follow up young people who have undergone surgery over an extended period of time to see if improvements in HRQoL and behavioral and emotional functioning are maintained.

4.2. Limitations

There are a number of limitations that need to be considered in the current study. We did not have a non-surgery control group of children to provide a comparison with respect to changes in HRQoL and behaviour. The measures of behaviour and HRQoL employed in the current study were not validated although have acceptable internal consistency and many items were subsequently included in the validated ELDQOL. Furthermore, our results may reflect the approach we have adopted with respect to HRQoL and questionnaire items which can be seen to consider quality of life as related to the broad physical, social and psychological impact of epilepsy. There is an ongoing debate regarding the nature of quality of life and HRQoL [36] in research and we may have found different results if we had used a different questionnaire with a different conceptualization of HRQoL.

The sample size although relatively large in this field was not sufficiently large enough to explore changes in HRQoL and behaviour in children with different pathologies or who underwent different surgical procedures. We relied solely on parent report measures. Clinical assessment of functioning or reports from the children themselves would have enhanced findings. We did not have information on the nature of supports received by the children in the two years between surgery and follow-up and these supports may have impacted on both behaviour and HRQoL. The children with multiple disabilities were selected based on parent report only and not professional assessment.

5. Conclusion

The findings of the current study add to the knowledge base on the impact of paediatric epilepsy surgery on behavioural-emotional functioning and HRQoL. There is a close relationship between HRQoL and behaviour and emotions in these children. Improvements in HRQoL are not confined to children without intellectual disability and seizure freedom is not the only factor contributing to improvements in behaviour and HRQoL.

Conflicts of interest

The authors have no conflicts of interest. 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.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.seizure.2019.11.004>.

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