






# The Dyadic Asthma Management Questionnaire for Adolescents and Their Caregivers

## Development and Psychometric Evaluation

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**Abstract:** *Background:* Validated English language measures for dyadic assessment and analyses of family asthma management are still rare and no such measure is available in the German Language so far. *Aim:* The aim of our study was the development and psychometric evaluation of a dyadic questionnaire allowing consideration of both adolescent and caregiver perceptions about responsibility sharing and collaboration in family asthma management. *Method:* The Dyadic Asthma Management Questionnaire (DAMQ) was developed with a combined theory-driven and empirical approach. For psychometric evaluation, structural validity, internal consistency, construct validity, and readability was tested in a sample of  $N = 150$  adolescents with asthma and their primary caregivers ( $N = 125$ ). Analyses included a dyadic methodology and examination of measurement invariance across different age groups. *Results:* The DAMQ was generated as a two-part measure assessing (1) responsibility sharing and (2) collaboration in adolescent-caregiver asthma management. For both parts of the DAMQ and both adolescent and caregiver versions, a coherent factor structure with interpretable subscales and good psychometric properties (e.g., Cronbach's  $\alpha$ ,  $\omega$ , and  $g_{lb} > 70$  for all scales) could be confirmed. Indices for older adolescents ( $\geq 14$  years) proved to be better than those for younger adolescents ( $< 14$  years). *Limitations:* Limitations concerning sampling, chosen factor analytic procedures, and the need for further research are discussed. *Conclusion:* The DAMQ has the potential to serve as a useful clinical tool to identify and compare adolescents' and caregivers' perspectives on asthma management, providing a potential starting point for targeted clinical interventions.

**Keywords:** juvenile asthma management, instrument development, dyadic analyses, adolescents, caregivers

Asthma is the most common pediatric chronic disease (WHO, 2022), affecting about 6% of children and adolescents in Germany (Thamm et al., 2018). Pediatric asthma management is a family affair (Fiese & Wamboldt, 2003); its overall aim is to achieve asthma control, allow unlimited activity in daily life, minimize the risk of exacerbations, and enable normal growth of pulmonary function (Gappa et al., 2019). This places great responsibility on the young patients and their families, as effective asthma management requires motivation and adherence to a complex and demanding multicomponent treatment regimen including consistent use of medications, trigger identification and avoidance, symptom monitoring, and the management of acute asthma exacerbations (Global Initiative for Asthma, 2022). Responsibility for the asthma regimen is typically shared between the young patients and their caregivers, with children assuming progressively greater responsibility throughout adolescence (Davis et al., 2022; Kaplan & Price, 2020; Netz et al., 2020). This transition is a complex and dynamic process that is highly dependent on individual

characteristics of the youth (e.g., age, cognitive-maturational development, psychological health, self-efficacy) as well as family-related variables (e.g., family conflicts, family resources, illness representations within the family) (Lerch & Thrane, 2019; Reed-Knight et al., 2014). Assuming more responsibility for the own illness has been found positively associated with juvenile quality of life, perceived self-efficacy, and illness self-management skills (Netz et al., 2020; Sleath et al., 2022). However, premature allocation of asthma responsibility or transferring responsibility without sufficient caregiver monitoring and support (Reed-Knight et al., 2014) can contribute to the decline in adherence typically observed during adolescence (Anderson et al., 1990; Kaplan & Price, 2020; Nansel et al., 2009), leading to an increased risk of higher morbidity and mortality, greater psychological burden, and more long-term medical complications (e.g., Desai & Oppenheimer, 2011; Kaplan & Price, 2020; Morton et al., 2014; Nansel et al., 2009). Overly protective parenting and hesitant transition, on the other hand, deny adolescents opportunities to

develop sufficient asthma management competence which is also known to contribute to negative health-related outcomes (Kronenberger & Thompson, 1990; Reed-Knight et al., 2014). The transition of asthma management responsibility, therefore, is recommended to occur gradually, based on the level of assistance needed by the adolescent (Reed-Knight et al., 2014), supported by “parent-child discussions and negotiations” (Sonney et al., 2019, p. 387), and accompanied by ongoing parental involvement, supervision, monitoring, and support (Reed-Knight et al., 2014).

In research, two key aspects of family chronic illness management have been highlighted: (1) sharing of responsibilities for specific illness management tasks (e.g., Hanna et al., 2005; McQuaid et al., 2001), and (2) adolescent-caregiver collaboration in illness management (Berg et al., 2008; Beveridge & Berg, 2007; Miller, 2009; Nansel et al., 2009). Responsibility sharing focuses on the allocation of responsibility for specific illness management tasks within the family, quantifying how much responsibility both adolescents and caregivers assume in the illness regimen (Anderson et al., 1990; McQuaid et al., 2001). Adolescent-caregiver collaboration, on the other hand, focuses on how adolescents and caregivers work together in illness management, with a focus on the quality of caregiver involvement and caregiver behaviors that support the development of the adolescent’s illness management competence (Beléndez et al., 2010; Nansel et al., 2009; Wysocki et al., 2009). Caregivers typically maintain a certain level of involvement and (shared) responsibility for their child’s illness management throughout adolescence (Lerch & Thrane, 2019; McQuaid et al., 2001), the quality of caregiver involvement, however, usually sees a “shift from a directive role to a more collaborative role” (Nansel et al., 2009, p. 31).

Measures to assess family asthma management involve qualitative methods (e.g., family interviews, McQuaid et al., 2005; Miller 2009), electronic monitoring (e.g., Lee et al., 2021), and, most commonly, questionnaires. Questionnaires assessing parental involvement and adolescent-caregiver-partnership were predominantly developed in the context of juvenile diabetes (for a review of measures see Beléndez et al., 2010) with the Diabetes Family Responsibility Questionnaire (Anderson et al., 1990), the Diabetes Social Support Questionnaire (La Greca & Bearman, 2002), the Parental Support for Adolescents’ Autonomy Scale (Hanna et al., 2005), the Collaborative Parent Involvement Scale (Nansel et al., 2009), and the Perceptions of Collaboration Questionnaire (Berg et al., 2008) being commonly used measures.

For the condition of asthma, the Asthma Responsibility Questionnaire (McQuaid et al., 2001) is one of the most widely applied quantitative measures of adolescent-caregiver shared responsibility in asthma management (e.g., Davis et al., 2022; Ekim & Ocakci, 2013; Greenley et al.,

2006; Munzenberger et al., 2010; Netz et al., 2020; Sleath et al., 2022; Sonney et al., 2019). The measure, however, is only available in the English language so far and has not been validated in the context of German adolescent asthma care. Regarding the aspect of adolescent-caregiver collaboration, there is a lack of both English and German language measures for asthma patients and their families.

Previous research (mainly in the context of diabetes) has also highlighted, that individual perceptions of responsibility sharing and adolescent-caregiver collaboration can differ significantly within a family, leading to an increased risk of disadvantageous illness management and adverse clinical outcomes (Anderson et al., 2009; Netz et al., 2020; Sonney et al., 2019; Vesco et al., 2010). Researchers, therefore, increasingly recognize the importance of dyadic measures when assessing juvenile illness management. Dyadic measures capture perceptions of both adolescents and caregivers, can disclose significant disagreements within adolescent-caregiver-dyads (e.g., Ekim & Ocakci, 2013; Sonney et al., 2019), provide a perspective beyond personal behavior (Anderson et al., 2009) and give insight into the complex work that is shared within the family (Horner & Brown, 2015). However, validated (English language) measures for dyadic assessment and analyses of family asthma management are still rare (McQuaid et al., 2001) and no such measure is available in the German Language so far.

Therefore, the research objectives addressed by our study were (1) the development of a dyadic questionnaire allowing consideration of both adolescent and caregiver perceptions about responsibility sharing and collaboration in adolescent-caregiver asthma management, (2) psychometric testing of the adolescent and caregiver versions including structural validity, internal consistency, hypotheses testing for construct validity and readability, (3) evaluation of the factor structure of the DAMQ using of dyadic data-analytic approach that acknowledges the natural interdependence of adolescent and caregiver data, and (4) examination of measurement invariance across different age groups.

## Methods

### Item Development

Guided by the COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN) risk of bias checklist (Mokkink et al., 2018) the Dyadic Asthma Management Questionnaire (DAMQ) was generated with a combined theory-driven and empirical approach. The first step was an in-depth review of the literature and evaluation of previously published measures. In a second step, we conducted semi-structured interviews with  $N = 15$  adolescents with asthma and their caregivers to further explore the key

issues of family asthma management as well as the terminology used by adolescents and caregivers to describe them. All details on procedures, qualitative data analyses, and results of this pre-study have been reported elsewhere (Heyduck et al., 2015). Based on our findings we generated an item pool of 46 items covering two theoretical dimensions of adolescent-caregiver partnership in asthma management: (1) responsibility-sharing (16 items), and (2) collaboration in asthma management (30 items). The collaboration items covered a variety of different sub-aspects as highlighted by previous research (e.g., Beléndez et al., 2010; Berg et al., 2008; Beveridge & Berg, 2007; Hanna et al., 2005; La Greca & Bearman, 2002; Nansel et al., 2009) including parental monitoring, instrumental support, emotional support, illness knowledge, teaching, tailoring of assistance, and promotion of autonomy. As our literature review revealed, most of the existing measures refer to the condition of diabetes and as we also aimed for a broader range of asthma management aspects to be included, we refrained from the mere translation of previously published questionnaires. For 33 items, however, German items contents were stimulated by existing English language measures: the Asthma Responsibility Questionnaire (McQuaid et al., 2001), the Diabetes Family Responsibility Questionnaire (Anderson et al., 1990), the Diabetes Social Support Questionnaire (La Greca & Bearman, 2002), the Parental Support for Adolescents' Autonomy Scale (Hanna et al., 2005), the Collaborative Parent Involvement Scale (Nansel et al., 2009), and the Perceptions of Collaboration Questionnaire (Berg et al., 2008). Thirteen items – capturing additional themes that emerged in our interview study – were generated directly from the adolescent and caregiver quotes. Details about which DAMQ items have been stimulated by our interview study and/or pre-existing measures are presented in Electronic Supplementary Materials (ESM 2 and 3).

In the next step, all items were pre-tested using a mixed-methods approach. We conducted semi-structured interviews with adolescents ( $N = 8$ ) using think-aloud techniques and verbal probing (Beatty & Willis, 2007) to assess the readability and clarity of the items. The content validity of the items was assessed by a panel of 10 consultants from the participating rehabilitation centers. The results of this pre-test led to a rephrasing of items and some revisions in layout and instructions. Following the development of the adolescent version of the DAMQ items, we prepared compatible and equally worded caregiver items.

## Design, Participants, and Procedure

For psychometric evaluation, we used a cross-sectional survey design. Adolescent patients and their primary caregivers were recruited consecutively at seven rehabilitation centers for children, where the adolescents attended a

3- to 6-week episode of inpatient treatment. Standardized, multidisciplinary inpatient rehabilitation programs for children are a major constituent of pediatric asthma care in Germany (Spindler & Berghem, 2021) and other countries (Jung et al., 2012). Children and adolescents attend these rehabilitation programs not only because of significant asthma severity but for many different reasons as the focus of rehabilitation is the improvement of health but also the enhancement of participation in daily life, prevention of deterioration of the disease, improvement of asthma self-management and quality of life as well as optimization of diagnostics and therapeutic interventions (Jung et al., 2012; Rosenecker et al., 2020; Spindler & Berghem, 2021).

Adolescent participant eligibility criteria for our study included ages 11–18 years at the time of enrolment, the diagnosis of asthma, and sufficient German language skills. Caregiver inclusion criteria were the status of the primary caregiver in asthma management and the ability to read and understand German. Eligible patients and caregivers were approached in person at the time of the adolescent's admission and informed about the study's purpose, procedures, and confidentiality. Informed consent/assent was obtained from both caregivers and adolescent patients. Adolescent participants were asked to complete the study's paper-pencil questionnaire at the beginning of their rehabilitation. Caregiver participants completed the questionnaire at home. All procedures were approved by our University Medical Centre's ethics committee.

## Measures

### Draft Dyadic Asthma Management Questionnaire (DAMQ)

The Dyadic Asthma Management Questionnaire (DAMQ; draft version) comes in parallel adolescent and caregiver versions and consists of two parts: responsibility sharing and collaboration. Responsibility sharing is covered with 16 items assessing adolescent and caregiver responsibility for different asthma management tasks. Items use a 5-point response scale with 1 = *caregiver takes responsibility for this all of the time*, 2 = *caregiver takes responsibility for this most of the time*, 3 = *caregiver and adolescent share equal responsibility*, 4 = *adolescent takes responsibility for this most of the time*, and 5 = *adolescent takes responsibility for this all of the time*. Additionally, there is an option to indicate that the task does not apply to individual adolescents' asthma management (0 = *not needed*). Collaboration is assessed with 30 items covering six key aspects of caregiver collaborative involvement in asthma management: caregiver monitoring, instrumental support, emotional support, caregiver knowledge/teaching, tailoring of assistance, and promotion of autonomy. Items are scored on a 5-point scale (1 = *never*, 2 = *rarely*, 3 = *sometimes*, 4 = *usually*, 5 = *always*).

## Validating Measures

In our study, we used four validating measures:

- (1) The Short Self-Management Questionnaire for Adolescents with Asthma (KM-J-AB; completed only by the adolescents; Petermann et al., 2009), a 6-item self-report questionnaire assessing adolescents' asthma self-management in the last 7 days.
- (2) The DISABKIDS Chronic Generic Measure (DCGM-12; completed by both adolescents and caregivers; DISABKIDS Group Europe, 2006), is a 12-item measure assessing health-related quality of life (HRQOL) in juveniles.
- (3) The DISABKIDS Asthma Module (DCSM-AsM; completed by both adolescents and caregivers; DISABKIDS Group Europe, 2006), a complement module of the DCGM-12, focusing on physical (asthma impact, six items) and emotional (asthma worries, five items) aspects specific to asthma.
- (4) The Ulm Quality of Life Inventory for Parents of chronically ill children (ULQIE; completed only by the caregivers; Goldbeck & Storck, 2002), a 29-item self-report questionnaire specified for parents with a chronically ill child. It covers five dimensions (physical/daily functioning, satisfaction with the situation in the family, emotional distress/health, self-development, and well-being), and a global scale of parental quality of life.

Detailed hypotheses about the expected associations with the DAMQ have been specified in the data analysis section "Hypotheses Testing for Construct Validity".

## Demographic and Medical Information

Demographic and medical information (e.g., age, gender, duration of illness, medication intake) were obtained through a demographics questionnaire that was completed by the caregivers at the beginning of rehabilitation. Specifics about the adolescents' diagnosis (ICD-10 code), comorbidities, and level of asthma control were obtained from the treating clinicians in the rehabilitation centers.

## Data Analysis

Data analysis included analyses of structural validity, internal consistency, construct validity, and readability of the newly developed DAMQ. Analyses were conducted separately for adolescent and caregiver items, with an exception of the confirmatory factor analysis (CFA) which included a dyadic methodology. For CFA, missing data were imputed with multiple imputation techniques using the expectation-maximization algorithm (Software NORM 2.03; Schafer & Graham, 2002). To examine the equivalence of the DAMQ's psychometric properties across younger and older

adolescents and, thus, evaluate the suitability of the measure for different age groups, parallel calculations were carried out on data from younger (< 14 years, representing early adolescence; Steinberg, 2010) and older ( $\geq 14$  years, representing middle to late adolescence; Steinberg, 2010) participants for the internal consistency analysis and CFA.

## Structural Validity: Item Analysis, Item Selection, and Factor Structure

Percentages of non-response, mean values, skewness, and kurtosis were calculated for all items. For the collaboration items also item difficulty and the distribution of extreme values were analyzed. In the next step, for both responsibility sharing and collaboration items and both adolescent and caregiver versions, separate exploratory factor analyses (EFA) with principal axis factoring and promax rotation were conducted to identify the most appropriate number of underlying factors and most informative items. Criteria for the number of factors to retain included consideration of scree plots, eigenvalues > 1, and interpretability (Field, 2013; Ford et al., 1986). After obtaining an acceptable factor model, we applied CFA for the collaboration items of the DAMQ. Due to the response scheme of the responsibility sharing items we had some items with higher levels of missing data owing to being rated as "not needed" by a substantial subset of the sample. As missing data imputation was also not applicable we refrained from calculating CFA for the responsibility-sharing items.

For the collaboration items, we conducted a dyadic CFA (Kenny et al., 2006) considering adolescent and caregiver data in one model. As recommended for CFA with dyadic data (Kenny et al., 2006), corresponding latent factors for the two members of the dyad as well as residual (error) covariances across their respective indicators were correlated. Additionally, factor loadings for corresponding adolescent and caregiver items were constrained to be equal (Kenny et al., 2006). For an acceptable model fit, we required non-significant values for the Chi-square ( $\chi^2$ ) statistic, a Comparative Fit Index (CFI) > 0.90 (preferably > 0.95), a Tucker-Lewis-Index (TLI) > 0.90 (preferably > 0.95), a Root Mean Square Error of Approximation (RMSEA)  $\leq 0.06$ , and Standardised Root Mean Square Residuals (SRMR)  $\leq 0.08$  (Hu & Bentler, 1999). In the last step, the resulting (modified) CFA model was applied to adolescent and caregiver data.

## Internal Consistency

For the final factor structure of the responsibility sharing and collaboration items, internal consistency estimates were calculated. We computed corrected item-total correlations, mean inter-item correlations, Cronbach's  $\alpha$ , coefficient  $\omega$  (Dunn et al., 2014), and the greatest lower bound (glb; Sijtsma, 2009).

### Hypotheses Testing for Construct Validity

Using Pearson's correlations, derived subscales of the DAMQ were tested against existing measures. For all hypotheses, we expected small to medium size correlations ( $r \geq 0.2$ ). For the responsibility sharing scales, we hypothesized: (1) a positive correlation with the KM-J-AB self-management scale, (2) a positive correlation with the DISABKIDS chronic generic scale, (3) a negative correlation with the DISABKIDS asthma worry scale, and (4) a positive correlation with all of the ULQIE scales. Hypotheses for the collaboration scales were: (1) a positive correlation with the KM-J-AB self-management scale, (2) a positive correlation with the DISABKIDS chronic generic scale, (3) a negative correlation with the DISABKIDS asthma impact scale and the DISABKIDS asthma worry scale, and (4) a positive correlation with the ULQIE scales satisfaction with the family, emotional distress/health, well-being, and global scale.

### Readability

Readability of the adolescent and the caregiver versions of the final DAMQ questionnaire was calculated using the Flesch Reading Ease and Flesch-Kincaid Grade Level (Flesch, 1948; Kincaid et al., 1975).

## Results

### Sample Characteristics

Over a period of 13 months,  $N = 206$  eligible families were invited to participate in the study. The response rate was 75.2% ( $N = 155$ ) for the adolescents and 63.1% ( $N = 130$ ) for their caregivers. Due to missing data of more than 30%, five adolescents and their corresponding caregivers had to be excluded from the analysis, resulting in a final sample of  $N = 150$  adolescents and  $N = 125$  caregivers. Dyadic datasets were available for  $N = 125$  families. There were no differences in sample characteristics between the whole sample of adolescents ( $N = 150$ ) and the subsample of adolescents nested in dyads ( $N = 125$ ). Adolescent participants were aged 11–18 years ( $M = 13.4$ ;  $SD = 1.9$ ); 54% were male. The mean age of participating caregivers was 44.5 years ( $SD = 5.6$ ; range: 29–65 years). Most caregiver participants were biological mothers (86.4%). A detailed description of the sample characteristics is presented in ESM 1.

### Structural Validity: Item Analysis, Item Selection, and Factor Structure

Item analysis for the responsibility-sharing items showed acceptable values for all items. Analysis of the collaboration items revealed that three items (coll24, coll27, and coll30)

had a skewed distribution, missing values  $> 5\%$ , and extreme values  $> 50\%$  in both adolescent and caregiver versions and therefore had to be excluded from further analysis. Detailed results of the item analyses are presented in ESM 2 and 3.

The results of the EFA for the responsibility-sharing items are presented in Table 1. For both adolescent and caregiver versions, Bartlett's test ( $p < .001$ ) and KMO measure ( $KMO > 0.70$ ; all KMO values for individual items  $> 0.65$ ) verified the sampling adequacy for the analysis. Eigenvalues and scree plots suggested the same model for both adolescent and caregiver data, with items clustering around three interpretable factors: asthma attack management and prevention, medical and school-related procedures, and self-care behaviors. One item (resp03) showed ambiguous factor loadings and two other items (resp05 and resp11) reached a clear factor assignment only for adolescent or caregiver data respectively; all three items were therefore excluded from the final model.

For the collaboration items, 27 items were entered into the EFA analysis. For both adolescent and caregiver versions, Bartlett's test ( $p < .001$ ) and KMO measure ( $KMO > 0.80$ ; all KMO values for individual items  $> 0.65$ ) confirmed the sampling adequacy for the analysis. An initial analysis was run for adolescent and caregiver data to obtain eigenvalues for all factors in the data. Seven factors in the adolescent version and four factors in the caregiver version had eigenvalues  $> 1$ . However, for both versions, the scree plots suggested that only three factors should be retained, covering three aspects of parental collaborative involvement: teaching and emotional support, monitoring and instrumental support, and promoting autonomy. Seventeen items showed clear and corresponding factor assignment for both adolescent and caregiver data and were therefore retained for further analysis. Detailed results of the EFA for the collaboration items are presented in Table 2.

Based on the results of the EFA, we conducted a dyadic CFA for the collaboration items. Calculating adolescent and caregiver data in one model, 34 items (17 adolescent report items and 17 caregiver report items), and six latent constructs were entered into the analysis. This original CFA model showed an unsatisfactory agreement with empirical data though. Hence, three items with low indicator reliability (items coll05, coll14, and coll22) and one item with multiple factor loadings (item coll01) were eliminated from the model sequentially. If item compatibility was poor for one family member, items for both members of the dyad were removed. As modification indices suggested that the model fit for the caregiver version would be improved if correlated error terms were included, we allowed for one error term correlation (coll19\_e and coll20\_e). The resulting modified CFA model included 26 items (13 adolescent report items

**Table 1.** Summary of exploratory factor analysis for the responsibility sharing items

Factor	Adolescent version			Caregiver version		
	1	2	3	1	2	3
Eigenvalue	6.82	1.47	1.04	7.17	1.79	1.35
% of variance	42.62	9.23	6.51	44.78	11.20	8.42
<b>resp01: Take emergency medication</b>	.662			.783		
<b>resp02: Take regular long-term medication</b>	.615			.788		
resp03: Notice when medications run out	.488	.479		.639	.443	
<b>resp04: Notice signs of an asthma attack</b>	.814			.577		
resp05: Take preventive medication	.347		.335	.637		.375
<b>resp06: Avoid triggers</b>	.980			.519		.312
<b>resp07: Take emergency spray along when leaving</b>	.501			.845		
<b>resp08: Talking with teachers about the asthma</b>		.541			.503	.340
<b>resp09: Talking with friends about the asthma</b>			.740			.864
<b>resp10: Take care not to overstrain myself</b>			.821			.751
resp11: Take care to use peak flow meter		.357	.521		.326	.391
<b>resp12: Make appointments with doctors</b>		.947			.894	
<b>resp13: Remember appointments with doctors</b>		.867			.779	
<b>resp14: Explain absences from school</b>		.592			.790	
<b>resp15: Take a break when asthma symptoms occur</b>	.399		.565		.374	.505
<b>resp16: Engage in regular sporting activity</b>			.619			.524

Note. Clear factor assignments (main factor loading  $\geq 0.5$  and loading  $< 0.4$  on all other factors) are highlighted in gray color. Items that reached clear and corresponding factor assignments for both adolescent and caregiver data appear in bold.

and 13 caregiver report items) representing three latent constructs each. All model-fit indices reached the threshold for acceptable fit ( $\chi^2 = 361.3$  [ $df = 270$ ],  $p = 0.226$ ; TLI = 0.91; CFI = 0.92; RMSEA = 0.06; SRMR = 0.07). In the last step, we applied the modified CFA model to adolescent and caregiver data, including a comparative calculation for younger ( $< 14$  years) and older ( $\geq 14$  years) adolescents. Model-fit indices for all calculations reached the threshold for acceptable fit. The comparison of model compatibility for data from different age groups, however, revealed a slightly better fit for older adolescents. Detailed results for all CFA are presented in Table 3.

The final factor structure for the DAMQ emerging from EFA and CFA included three interpretable scales for the responsibility sharing items, that is, asthma attack management and prevention (5 items), medical and school-related procedures (4 items), and self-care behaviors (4 items), and three interpretable scales for the collaboration items, that is, teaching and emotional support (5 items), monitoring and instrumental support (4 items), and promoting autonomy (4 items).

## Internal Consistency

The results of the internal consistency analyses are presented in Table 4. For both adolescent and caregiver versions, values of Cronbach's  $\alpha$ ,  $\omega$ , and  $g_{lb}$  were  $> .70$  for

all scales. Separate analyses for younger ( $< 14$  years) and older ( $\geq 14$  years) adolescents revealed good to excellent indices for both younger and older adolescents in all collaboration scales. For the responsibility-sharing scales, however, indices proved to be good only for older adolescents.

## Hypotheses Testing for Construct Validity

For the responsibility sharing scales, we found hypotheses-compliant (1) a positive correlation between self-care behaviors and DISABKIDS chronic generic, (2) a negative correlation between asthma attack management and DISABKIDS asthma worry, (3) a negative correlation between self-care behaviors and DISABKIDS asthma worry, and (4) positive correlations between all three responsibility sharing scales and most of the ULQIE scales. The hypothesized positive correlation between the responsibility sharing scales and the KM-J-AB self-management scale, however, could not be confirmed. For the collaboration scales, we found hypotheses-compliant (1) a positive correlation between teaching and emotional support and the KM-J-AB self-management scale, (2) a positive correlation between monitoring and instrumental support and the KM-J-AB self-management scale, (3) a positive correlation between teaching and emotional support and ULQIE satisfaction with the situation in the family, and (4) positive correlations between promoting autonomy and ULQIE

**Table 2.** Summary of exploratory factor analysis for the collaboration items

Factor	Adolescent version			Caregiver version		
	1	2	3	1	2	3
Eigenvalue	9.77	3.00	1.47	7.91	3.39	1.80
% of variance	36.19	11.10	5.44	29.29	12.56	6.67
<b>coll01: Parents help if adolescent has asthma-related problems</b>	<b>.578</b>			<b>.757</b>		
coll02: Parents and adolescent work together as a team	.741				.401	.330
coll03: Parents and adolescent share decisions	.649	.401			.470	.529
<b>coll04: Parents take over certain things</b>		<b>.712</b>			<b>.608</b>	
<b>coll05: Parents and adolescent do certain things together</b>		<b>.647</b>			<b>.552</b>	
coll06: Parents make certain things easier		.510		.730		
<b>coll07: Parents help to learn how to deal with problems</b>	<b>.646</b>			<b>.882</b>		
coll08: Parents help to plan how to spend time with friends	.390	.435		.821		
<b>coll09: Parents help to learn how to adapt behavior</b>	<b>.500</b>	.340		.716		
<b>coll10: Parents help to understand why you do certain things</b>	<b>.526</b>	.310		.725		
<b>coll11: Parents help when adolescent needs help</b>	<b>1.02</b>	−.310		<b>.501</b>		
coll12: Parents ask if support is needed before they help	.853					.526
coll13: Parents notice if more support than usual is needed	.631			.382		.374
<b>coll14: Parents notice if adolescent prefers doing things alone</b>	<b>.333</b>		<b>.523</b>			<b>.629</b>
<b>coll15: Parents let adolescent do things alone if he wants</b>			<b>.743</b>			<b>.564</b>
<b>coll16: Parents let adolescent make choices alone if he wants</b>			<b>.798</b>			<b>.717</b>
<b>coll17: Parents trust adolescent to manage things alone</b>			<b>.709</b>			<b>.779</b>
<b>coll18: Parents allow adolescent to make own experiences</b>			<b>.725</b>			<b>.552</b>
<b>coll19: Parents ask if adolescent has done things</b>		<b>.848</b>			<b>.829</b>	
<b>coll20: Parents check if adolescent has done things</b>		<b>.818</b>			<b>.914</b>	
<b>coll21: Parents remind adolescent to do things</b>		<b>.830</b>			<b>.693</b>	
<b>coll22: Parents insist that asthma-related things are done</b>		<b>.558</b>			<b>.677</b>	
coll23: Parents understand what things stress adolescent	.539				.407	.529
coll24: Parents listen to adolescent if he has concerns						
coll25: Parents show that they are proud	.349		.363		.364	
<b>coll26: Parents motivate adolescent</b>	<b>.569</b>			<b>.572</b>		
coll27: Parents take adolescent seriously if he has problems						
coll28: Parents understand adolescent's lack of motivation	.471		.326			.420
coll29: Parents and adolescent have become closer		.375	.417		.466	
coll30: Parents and adolescent have drifted apart						

Note. Due to a skewed distribution ( $k > 2$ ) and more than 50% of responses in the range of extreme values, in both adolescent and caregiver versions, items coll24, coll27, and coll30 were excluded from the analysis. Clear factor assignments (main factor loading  $\geq 0.5$  and loading  $< 0.4$  on all other factors) are highlighted in gray color. Items that reached clear and corresponding factor assignments for both adolescent and caregiver data appear in bold.

satisfaction with the situation in the family, ULQIE well-being and ULQIE global scale. Incompliant with our hypotheses we found a positive correlation (instead of a negative) between monitoring and instrumental support and DISABKIDS asthma worry and a negative correlation (instead of positive) between monitoring and instrumental support and ULQIE emotional distress/health and ULQIE well-being. DIABKIDS chronic generic measure and DISABKIDS asthma impact also failed the hypothesized correlations with the DAMQ collaboration scales. All correlations were in the range of small to medium correlations ( $0.2 \leq r \leq 0.4$ ). Detailed results of the hypotheses testing for construct validity are presented in ESM 4.

## Readability

For both the adolescent and the caregiver measure, indices of reading comprehension level specified good readability (equivalent to school grade level 8), with Flesch Reading Ease = 69 (adolescent version) and 75 (caregiver version) and Flesch-Kincaid Grade Level = 8.

## Discussion

The Dyadic Asthma Management Questionnaire (final version available in ESM 5) was generated as a two-part

**Table 3.** Global fit indices of dyadic confirmatory factor analyses for the collaboration items

			$\chi^2$	df	p	$\chi^2/df$	TLI	CFI	RMSEA	RMSEA 90% CI	SRMR
Dyadic calculation of adolescent and caregiver data in one model											
Original CFA model	$N_A = 125$ $N_C = 125$	34 items assigned to 6 latent constructs	815.07	495	.021	1.65	0.81	0.83	0.07	0.06–0.08	0.09
Modified CFA model	$N_A = 125$ $N_C = 125$	26 items assigned to 6 latent constructs	361.30	270	.226	1.34	0.91	0.92	0.06	0.04–0.07	0.07
Modified CFA model applied to adolescent and caregiver data separately											
Adolescents total sample	$N = 150$	13 items assigned to 3 latent constructs	75.23	62	.384	1.21	0.98	0.98	0.04	0.01–0.06	0.06
Adolescents < 14 years	$N = 81$	13 items assigned to 3 latent constructs	91.49	62	.235	1.48	0.90	0.91	0.07	0.04–0.10	0.08
Adolescents $\geq$ 14 years	$N = 69$	13 items assigned to 3 latent constructs	72.19	62	.488	1.16	0.96	0.97	0.05	0.01–0.09	0.08
Caregivers	$N = 125$	13 items assigned to 3 latent constructs	110.85	61	.200	1.82	0.91	0.93	0.06	0.04–0.09	0.07

Note.  $N_A$  = number of adolescent participants;  $N_C$  = number of caregiver participants. Where Mardia's coefficient of multivariate kurtosis indicated that multivariate normality was not achieved we used the Bollen-Stine-Bootstrap correction for  $\chi^2$  p-values.

**Table 4.** Internal consistency

Scale and items	Version/sample	N	Item-total correlation	Mean inter-item correlation	Cronbach's $\alpha$ (CI)	$\omega$ (CI)	Greatest lower bound (glb)
Responsibility sharing							
<i>Asthma attack management and prevention</i>	Adolescent version	81	0.59–0.69	0.49	0.83 (0.77–0.89)	0.83 (0.77–0.89)	0.86
	Subsample < 14 years	44	0.44–0.67	0.45	0.79 (0.68–0.90)	0.80 (0.70–0.90)	0.83
	Subsample $\geq$ 14 years	37	0.44–0.70	0.43	0.80 (0.71–0.90)	0.80 (0.73–0.90)	0.89
Includes items resp01, resp02, resp04, resp06, and resp07	Caregiver version	92	0.64–0.73	0.58	0.87 (0.83–0.91)	0.87 (0.83–0.91)	0.90
<i>Medical and school-related procedures</i>	Adolescent version	120	0.47–0.66	0.45	0.75 (0.68–0.82)	0.75 (0.68–0.82)	0.80
	Subsample < 14 years	64	<b>0.29</b> –0.45	0.29	<b>0.59</b> (0.44–0.74)	<b>0.59</b> (0.43–0.75)	<b>0.69</b>
	Subsample $\geq$ 14 years	56	0.53–0.70	0.47	0.77 (0.67–0.87)	0.77 (0.67–0.87)	0.83
Includes items resp08, resp12, resp13, and resp14	Caregiver version	113	0.53–0.73	0.53	0.81 (0.75–0.86)	0.80 (0.74–0.86)	0.86
<i>Self-care behaviors</i>	Adolescent version	97	0.39–0.57	0.38	0.71 (0.62–0.81)	0.73 (0.64–0.82)	0.75
	Subsample < 14 years	51	<b>0.29</b> –0.47	0.29	<b>0.62</b> (0.45–0.79)	<b>0.63</b> (0.47–0.80)	0.76
	Subsample $\geq$ 14 years	46	0.49–0.66	0.45	0.76 (0.65–0.87)	0.78 (0.68–0.89)	0.83
Includes items resp09, resp10, resp15, and resp16	Caregiver version	105	0.42–0.69	0.42	0.73 (0.65–0.81)	0.74 (0.66–0.82)	0.82
Collaboration							
<i>Teaching and emotional support</i>	Adolescent version	140	0.54–0.75	0.56	0.86 (0.83–0.90)	0.88 (0.84–0.91)	0.90
	Subsample < 14 years	78	0.50–0.76	0.50	0.83 (0.77–0.89)	0.85 (0.80–0.90)	0.86
	Subsample $\geq$ 14 years	62	0.52–0.80	0.56	0.87 (0.81–0.92)	0.88 (0.83–0.92)	0.92
Includes items coll07, coll09, coll10, coll11, and coll26	Caregiver version	122	0.55–0.77	0.54	0.85 (0.81–0.90)	0.87 (0.83–0.91)	0.87
<i>Monitoring and instrumental support</i>	Adolescent version	143	0.46–0.73	0.54	0.83 (0.78–0.87)	0.85 (0.81–0.89)	0.84
	Subsample < 14 years	75	0.34–0.69	0.46	0.79 (0.70–0.87)	0.82 (0.75–0.88)	0.81
	Subsample $\geq$ 14 years	67	0.38–0.68	0.47	0.79 (0.70–0.87)	0.82 (0.75–0.89)	0.81
Includes items coll04, coll19, coll20, and coll21	Caregiver version	123	0.40–0.78	0.53	0.82 (0.77–0.88)	0.85 (0.81–0.90)	0.87
<i>Promoting autonomy</i>	Adolescent version	144	0.47–0.63	0.45	0.76 (0.69–0.82)	0.76 (0.69–0.82)	0.82
	Subsample < 14 years	77	0.42–0.55	0.39	0.71 (0.61–0.82)	0.71 (0.61–0.82)	0.77
	Subsample $\geq$ 14 years	66	0.50–0.72	0.51	0.79 (0.71–0.87)	0.78 (0.70–0.86)	0.86
Includes items coll15, coll16, coll17, and coll18	Caregiver version	124	0.30–0.63	0.37	0.71 (0.62–0.79)	0.73 (0.66–0.81)	0.77

Note. Item-total correlations < 0.3 and Cronbach's  $\alpha$ ,  $\omega$ , and glb values < 0.70 appear in bold. The total sample used for internal consistency analyses comprised  $N = 150$  adolescents and  $N = 125$  caregivers. The high rates of missing values in the "responsibility sharing" scale analyses are the result of the answer format of the items.



measure assessing (1) responsibility sharing and (2) collaboration in adolescent-caregiver asthma management. It comes in parallel adolescent and caregiver versions. For both parts of the DAMQ and both adolescent and caregiver versions, a coherent factor structure with interpretable subscales and good psychometric properties could be confirmed.

The responsibility sharing part of the DAMQ is closely related to the English language Asthma Responsibility Questionnaire (ARQ; McQuaid et al., 2001) with 7 out of 13 items of the DAMQ sharing item contents with the ARQ. The DAMQ multi-factor structure, covering a broader range of responsibilities including (1) asthma attack management and prevention, (2) medical and school-related procedures, and (3) self-care behaviors, however, marks a difference to the unidimensional ARQ (McQuaid et al., 2001). As the DAMQ covers not only items that were stimulated by the ARQ but also six additional items capturing themes that emerged in our preceding interview study (Heyduck et al., 2015), the differing factor structure appears plausible though. For the collaboration part of the DAMQ, 13 out of the 30 items that were entered in the analyses were retained in the final measure, forming three scales of adolescent-caregiver collaboration in asthma management: (1) teaching and emotional support, (2) monitoring and instrumental support and (3) promoting autonomy. Despite the significant item reduction during structural validity analyses, all key aspects of caregiver involvement we initially intended to incorporate (as highlighted by previous research, e.g., Beléndez et al., 2010; Berg et al., 2008; Beveridge & Berg, 2007; Hanna et al., 2005; La Greca & Bearman, 2002; Nansel et al., 2009) were still represented in the final measure. Also, the considerable reduction in the item pool was in line with the aims of our study as we expect a concise measure to be easier to apply in our target population.

In our internal consistency analysis, item homogeneity could be demonstrated within all DAMQ scales, with medium to high values evident in traditional Cronbach's  $\alpha$  as well as  $\omega$  and  $g_{lb}$  – two estimates of scale reliability increasingly gaining in importance in recent times (Dunn et al., 2014; Peters, 2014; Sijtsma, 2009). Hypotheses testing for construct validity demonstrated correlations of the DAMQ scales with measures of juvenile asthma self-management (KMJ-AB), juvenile quality of life (DISABKIDS), and parental quality of life (ULQIE). Positive correlations with the KMJ-AB, which assesses actual asthma behavior in the last seven days, however, could only be confirmed for the collaboration scales. The relation between higher caregiver collaborative involvement and better juvenile illness self-management and outcomes is consistent with prior work (Nansel et al., 2009; Reed-Knight et al., 2014; Wysocki et al., 2009), although the form of caregiver involvement

may change throughout adolescence from doing asthma-related tasks for the adolescent to adopting a mentoring and supervising role (Reed-Knight et al., 2014).

The association between perceived illness responsibility and actual illness behavior, however, appears to be more complex, and significant reporting biases have been emphasized in prior research (Anderson et al., 1990; McQuaid et al., 2001; Munzenberger et al., 2010; Sonney et al., 2019). Linking family reports of responsibility for asthma management tasks with actual behavioral observations and electronic monitoring, for example, with electronic adherence monitoring devices (Gupta et al., 2021; Lee et al., 2021; Morton et al., 2017), therefore, seems to be pivotal in future research. Other interesting results of the hypotheses testing for construct validity were the hypotheses-incompliant correlations of caregiver monitoring and instrumental support with juvenile asthma worries and parental emotional health and wellbeing in our sample. Hence, high caregiver involvement seems to have the potential to enhance awareness and concerns about asthma-related complications in adolescents, while also potentially decreasing emotional health and well-being on the caregivers' side, all of which should be further addressed in future research.

Analyses of measurement invariance across different age groups found a good to excellent fit for adolescents  $\geq 14$  years, but a slightly poorer fit for adolescents  $< 14$  years. It is conceivable, that the families with younger adolescents in our study were just starting with the transition stage of asthma management and that some of the DAMQ questions did not yet reflect their lived experiences. As the Flesch-Kincaid Grade level also indicates that the DAMQ requires higher reading comprehension skills, we would recommend using the measure preferably for adolescents aged 14 years or older, with further research needed to fully determine its utility for younger patients.

The study has some limitations that should be noted. First, the sampling procedure with its reliance on rehabilitation centers and restriction to volunteer participants, as well as the fact that the caregiver sample was biased toward biological mothers may limit the generalizability of our findings. Further, for practical and economic reasons – particularly the challenging and lengthy process of recruiting dyads – we chose to conduct both EFA and CFA with the same sample, which is not ideal. Also, CFA has only been conducted for the collaboration items, but not for the responsibility items and the samples for the CFA models with different age groups were rather small. Confirming the results of the CFA with an independent sample of adolescents and caregivers and further validation of the factor structure of the DAMQ, therefore, remain objectives for future research. Further, most of the correlations in our construct validity analysis were modest and await replication in future studies. Test-retest reliability was also not

tested in our study and remains an objective for future research. The strengths of our study include: (1) the involvement of adolescents, caregivers, and experts in the development of the DAMQ items, (2) the development of a dyadic questionnaire with parallel adolescent and caregiver versions allowing holistic consideration of adolescent and caregiver data, (3) the implementation of a comprehensive psychometric testing scheme, (4) the inclusion of a novel dyadic data-analytic approach that acknowledges the natural non-independence of adolescent and caregiver data, (5) the inclusion of age-specific analyses, and finally (5) the creation of a family asthma management questionnaire that adds to the existing literature by including both responsibility sharing and adolescent-caregiver collaboration in a comprehensive – but still concise – measure.

The DAMQ has the potential to serve as a useful clinical tool to identify adolescents' and caregivers' perspectives on asthma management, disclose developmentally inappropriate expectations or maladaptive perceptions of asthma care, discover discrepancies within adolescent-caregiver dyads and eventually identify patients and families that are at risk of poor treatment adherence and adverse clinical outcomes. Subsequently, clinical interventions could be targeted to address difficulties in adolescents' adherence and shared asthma management.

## Electronic Supplementary Materials

The electronic supplementary material is available with the online version of the article at <https://doi.org/10.1027/2512-8442/a000131>

**ESM 1.** Sample characteristics

**ESM 2.** Item analysis responsibility items

**ESM 3.** Item analysis collaboration items

**ESM 4.** Hypotheses testing for construct validity

**ESM 5.** Final DAMQ German

## References

- Anderson, B. J., Auslander, W. F., Jung, K. C., Miller, J. P., & Santiago, J. V. (1990). Assessing family sharing of diabetes responsibilities. *Journal of Pediatric Psychology, 15*(4), 477–492. <https://doi.org/10.1093/jpepsy/15.4.477>
- Anderson, B. J., Holmbeck, G., Iannotti, R. J., McKay, S. V., Lochrie, A., Volkening, L. K., & Laffel, L. (2009). Dyadic measures of the parent-child relationship during the transition to adolescence and glycemic control in children with type 1 diabetes. *Families, Systems & Health, 27*(2), 141–152. <https://doi.org/10.1037/a0015759>
- Beatty, P. C., & Willis, G. B. (2007). Research synthesis: The practice of cognitive interviewing. *Public Opinion Quarterly, 71*(2), 287–311. <https://doi.org/10.1093/poq/nfm006>
- Beléndez, M., de Wit, M., & Snoek, F. J. (2010). Assessment of parent-adolescent partnership in diabetes care: A review of measures. *The Diabetes Educator, 36*(2), 205–215. <https://doi.org/10.1177/0145721709359205>
- Berg, C. A., Schindler, I., & Maharajah, S. (2008). Adolescents' and mothers' perceptions of the cognitive and relational functions of collaboration and adjustment in dealing with type 1 diabetes. *Journal of Family Psychology, 22*(6), 865–874. <https://doi.org/10.1037/a0013641>
- Beveridge, R. M., & Berg, C. (2007). Parent-Adolescent Collaboration: An interpersonal model for understanding optimal interactions. *Clinical Child and Family Psychology Review, 10*(1), 25–52. <https://doi.org/10.1007/s10567-006-0015-z>
- Davis, S. A., Beznos, B., Carpenter, D. M., Tudor, G., Garcia, N., & Sleath, B. (2022). Trends in adolescent asthma responsibility over a 12-month study period. *Journal of Adolescent Health, 70*(3), 478–482. <https://doi.org/10.1016/j.jadohealth.2021.10.008>
- Desai, M., & Oppenheimer, J. J. (2011). Medication adherence in the asthmatic child and adolescent. *Current Allergy and Asthma Reports, 11*(6), 454–464. <https://doi.org/10.1007/s11882-011-0227-2>
- DISABKIDS Group Europe. (2006). *The DISABKIDS Questionnaires: Quality of life questionnaires for children with chronic conditions*. Pabst Science.
- Dunn, T. J., Baguley, T., & Brunsden, V. (2014). From alpha to omega: A practical solution to the pervasive problem of internal consistency estimation. *British Journal of Psychology, 105*(3), 399–412. <https://doi.org/10.1111/bjop.12046>
- Ekim, A., & Ocakci, A. F. (2013). Perceptions of parents and children regarding asthma management responsibilities. *Journal of Specialists in Pediatric Nursing, 18*(4), 289–296. <https://doi.org/10.1111/jspn.12037>
- Field, A. (2013). *Discovering statistics using SPSS* (4th ed.). Sage Publications.
- Fiese, B. H., & Wamboldt, F. S. (2003). Tales of pediatric asthma management: Family-based strategies related to medical adherence and health care utilization. *The Journal of Pediatrics, 143*(4), 457–462. [https://doi.org/10.1067/S0022-3476\(03\)00448-7](https://doi.org/10.1067/S0022-3476(03)00448-7)
- Flesch, R. (1948). A new readability yardstick. *Journal of Applied Psychology, 32*(3), 221–233. <https://doi.org/10.1037/h0057532>
- Ford, J. K., MacCallum, R. C., & Tait, M. (1986). The application of exploratory factor analysis in applied psychology: A critical review and analysis. *Personnel Psychology, 39*(2), 291–314. <https://doi.org/10.1111/j.1744-6570.1986.tb00583.x>
- Gappa, M., Gerstlauer, M., Hamelmann, E., Kopp, M., Schuster, A., Spindler, T., & Vogelberg, C. (2019). Die Nationale Versorgungsleitlinie Asthma: Pädiatrische Aspekte [The National Care Guideline Asthma: Pediatric aspects]. *Der Pneumologe, 16*(3), 181–185. <https://doi.org/10.1007/s10405-019-0245-7>
- Global Initiative for Asthma. (2022). *Global strategy for asthma management and prevention*. <https://ginasthma.org>
- Goldbeck, L., & Storck, M. (2002). Das Ulmer Lebensqualitäts-Inventar für Eltern chronisch kranker Kinder (ULQIE) [The Ulm quality of life inventory for parents of chronically ill children (ULQIE)]. *Zeitschrift für Klinische Psychologie und Psychotherapie, 31*(1), 31–39. <https://doi.org/10.1026/1616-3443.31.1.31>
- Greenley, R. N., Josie, K. L., & Drotar, D. (2006). Perceived involvement in condition management among inner-city youth with asthma and their primary caregivers. *Journal of Asthma, 43*(9), 687–693. <https://doi.org/10.1080/02770900600925510>
- Gupta, R. S., Fierstein, J. L., Boon, K. L., Kanaley, M. K., Bozen, A., Kan, K., Vojta, D., & Warren, C. M. (2021). Sensor-based electronic monitoring for asthma: A randomized controlled trial. *Pediatrics, 147*(1), Article e20201330. <https://doi.org/10.1542/peds.2020-1330>

- Hanna, K. M., DiMeglio, L. A., & Fortenberry, J. D. (2005). Parent and adolescent versions of the Diabetes-Specific Parental Support for Adolescents' Autonomy Scale: Development and initial testing. *Journal of Pediatric Psychology, 30*(3), 257–271. <https://doi.org/10.1093/jpepsy/jsi036>
- Heyduck, K., Bengel, J., Farin, E., & Glattacker, M. (2015). Adolescent and parental perceptions about asthma and asthma management: A dyadic qualitative analysis. *Child: Care, Health and Development, 41*(6), 1227–1237. <https://doi.org/10.1111/cch.12277>
- Horner, S. D., & Brown, A. (2015). An exploration of parent-child dyadic asthma management influences on quality of life. *Issues in Comprehensive Pediatric Nursing, 38*(2), 85–104. <https://doi.org/10.3109/01460862.2015.1017668>
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*(1), 1–55. <https://doi.org/10.1080/10705519909540118>
- Jung, A., Heinrichs, I., Geidel, C., & Lauener, R. (2012). Inpatient paediatric rehabilitation in chronic respiratory disorders. *Paediatric Respiratory Reviews, 13*(2), 123–129. <https://doi.org/10.1016/j.prrv.2011.08.001>
- Kaplan, A., & Price, D. (2020). Treatment adherence in adolescents with asthma. *Journal of Asthma and Allergy, 13*, 39–49. <https://doi.org/10.2147/JAA.S233268>
- Kenny, D. A., Kashy, D. A., & Cook, W. L. (2006). *Dyadic data analysis*. The Guilford Press.
- Kincaid, J. P., Fishburne, R. P., Rogers, R. L., & Chissom, B. S. (1975). *Derivation of new readability formulas (automated readability index, fog count and Flesch reading ease formula) for navy enlisted personnel*. Tenn Naval Air Station, Research Branch Report. <https://apps.dtic.mil/sti/citations/ADA006655>
- Kronenberger, W. G., & Thompson, R. J. (1990). Dimensions of family functioning in families with chronically ill children: A higher order factor analysis of the Family Environment Scale. *Journal of Clinical Child Psychology, 19*(4), 380–388. [https://doi.org/10.1207/s15374424jccp1904\\_10](https://doi.org/10.1207/s15374424jccp1904_10)
- La Greca, A. M., & Bearman, K. J. (2002). The Diabetes Social Support Questionnaire-Family Version: Evaluating adolescents' diabetes-specific support from family members. *Journal of Pediatric Psychology, 27*(8), 665–676. <https://doi.org/10.1093/jpepsy/27.8.665>
- Lee, J. R., Leo, S., Liao, S., Ng, W. R., Tay, T. Y. N., Wang, Y., Ang, W. H. D., & Lau, Y. (2021). Electronic adherence monitoring devices for children with asthma: A systematic review and meta-analysis of randomised controlled trials. *International Journal of Nursing Studies, 122*, Article 104037. <https://doi.org/10.1016/j.ijnurstu.2021.104037>
- Lerch, M. F., & Thrane, S. E. (2019). Adolescents with chronic illness and the transition to self-management: A systematic review. *Journal of Adolescence, 72*(5), 152–161. <https://doi.org/10.1016/j.adolescence.2019.02.010>
- McQuaid, E. L., Penza-Clyve, S. M., Nassau, J. H., Fritz, G. K., Klein, R., O'Connor, S., Wamboldt, F., & Gavin, L. (2001). The Asthma Responsibility Questionnaire: Patterns of family responsibility for asthma management. *Children's Health Care, 30*(3), 183–199. [https://doi.org/10.1207/S15326888CHC3003\\_2](https://doi.org/10.1207/S15326888CHC3003_2)
- McQuaid, E. L., Walders, N., Kopel, S. J., Fritz, G. K., & Klinnert, M. D. (2005). Pediatric asthma management in the family context: The Family Asthma Management System Scale. *Journal of Pediatric Psychology, 30*(6), 492–502. <https://doi.org/10.1093/jpepsy/jsi074>
- Miller, V. A. (2009). Parent-child collaborative decision making for the management of chronic illness: A qualitative analysis. *Families, Systems & Health, 27*(3), 249–266. <https://doi.org/10.1037/a0017308>
- Mokkink, L. B., de Vet, H. C. W., Prinsen, C. A. C., Patrick, D. L., Alonso, J., Bouter, L. M., & Terwee, C. B. (2018). COSMIN Risk of Bias Checklist for systematic reviews of patient-reported outcome measures. *Quality of Life Research, 27*(5), 1171–1179. <https://doi.org/10.1007/s11136-017-1765-4>
- Morton, R. W., Everard, M. L., & Elphick, H. E. (2014). Adherence in childhood asthma: The elephant in the room. *Archives of Disease in Childhood, 99*(10), 949–953. <https://doi.org/10.1136/archdischild-2014-306243>
- Morton, R. W., Elphick, H. E., Rigby, A. S., Daw, W. J., King, D. A., Smith, L. J., & Everard, M. L. (2017). STAAAR: A randomised controlled trial of electronic adherence monitoring with reminder alarms and feedback to improve clinical outcomes for children with asthma. *Thorax, 72*(4), 347–354. <https://doi.org/10.1136/thoraxjnl-2015-208171>
- Munzenberger, P., Secord, E., & Thomas, R. (2010). Relationship between patient, caregiver, and asthma characteristics, responsibility for management, and indicators of asthma control within an urban clinic. *Journal of Asthma, 47*(1), 41–45. <https://doi.org/10.3109/027709003903395226>
- Nansel, T. R., Rovner, A. J., Haynie, D., Iannotti, R. J., Simons-Morton, B., Wysocki, T., Anderson, B., Weissberg-Benchell, J., & Laffel, L. (2009). Development and validation of the Collaborative Parent Involvement Scale for Youths with Type 1 Diabetes. *Journal of Pediatric Psychology, 34*(1), 30–40. <https://doi.org/10.1093/jpepsy/jsn058>
- Netz, M., Fedele, D. A., Sweenie, R., Baker, D., Light, M., & McQuaid, E. L. (2020). Asthma management responsibility, control, and quality of life among emerging adolescents. *Journal of Pediatric Psychology, 45*(1), 40–49. <https://doi.org/10.1093/jpepsy/jsz069>
- Petermann, F., Stachow, R., Tiedjen, U., & Karpinski, N. (2009). Entwicklung eines Kurz-Fragebogens zum Krankheitsmanagement chronisch kranker Jugendlicher [Development of a short questionnaire on illness management of chronically ill adolescents]. *Rehabilitation, 48*(4), 228–237. <https://doi.org/10.1055/s-0029-1234050>
- Peters, G.-J. Y. (2014). The alpha and the omega of scale reliability and validity: Why and how to abandon Cronbach's alpha and the route towards more comprehensive assessment of scale quality. *European Health Psychologist, 16*(2), 56–69. <https://doi.org/10.31234/osf.io/h47fv>
- Reed-Knight, B., Blount, R. L., & Gilleland, J. (2014). The transition of health care responsibility from parents to youth diagnosed with chronic illness: A developmental systems perspective. *Families, Systems & Health, 32*(2), 219–234. <https://doi.org/10.1037/fsh0000039>
- Rosenecker, J., Urban, C., Eccles, A., & Jäger, R. (2020). Rehabilitation im Kindes- und Jugendalter [Rehabilitation in childhood and adolescence]. *Monatsschrift Kinderheilkunde, 168*(9), 849–859. <https://doi.org/10.1007/s00112-020-00934-8>
- Schafer, J. L., & Graham, J. W. (2002). Missing data: Our view of the state of the art. *Psychological Methods, 7*(2), 147–177. <https://doi.org/10.1037/1082-989X.7.2.147>
- Sijtsma, K. (2009). On the use, the misuse, and the very limited usefulness of Cronbach's alpha. *Psychometrika, 74*(1), 107–120. <https://doi.org/10.1007/s11336-008-9101-0>
- Sleath, B., Carpenter, D., Davis, S. A., Garcia, N., Reuland, D. S., Tudor, G., & Loughlin, C. E. (2023). Adolescent asthma management self-efficacy and responsibility: Impact on asthma control and quality-of-life. *Journal of Asthma, 60*(2), 331–338. <https://doi.org/10.1080/02770903.2022.2051541>

- Sonney, J., Segrin, C., & Kolstad, T. (2019). Parent- and child-reported asthma responsibility in school-age children: Examining agreement, disagreement, and family functioning. *Journal of Pediatric Health Care*, 33(4), 386–393. <https://doi.org/10.1016/j.pedhc.2018.11.005>
- Spindler, T., & Berghem, S. (2021). Rehabilitation von Atemwegserkrankungen im Kindes- und Jugendalter – Eine besondere Altersgruppe mit besonderen Herausforderungen [Rehabilitation in children with chronic pulmonary diseases – A special age group with special challenges]. *Atemwegs- und Lungenkrankheiten*, 47(2), 74–83.
- Steinberg, L. (2010). *Adolescence* (9th ed.). McGraw Hill Book.
- Thamm, R., Poethko-Müller, C., Hüther, A., & Thamm, M. (2018). Allergische Erkrankungen bei Kindern und Jugendlichen in Deutschland – Querschnittergebnisse aus KiGGS Welle 2 und Trends [Allergic diseases in children and adolescents in Germany – Cross-sectional results from KiGGS wave 2 and trends]. *Journal of Health Monitoring*, 3(3), 3–18. <https://doi.org/10.17886/RKI-GBE-2018-075>
- Vesco, A. T., Anderson, B. J., Laffel, L. M. B., Dolan, L. M., Ingerski, L. M., & Hood, K. K. (2010). Responsibility sharing between adolescents with type 1 diabetes and their caregivers: Importance of adolescent perceptions on diabetes management and control. *Journal of Pediatric Psychology*, 35(10), 1168–1177. <https://doi.org/10.1093/jpepsy/ajs038>
- World Health Organization. (2022). *Asthma*. WHO. <https://www.who.int/news-room/fact-sheets/detail/asthma>
- Wysocki, T., Nansel, T. R., Holmbeck, G. N., Chen, R., Laffel, L., Anderson, B. J., & Weissberg-Benchell, J. (2009). Collaborative involvement of primary and secondary caregivers: Associations with youths' diabetes outcomes. *Journal of Pediatric Psychology*, 34(8), 869–881. <https://doi.org/10.1093/jpepsy/jsn136>

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