Socioeconomic status and quality of life in children with chronic disease – a systematic review

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Abbreviations: CHQ - Child Health Questionnaire; CKD - Chronic Kidney Disease; DQLQY-SF - Diabetes Quality of Life for Youth short form; GFR - Glomerular Filtration Rate; HADS - Hospital Anxiety and Depression Scale; HRQoL - Health-related Quality of Life; ICI - Impact of Childhood Illness; PAQLQ - Paediatric Asthma Quality of Life Questionnaire; PedsQL - Pediatric Quality of Life Inventory; QoL - Quality of Life; QOLCE - Quality of Life in Children with Epilepsy; QOLIE-AD-48 - Quality of Life in Epilepsy Inventory for adolescents; SES - Socioeconomic Status; SF-36 - Short-Form 36; SMD - Standard Mean Difference; T1DM - Type 1 Diabetes Mellitus

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ABSTRACT

Background: Reduced quality of life (QoL) is a known consequence of chronic disease in children, and this association may be more evident in those who are socioeconomically disadvantaged.

Aim: The aims of this systematic review were to assess the association between socioeconomic disadvantage and QoL among children with chronic disease, and to identify the specific socioeconomic factors that are most influential.

Methods: MEDLINE, Embase and PsycINFO were searched to March 2015. Observational studies that reported the association between at least one measure of social disadvantage in caregivers and at least one QoL measure in children and young people (age 2-21 years) with a debilitating non-communicable childhood disease (asthma, chronic kidney disease (CKD), type 1 diabetes mellitus (T1DM) and epilepsy) were eligible.

Results: Thirty studies involving 6,957 patients were included (asthma [6 studies, n=576], CKD [4 studies, n=796], epilepsy [14 studies, n=2121], T1DM [6 studies, n=3464]). 22 (73%) studies reported a statistically significant association between at least one socioeconomic determinant and QoL. Parental education, occupation, marital status, income, and health insurance coverage were associated with reduced QoL in children with chronic disease. The quality of the included studies varied widely and there was a high risk of reporting bias.

Conclusion: Children with chronic disease from lower socioeconomic backgrounds experience reduced QoL compared to their wealthier counterparts. Initiatives to improve access to and usage of medical and psychological services by children and their families who are socioeconomically disadvantaged may help to mitigate the disparities and improve outcomes in children with chronic illnesses.

INTRODUCTION

Socioeconomic disadvantage is recognized as a key determinant of health among people of all ages, presenting a major challenge for healthcare worldwide. For every decrement in the socioeconomic gradient, there is a proportional reduction in health outcomes among school-aged children.¹

Children and adolescents of socioeconomically disadvantaged families are more than twice as likely to experience acute illness but also chronic conditions such as asthma, obesity,² mental illness,³ and developmental delay,⁴ compared with their wealthier counterparts. Such relationships are observed worldwide across all incomes.⁵

The aims of this study were to synthesise the available evidence regarding the association between socioeconomic indicators and health related quality of life (HRQoL) of children with four common chronic diseases of childhood (asthma, chronic kidney disease (CKD), type 1 diabetes mellitus and epilepsy), and to identify the specific socioeconomic indicators that may have the greatest impact on their QoL.

METHODS

We conducted a systematic review based on standard methods and reporting in accordance with the Meta-Analysis Of Observational Studies in Epidemiology (MOOSE) guidelines.

Inclusion criteria

Studies were included, without language restriction, if they had measured and reported the QoL in children and young people (aged 2 to 21 years) in one of four conditions (epilepsy, CKD, type 1 diabetes mellitus or asthma) and had measured and reported at least one of the following socioeconomic variables (family income, mother's and/or father's educational attainment, mother's

and/or father's occupation, measures of socioeconomic position such as parents' marital status, parents' health, and health insurance). All types of observational studies were eligible for inclusion, including cross-sectional, cohort and case-control designs.

Data sources and literature searches

MEDLINE, Embase and PsycINFO were searched without language restriction from inception to March 2015. The search strategies are shown in Appendix 1. The reference lists of included studies were also hand searched for studies for inclusion.

Data Extraction

Study titles, abstracts and full text articles were reviewed independently by two authors to determine eligibility. Data were extracted using standardized data extraction forms by M.D. and M.M.. Relevant information such as the number and characteristics of participants, SES measures and QoL outcomes were extracted.

We collected data on all reported QoL measures including individual domains that were related to physical, mental, emotional and social functioning of the child where socioeconomic determinants were measured as independent variables. Non-English language publications were translated before assessment. Where further data were needed, corresponding authors were contacted. Due to substantial variability in the magnitude of the data reported, and how analyses were conducted and reported (see appendix 2), we were unable to estimate the point estimate and degree of imprecision for most studies, and so have reported the p values, as calculated by the study authors.

Risk of bias assessment

The risk of bias of included studies was assessed independently by two authors (M.D. and M.M.) using the Ottawa-Newcastle tool adapted for cross-sectional studies. The domains included rationale and objectives, study design, setting and participants, data sources and measurement bias, statistical methods, limitations and generalizability. Any differences were resolved by discussion until consensus.

Data synthesis and statistical analyses

Given the heterogeneity of QoL measures reported, standardized mean differences were calculated using random effects models with p values less than 0.05 considered statistically significant. Heterogeneity was assessed using the chi-square test and the I^2 statistic. We attempted to assess the possible sources of heterogeneity using pre-defined covariates, but insufficient data precluded this approach. Outcomes were stratified by the four disease type. Publication bias was assessed using funnel plots where appropriate. All analyses were conducted using Review Manager Version 5.

RESULTS

Characteristics of the included studies

Of the 8,311 records identified, 30 eligible studies involving 6,957 children aged 2 to 21 years from 14 countries were included (asthma [6 studies, n=576], CKD [4 studies, n=796], epilepsy [14 studies, n=2121], Type 1 diabetes mellitus [6 studies, n=3464]) (Figure 1). Twenty-nine studies were cross-sectional and one was a two-year longitudinal cohort study. The characteristics of included studies are shown in Table 1. A wide variety of QoL measures were used including generic QoL instruments (11 studies), disease specific instruments (17 studies), and a combination of both (2 studies). The most frequently used generic QoL instruments were the Pediatric Quality of Life Inventory (PedsQL) or an adapted version of the PedsQL (6 studies),⁶⁻¹¹ the Short-form 36 (SF-36) (2 studies),^{12,13} the Impact of Childhood Illness scale (ICI)(2 studies),^{14,15} the Child Health Questionnaire- Parent Form (1 study),¹⁶ the DISABKIDS chronic generic model (1 study),¹⁷ and the KINDL questionnaire (1 study).¹⁸ Disease specific questionnaires included the Paediatric Asthma Quality of Life Questionnaire (PAQLQ) (6 studies),¹⁹⁻²⁴ the Quality of Life in Children with Epilepsy (QOLCE) questionnaire (5 studies),^{16,25-28} the Quality of Life in Epilepsy Inventory for adolescents (QOLIE-AD-48) (3 studies),^{18,29,30} the PedsQL T1DM module (2 studies),^{31,32} the Diabetes Quality of Life for Youth short form (DQLQY-SF)(1 study),³³ the Impact of Epilepsy Schedule (1 study),³⁴ and the Epilepsy and Children questionnaire (1 study).³⁵

Single-domain SES factors included household income (11 studies),^{9,12,16,19-22,25,28,33,34} mother's education (15 studies),^{6,8,11,13,14,17,19,22-28,34} father's education (11 studies),^{8,13,14,19,22,24-28,34} highest level of parent's educational attainment (2 studies),^{16,32} and the level of health insurance (1 study).³² Eleven studies utilized composite measures including the two- and four-factor Hollingshead indices

(a combined measure of education and occupation) (5 studies),^{7,10,15,30,31} the criteria for socioeconomic stratification in Brazil (2 studies),^{19,21} the revised Kuppuswamy scale (1 study)²⁶ or were based on social class (3 studies).^{11,18,34}

Risk of bias assessment

The risk of bias assessment of included studies is shown in Figure 2. Overall, the risk of bias was high. Of the 30 studies included in the review, only 14 studies (47%) reported the number of patients at each stage. Twenty-one studies (70%) reported their eligibility criteria and methods of selection. Twenty-eight studies (93%) used a validated QoL tool while 2 studies (7%) did not. Reporting of outcome measurement and statistical methods was adequate in 27 (90%) studies and unclear in 3 studies (10%). Adjustment for confounders was only conducted and reported in two studies (7%).^{7,32}

Association between socioeconomic measures and QoL

The clinical outcomes are summarized in Appendix 2. Twenty-two of the 30 included studies (73%) reported a significant association between at least one SES measure and the health-related quality of life (HRQoL) of children and adolescents with chronic disease (Figure 3). Of the 30 studies included, only 4 reported data with sufficient detail allowing an estimate of the summary effect.

Mother's educational attainment (15 studies, 2440 children): Of the fifteen studies that examined this, ten (67%) reported a statistically significant association between higher level of maternal education and better QoL of the child. This was seen across all four diseases. In 42

Brazilian children with asthma, maternal educational attainment was the single significant predictor of the child's QoL, but no statistically significant association between other factors such as maternal occupation, marital status, the child's disease severity and QoL outcomes were observed.²³

Children with CKD whose mothers had completed more than 16 years of schooling experienced better overall mean scores across the four domains of the PedsQL questionnaire [schooling ($p < 0.05$), emotional functioning ($p < 0.05$), physical functioning ($p < 0.05$) and social functioning ($p < 0.05$)] compared to children whose mothers with less schooling.⁶ In children with type 1 diabetes mellitus, the levels of maternal educational attainment were important determinants of general health ($p < 0.01$), social functioning ($p < 0.006$) and mental health ($p < 0.04$) components of the SF-36 in adolescents studied.¹³

Father's education attainment (11 studies, 1530 children): Of the eleven studies that included this as a predictor variable, only one reported a statistically significant association between the level of paternal educational attainment and QoL outcomes of the child. One study of children with epilepsy found that children whose fathers had higher educational degrees scored better in the social activities domain of the QOLCE questionnaire than those whose fathers were less educated ($p = 0.04$).

Parents' educational attainment (not specified mother or father or combined) (2 studies, 2885 children): Children with type 1 diabetes mellitus whose parents' highest level of education was less than high school experienced reduced QoL scores (Pediatric Quality of Life- Diabetes Mellitus (PedsQL-DM) compared to those whose parents' collective highest education was of high school standard or had received tertiary education ($p < 0.001$) in the univariate analysis.³² The combined

measure of parental educational status did not have any significant association with QoL outcomes amongst the children with epilepsy.¹⁶

Parents' education (4 studies, 2,896 children): Children with epilepsy or type 1 diabetes mellitus whose parents had attained high school and tertiary levels of education had better overall QoL compared to those whose parents were of primary education levels (mean difference (MD): 5.74, [95% CI 1.22 to 10.26, $I^2 = 73\%$, $p = 0.01$], standardized mean difference (SMD): 0.52, [95% CI 0.01 to 1.03], $I^2 = 85\%$, $p = 0.05$, $n = 4$ studies, 2896 patients) (figure 4).

Parents' occupation/employment status (11 studies, 1585 children): Parental occupation and employment status were significant predictors of the child's HRQoL in three out of eleven studies (27%). Following the socioeconomic classification proposed by Domingo-Salvany and Marcos-Alonso³⁶, based predominantly on parents' occupation, children with epilepsy whose parents were classified as lower SES experienced worse mean QoL scores across the three domains of the Quality of Life in Epilepsy Inventory for Adolescents (QOLIE-AD-48) [physical functioning ($p = 0.03$), social support ($p < 0.01$), and school behavior ($p = 0.01$)] compared to those whose parents were from a higher SES background.²⁹

Household income (11 studies, 1670 children): Of the eleven studies that considered income as a SES measure, four (36%) reported a statistically significant and positive association between this and the overall HRQoL.^{12,20,28} Children with CKD, epilepsy and asthma living in families considered affluent had higher overall mean QoL scores in all domains of the PAQLQ, the SF-36,^{12,20} and the QOLCE questionnaires^{28,37} compared to families who were less well-off. Only one

study explored the effect of household income on QoL in children with type 1 diabetes mellitus, and did not report a statistically significant relationship between income and QoL outcomes.³³

Parental marital status (8 studies, 1615 children): This was also an important predictor of overall QoL. Adolescents with diabetes whose parents were living together experienced better overall QoL scores on the DISABKIDS questionnaire (mean score 82.8 ± 10.4) compared to those whose parents were separated (71.7 ± 14.9 , $p = 0.027$).¹⁷ Similarly, children with epilepsy whose parents were living together or with other partners had higher overall QoL scores compared to those whose parents who were either separated or divorced ($p = 0.02$).¹⁴ Similar findings were observed amongst children with CKD and type 1 diabetes mellitus.^{17,38}

Insurance status (1 study, 2602 children): A single study conducted in the United States ($n = 2,606$) reported that the overall QoL scores on the PedsQL-T1DM among adolescents with type 1 diabetes whose parents have private health insurance (mean score 75.0 ± 12.9) or government-funded insurance (74.5 ± 15.5) were significantly higher compared to those with Medicaid (70.2 ± 14.2) or no insurance (68.8 ± 16.5 , $p < 0.001$).¹⁴

Parents' health (1 study, 418 children): Parental self-rated physical and psychological health may have a significant effect on the overall QoL outcomes in children with epilepsy. Children whose parents/caregivers with depressive symptoms, measured using the hospital anxiety and depression scale (HADS), experienced lower overall QoL scores (mean score 54.2 ± 17.5) compared to children with non-depressed parents (67.6 ± 13.4 , $p < 0.001$). Similarly, children of parents with a

history of anxiety had lower mean scores (57.7 ± 17) than those whose parents did not have anxiety (69.3 ± 13.6 , $p < 0.001$).²⁸

Composite measures of socioeconomic status (11 studies, 1354 children): Of the eleven studies that included composite measures of SES in their analyses such as the Hollingshead index, five studies (45%) reported better QoL with higher SES quintiles. Among children with epilepsy, those with lower SES experienced poorer overall QoL scores using the QOLIE-AD-48 instrument, and lower scores for the stigma and health perceptions domains compared to children whose families were from higher SES background.³⁰ A similar effect on QoL was observed in children with asthma, epilepsy and type 1 diabetes mellitus.^{21,31,39}

DISCUSSION

Our findings suggest that the SES of parents/caregivers may be a determinant of health related QoL of children and adolescents with chronic disease. The impact on QoL appears to be consistent across the four conditions studied. The most frequently reported SES indicators that predicted this were household income and the level of maternal educational attainment.

Although income may be an imperfect measure of SES, we have shown that low household income may be associated with negative well-being and QoL amongst children with chronic disease. This finding is consistent with studies that involved children without chronic illness, with the majority of these studies indicating a causal and incremental relationship between financial resources and child health outcomes.⁴⁰ In our review, the lack of available data precluded detailed assessment of the relationship between income levels and HRQoL in children with chronic disease but previous

literature have suggested a disproportionately poorer health outcomes as the total household income decreased.⁴¹

The level of parental education may play an important role in influencing the HRQoL in this group. The majority of studies reported a statistically significant relationship between higher maternal education and improved overall children's QoL outcomes across all four conditions. Higher educational levels may increase caregivers' knowledge facilitating better coping strategies to manage the health of their children.⁴² While children with chronic illness whose caregivers have low health literacy are twice as likely to use health services,⁴³ the caregivers may experience difficulty with medication and treatment instructions, and thus implementing health care for the child.⁴² Parents who have low health literacy are more likely to report their child's health as "fair" or "poor" even after controlling for social factors and disease severity.⁴³ Greater education attainment also led to better employment opportunities and higher household incomes, which were also associated with better QoL and life expectancy.

The findings between private insurance status and health outcomes were largely confined to studies in the United States, where uninsured children were less likely to have access to a regular primary care physician and have more difficulty accessing after-hours care compared to insured children.⁴⁴ Even though insurance did not improve a child's parent-reported health status,⁴⁵ children without insurance suffer from greater illness severity, are more likely to be hospitalized, and have higher overall mortality rates than those with private insurance in the United States.⁴⁶ Whilst only a single study in this review examined parents' health as a QoL determinant in children with chronic disease, studies in the general population have shown that parental health affects the overall health

and well-being of children without chronic illness.⁴⁷ Parental mental illness may also negatively influence the child's emotional and social functioning, development, and is further perpetuated by lower household income.⁴⁸

Our study has a number of potential limitations. Estimating the magnitude of the impact of SES was problematic given the heterogeneous outcomes measures, high risk of bias, the potential for reporting bias, low power of the included studies, and imprecision in the point estimates of individual studies. In addition, there was little consistency in how QoL is measured with 13 different instruments being used across the 30 studies highlighting a need to define a minimal set of core outcome measures when assessing QoL in children with chronic illness. Few studies had provided adequate information regarding a clinically significant difference in QoL making the interpretation of the findings difficult. QoL outcomes are commonly secondary outcomes or reported ad-hoc and therefore may not be indexed or found using a text word search, and so we may have missed some eligible studies. All but one of the included studies were cross-sectional studies and provided a “snapshot” of the association between socioeconomic factors and QoL outcomes, at a specific point in time, without follow-up data. As such, inference of causality between SES and quality of life outcomes in children with one of the four chronic illnesses is limited. In addition, variations in income within households over time and health outcomes were not explored. Finally, we were unable to reliably generate estimates of the association given the significant heterogeneity in the measurement and reporting of the socioeconomic and QoL domains. Given the relatively small number of studies available in the meta-analyses, we were also unable to perform any detailed subgroup analyses to explore interactions between patient characteristics such as ethnicity, cultural

beliefs, variability in the healthcare and social structures across the countries and their impact on the overall QoL.

Reports of intervention towards reducing health inequities in children are scarce and largely directed towards illness prevention in childhood development, and more condition-specific research is needed in the population of children with chronic disease. Previous trials have demonstrated that multidisciplinary team care arrangements where asthma education is provided to children and their families improves quality of life and self-management, and reduces unscheduled visits to hospital and inpatient admissions.⁴⁹ A review of interventions to reduce health disparities in the adult population has shown that multifactorial, culturally tailored interventions involving multi-disciplinary collaboration are the most effective at improving outcomes in disadvantaged patients.⁵⁰ Based on the current available evidence, it is likely that interventions that strengthen the relationships between clinical and social services, the family and the wider community will be the most effective in improving quality of life in children with chronic disease.

CONCLUSION

The level of education attainment of the caregivers and household income are the two most frequently reported SES indicators that may directly influence the overall health and well-being of these children with asthma, epilepsy, type 1 diabetes mellitus and CKD. Although many of these SES determinants are difficult to modify, the health system may play an important role in achieving more equitable health outcomes for the populations. This could possibly be attained through improving availability, accessibility and acceptability of health services to children of the lowest

SES or marginalized groups, by providing culturally sensitive, holistic and affordable general and specialty paediatric services with multidisciplinary and community involvement.

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Ms Didsbury designed and performed the research, analyzed the data, and wrote the article.

Dr Kim designed and performed the research, analyzed the data, and contributed to the writing of the article.

Ms Medway performed the research, analyzed the data, and contributed to the writing of the article.

A/Prof Tong advised on the performance of the research and data analysis and contributed to the writing of the article.

Drs McTaggart, Walker, White, Mackie and Kara advised on the performance of the research and revised the article.

Prof Craig designed and performed the research, analyzed the data, and revised the article.

A/Prof Wong conceived, designed and performed the research, analyzed the data, and wrote the article.

KEY POINTS

1. Socioeconomic status appears to affect the quality of life in children with asthma, epilepsy, type 1 diabetes mellitus and chronic kidney disease
2. Social factors that may play a role in determining outcomes of children with chronic disease include household income, the mother's and father's educational attainment and occupation, the parent's marital status, parent's level of health, and health insurance.
3. Further data with a core set of outcomes is needed to delineate the relationship between carer social status and the child's quality of life in children with chronic illness.

MULTIPLE CHOICE QUESTIONS

1. Which socioeconomic factors may play a role in determining quality of life in children with chronic disease?

- A. Household income
- B. Level of mother's educational attainment
- C. Parents' occupation
- D. Parents' marital status
- E. All of the above

Answer: E. All of the above factors have been shown to influence quality of life in children with chronic disease by studies included in this review.

2. In this review, which socioeconomic variable was most frequently associated with better quality of life outcomes in children with chronic disease?

- A. High educational level of father
- B. High educational level of mother
- C. Higher household income
- D. Level of health insurance
- E. Better parental health

Answer: B. Higher maternal education levels. In this review, 10 studies reported a statistically significant association between higher level of maternal education and better QoL of the child.

3. Which subgroup of children with chronic disease are most affected by socioeconomic status according to this review?

- A. Asthma
- B. Epilepsy
- C. Type 1 diabetes
- D. Chronic kidney disease
- E. It remains unclear

Answer: E. Estimating the magnitude of impact was impossible given the heterogeneity of reporting across studies.

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Appendix 1: Search strategy

1. exp Diabetes mellitus/
2. exp renal insufficiency, Chronic/
3. exp asthma/
4. exp epilepsy/
5. 1 or 2 or 3 or 4
6. exp socioeconomic factors/
7. socio economic factors.tw.
8. socioeconomic factors.tw.
9. (socioeconomic adj3 conditions).tw.
10. (socio economic adj3 conditions).tw.
11. (socio economic adj3 disadvant\$).tw.
12. (socioeconomic adj3 disadvant\$).tw.
13. (socio economic adj3 position).tw.
14. (socioeconomic adj3 position).tw.
15. socio economic status.tw.
16. socioeconomic status.tw.
17. 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16
18. exp Social Class/
19. social class.tw.
20. exp social conditions/
21. social conditions.tw.
22. Poverty/
23. poverty.tw.
24. health status disparities/
25. 18 or 19 or 20 or 21 or 22 or 23 or 24
26. 17 or 25
27. exp Child/
28. child*.tw.
29. girl*.tw.
30. boy*.tw.
31. exp Pediatrics/
32. pediatric*.tw.
33. paediatric*.tw.
34. Adolescent/
35. adolescent*.tw.
36. 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35
37. 26 and 36
38. 5 and 37
39. 27 or 28 or 29 or 30 or 31 or 32 or 33
40. 26 and 39
41. 5 and 40

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Appendix 2: Study Outcomes

Study	QoL measure	Analysis type	Data	P value
ASTHMA (6 Studies)				
Amaral 2014	PAQLQ	Multivariate regression analysis	PAQLQ scores (Mean, SD)	
			Household income	
			Up to 308 USD	
			≥2 minimum wages	
			Household income	0.317
			Summary scale	4.1(1.21)
			Activity domain	4.34(1.3)
			Symptom domain	3.91(1.42)
			Emotion domain	4.02(1.39)
			Social class	0.352
			Summary scale	3.97(1.25)
			Activity domain	4.26(1.42)
Erickson 2002	PAQLQ	Multiple linear regression, then bivariate correlations for variables with >0.4 correlation with PAQLQ scores	ABEP Class B	
			ABEP Class C/D	
			Summary scale	4.45(1.39)
			Activity domain	4.15(1.21)
			Symptom domain	3.93(1.58)
			Emotion domain	4.04(1.28)
			Education	0.301
			Summary scale	4.77(1.52)
			Activity domain	4.44(1.34)
			Symptom domain	4.13(1.59)
			Emotion domain	4.25(1.24)
			SE	R (R ²)
Gomes de Souza 2012	PAQLQ	Mean HRQoL scores were analysed against independent variables with Mann-Whitney, Kruskal-Wallis and Dunn tests	Mean PAQLQ scores	
			Employed	
			Unemployed	
			Occupation of the head of the family	0.51
			Summary scale	4.8
			Activity domain	4.4
			Symptom domain	4.3
			Emotion domain	0.66
			Household income	0.56
			Summary scale	4.7
			Activity domain	4.4
			Symptom domain	4.6
Perosa 2012	PAQLQ	Univariate logistic regression	equal to two minimum wages	
			greater than 2 minimum wages	
			Summary scale	4.7
			Activity domain	4.8
			Symptom domain	4.7
			Emotion domain	0.9
			Social class	0.96
			Upper middle	4.6
			Lower middle	4.8
			Working	0.61
			Summary scale	5.4
			Activity domain	4.6
Ramirez Narvaez 2006	PAQLQ	Bivariate analysis and student T test	Maternal education	0.02
			Maternal occupation	0.56
			Maternal occupation	0.85
			Maternal education	0.56
			Maternal occupation	0.85
			Maternal education	0.56
			Maternal occupation	0.85
			Maternal education	0.56
			Maternal occupation	0.85
			Maternal education	0.56
			Maternal occupation	0.85
			Maternal education	0.56
			Maternal occupation	0.85
Nogueira 2009	PAQLQ	Multivariate analysis (log-bivariate regression model)	Good QoL, n (%)	
			Bad QoL, n (%)	
			P	
			Primary not complete	34 (52.31)
			Primary complete	25 (48.08)
			High school not completed	12 (54.55)
			High school completed	39 (66.10)
			Primary not complete	38 (55.88)
			Primary complete	27 (48.21)
			High school not completed	11 (45.83)
			High school completed	40 (65.57)
			Up to 1 minimum wage	6 (46.15)
			1 to 2 minimum wages	40 (55.56)
			2 to 4 minimum wages	54 (57.45)
			4+ minimum wages	16 (51.61)
			Single	3 (100)
			Married	72 (53.73)
			Separated	32 (56.14)
			Widowed	9 (50)

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Study	QoL measure	Analysis type	Data	P value
CHRONIC KIDNEY DISEASE (4 Studies)				
Gerson 2010	PedsQL	Linear regression	Mother's education	
			Maternal education 15-16 y beta (95% CI)	
			Overall QoL	-0.2 (-4.4 to 4.0)
			Physical QoL	2.5 (-2.4 to 7.3)
			School QoL	-1.4 (-6.9 to 4.0)
			Emotional QoL	-1.9 (-7.3 to 3.4)
			Social QoL	-1.6 (-7.2 to 4.1)
			Overall QoL	2.4 (-1.7 to 6.5)
			Physical QoL	4.3 (-0.8 to 9.4)
			School QoL	5.6 (0.2 to 10.9)
			Emotional QoL	-3.2 (-7.7 to 1.4)
			Social QoL	3.5 (-1.8 to 8.8)
Kitts-Patrusinska 2013	PedsQL	Mann-whitney test, student's t test, univariate and multivariate analyses	Marital status	
			Overall QOLCE Score	68.0 (55-88)
			Social domain	68.0 (55-88)
			Socioeconomic block	0.57±0.56 (-0.58 to 1.72)
Malekshahi 2011	SF-36	Hierarchical regression analysis	Age	0.011
			Sex	0.009
			Family income	0.009
			Education	0.009
Marciano 2011	PedsQL	Logistic regression	No data available. Socioeconomic status [Family income] was not associated with lower HRQoL scores.	

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Study	QoL measure	Analysis type	Data	P value
EPILEPSY (14 Studies)				
Arya 2014	QOLCE	Student t test, ANOVA	Overall QOLCE score (mean, SD)	
			Mother's education	0.894
			Illiterate	66.8 (4.83)
			Until high school	66.8 (5.05)
			Above high school	65.8 (5.21)
			Father's education	0.673
			Illiterate	68.1 (4.27)
			Until high school	66.3 (5.65)
			Above high school	66.3 (5.65)
			Socioeconomic status	0.968
Aggarwal 2011	QOLCE	Mean (SD), intragroup Tukey test used for QOLCE vs SES	Overall QOL Mean (SD)	0.044
			Mother's education	59.8 (15.4)
			Primary school (n=23)	51.2 (11.60)
			High school (n=9)	55.0 (13.8)
			SES (based on parent's occupation)	P value
Benavente-Aguilar 2004	QOLIE-AD-48	ANOVA	Physical function	0.03
			Social Support	<0.01
			School behaviour	0.01
			SES (based on educational achievement and occupation of both parents)	0.05
			Stigma	0.05
Devinsky 1999	QOLIE-AD-48	Multiple regression analysis	Health perceptions	0.05
			Standardized estimate (beta)	
			Total QOLIE-AD-48 score	0.16
Haneef 2010	PEDS-Q	Pearson's test	Not data available. The socioeconomic status of the family correlated positively with the child's psychosocial and total summary scores.	
			RR	95% CI
			Maternal education <10 years	1.43 1.04, 1.97
Lagunja 2009	Own questionnaire based on PedsQL	Chi-squared, OR, logistic regression analysis	Low social class	0.61 0.31, 1.19
			Family separation	0.45 0.15, 1.42
			Maternal education <12 years	9 SE
			Exp (ß)	95%CI Exp (ß)
			-0.014 0.966 0.986	0.15, 6.54 0.989
Mahf 2005	Impact of Epilepsy Schedule	Multiple regression analysis	No data available. Higher psychopathology and lower mother's education were associated with lower quality of life scores.	
Montanaro 2004	Epilepsy and Children	General linear model	No data available. Age and socioeconomic status do not affect the QoL of young people with epilepsy.	
Nadkarni 2011	QOLCE	Chi-squared-test, ANOVA and post hoc Tukey test	Mother's education	Mean QoL (SD)
			Illiterate	52.76 (10.33)
			Literate	64.33 (7.20)
Sherman 2008	Impact of Childhood illness	Pearson's/ Spearman's r, multiple regression analysis	Predictor	B SE Beta Sempartial R
			Marital status	5.16 3.14 0.15 0.14
			Separation/divorce associated with worse HRQoL	0.23 0.02*
Speechley 2012	QOLCE, CHQ	ANOVA, multiple regression	Household income	F = 5.31
Taylor 2011	KINDL, QOLIE-AD-48	Chi-square, Mann-Whitney, independent t, Kruskal-Wallis	KINDL total score	Mean QoL (SD)
			Married	67.68 (13.78)
			Not married	65.61 (13.58)
			Social class	
			Manual	67.49 (11.82)
Williams 2003	Impact of Childhood illness	Correlation coefficients, t tests, ANOVA	Non-manual	67.53 (14.36)
			Socioeconomic status	Impact of childhood illness scale total frequency score
Yong 2006	QOLCE	Pearson analysis, multiple regression analysis	Pearson's coefficient	P value QOLCE overall score SD
			0.043	NS
			Family monthly income (RMB)	
			Low (<600)	61.7 17.5
			Middle (600-2000)	63.4 16.2
			High (>2000)	63.7 16.2
			Paternal health	0.131 <0.001
			Good	64.2 16.4
			Normal	58.0 12.8
			Poor	57.0 20.0
			Maternal health	0.167 <0.001
			Good	64.8 16.4
			Normal	56.2 14.8
			Poor	55.9 15.9
			Items	R (%) P-value
			QOLCE score	Factors
			Paternal career	4 0.00
			Physical activities	Maternal health 7 0.02
			Well-being	Family economic 5 0.06
			Social activities	Maternal education 5 0.07
			General QoL	Paternal health 6 0.04
				7 0.01
				Maternal health 4 0.05

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Study	QoL measure	Analysis type	Data	P value															
TYPE 1 DIABETES (6 studies)																			
Al-Akour 2010	DQLQY-SF	Multivariate analysis: general linear model	"Mothers' and fathers' employment status and family income were not significantly associated with any aspects of DQLQY-SF". (No further data available).																
Harberger 2009	DISABKIDS	Multiple linear regression	<table><tr><td>Mother's education for children aged 8-12</td><td>Mean generic HRQL score</td><td>Mean diabetes specific HRQL score</td><td>Beta coefficient</td><td>p value</td></tr><tr><td>More than high school</td><td>81.1 (9.3)</td><td>60.2(14.8)</td><td>3.4</td><td>0.043</td></tr><tr><td>Less than high school</td><td>76.0(14.1)</td><td>55.3(16.6)</td><td></td><td>0.048</td></tr></table>	Mother's education for children aged 8-12	Mean generic HRQL score	Mean diabetes specific HRQL score	Beta coefficient	p value	More than high school	81.1 (9.3)	60.2(14.8)	3.4	0.043	Less than high school	76.0(14.1)	55.3(16.6)		0.048	
Mother's education for children aged 8-12	Mean generic HRQL score	Mean diabetes specific HRQL score	Beta coefficient	p value															
More than high school	81.1 (9.3)	60.2(14.8)	3.4	0.043															
Less than high school	76.0(14.1)	55.3(16.6)		0.048															
Hassan 2006	PedsQL T1DM	General linear model: univariate analysis	No data available. Higher SES was associated with better QoL. (P < 0.0005).																
Lawrence 2012	PedsQL T1DM	ANOVA-F tests, GED, Pearson correlation coefficients, multivariate linear regression model, then separate multiple linear regression models	All youth (n =2606) n (%) for total sample	PedsQL-DM total score Mean (SD)	P value unadjusted	Multivariate linear regression Beta (95% CI)	P value												
			Highest parental education			<0.0001		0.0232											
			<high school graduate	112(4.3)	71.6 (16.2)		0.97 (-1.81 to 3.76)												
			High school graduate or parson correlation coefficients,	433 (16.7)	73.3 (13.6)		reference												
			Some college	861 (33.2)	75.8 (12.6)		0.53 (-0.99 to 2.04)												
			≥ bachelor degree	1184 (45.7)	71.8 (14.2)		2.03 (0.51 to 3.54)												
			Health insurance			<0.0001		0.0004											
			Private	2088 (80.4)	75.0 (12.9)		reference												
			Medicaid/Medicare	422 (16.3)	70.2 (14.2)		-3.09 (-4.60 to -1.59)												
			Other	42 (1.6)	74.5 (15.5)		0.55 (-3.51 to 4.60)												
None	45 (1.7)	68.8 (16.5)		-3.39 (-7.30 to 0.51)															
Rendell 2003	SF-36	Spearman's r test, comparison between groups with U-Mann Whitney test	Mother's education level	r															
			General health	0.5			<0.01*												
			Social functioning	0.5			<0.006*												
			Mental Health	0.4			<0.04*												
There were no significant differences in scores between lower and middle SES of diabetic children and parents across all domains according to the assessment of children and parents.																			
Tahirovic 2013	PedsQL	Mann-Whitney U test	Median score		IQR														
			Lower SES	90.4	86.3-95														
			Middle SES	87.1	78.3-93.8														

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Figure 1. Process for the selection of studies

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Figure 2. Risk of bias of included studies

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Figure 3. Association between socioeconomic factors and quality of life in children with chronic illness

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Figure 4. Association between educational level of mothers and the quality of life of their children

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