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Psychometric properties of the parent strengths and difficulties questionnaire in the general population of German children and adolescents: results of the BELLA study

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■ **Abstract** *Background* The strengths and difficulties questionnaire (SDQ) is a brief screening instrument that addresses negative and positive behavioural attributes of children and adolescents in the age range of 4–16 years and can be completed by parents, teachers, and as a self-report. Furthermore, the impact supplement of the extended SDQ surveys for perceived problems, impact, and burden. *Objective* This paper aims to examine the psychometric properties of the parent form and to investigate differences in the SDQ scores for sociodemographic and socioeconomic subgroups. Patterns of association with other measures of mental health and descriptive comparison with the first normative sample are also reported. *Methods* Within the BELLA study module of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS), a total of 2,406 children and adolescents aged 7–16 years as well as their parents answered the items of the SDQ and the additional impact supplement. The internal consistency of scale responses was assessed via Cronbach's α (alpha). Likert scale assumptions of sufficient and similar item-total correlation and

item variance were investigated. The factorial validity of the SDQ measurement model was tested by means of exploratory and confirmatory factor analysis. Mean score differences between males and females, age groups (7–10 years vs. 11–16 years), and socioeconomic status groups (Winkler index) were examined via ANOVA. *Results* Factor analysis provided an exact replication of the original five-factor SDQ subscale structure. All subscales were sufficiently homogeneous. The mean total difficulties and SDQ subscale scores of the BELLA sample did not differ from the first German normative data. Younger children were more impaired on various SDQ scales than older children, girls were more emotionally affected, and boys showed more externalising problems. *Conclusions* The present study confirmed the validity and reliability of the parent-reported SDQ scale structure. The SDQ was found to be a valid and helpful questionnaire for use in the framework of an epidemiological survey.

■ **Key words** strengths and difficulties questionnaire (SDQ) – parent-report – reliability – factorial validity

Introduction

Early recognition of mental health problems in children is crucial since such problems may have major implications for individual psychosocial well-being as well as the child's further development [2]. In addition, these problems often present a burden on the individual's social partners. Psychosocial interventions can be expensive for the individual's family as well as for society as a whole [6]. Mental health problems in childhood and adolescence may persist and may develop into corresponding problems in adulthood, leading to long-lasting psychosocial impairment. Hence, valid interventions are needed to reliably detect deviant behaviours and emotions.

However, the boundaries between normal and abnormal behaviour are not always clear cut, and different cultural and social assumptions may determine what is considered to be abnormal [8]. Therefore, inventories for screening psychopathology need to fulfil quite strict psychometric properties from a multi-cultural perspective [1].

The strength and difficulties questionnaire (SDQ, [7]) is a brief behavioural screening questionnaire for 4 to 16-year-old children and teenagers that surveys their mental health symptoms and positive attitudes. Several validated versions are available. Positive or negative attributes are assessed using 25 items focused on the following dimensions: emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems, and prosocial behaviour. Each of the 25 items of the SDQ is scored on a 3-point scale with 0, not true; 1, somewhat true; and 2, certainly true with higher scores indicating larger problems (except in the case of prosocial behaviour in which a higher score indicates more positive behaviour). Items from the four problem areas are summed up to generate a total difficulties score (0–40). The subscores of the four difficulties dimensions range from 0–10. The SDQ has been translated and validated in several countries [1, 19]. From the large, representative sample of the United Kingdom, cut-off points have been defined that classify the test results into normal, borderline, and abnormal mental health problem scores [14].

The German translation of the parent SDQ has been applied, tested, and validated in several studies. Both Woerner et al. [20] and Becker et al. [4] found factor analysis providing an exact replication of the original five-dimensional structure of the SDQ measurement model. For parent and teacher SDQs in a German clinical sample, the mean subscale Cronbach's α were 0.76 and 0.78, respectively, while the total difficulties Cronbach's α was 0.83 for both the parent and teacher SDQs [3]. For parent SDQs in a

European ADHD sample of 1,454 children, Cronbach's α ranged from 0.58 to 0.72 and were fairly consistent in all ten participating countries [4].

Bettge et al. [5] compared two adolescent mental health screening instruments and found the SDQ to be superior with regards to sensitivity and specificity. Thus far, for the German version, normative data has only been provided for the parent SDQ [18, 20].

The present report aimed to replicate the psychometric properties of the German parent-report version of the SDQ. The population under study is the large, representative sample of German children and adolescents included in the BELLA study [16]. Psychometric properties are the mean scale levels and dispersions stratified for socio-demographic groups (i.e., low vs. high socioeconomic status), the reliability, and the factorial validity of the SDQ scores. Exploratory analysis of the SDQ factor structure will be supplemented by a confirmatory approach.

Methods

■ Study design and sample

The conceptualisation, design, and procedure of the Mental Health Module (BELLA study) are described in detail in Ravens-Sieberer et al. [16] in this issue. The participants in the BELLA study were randomly recruited from the national, representative sample of 17,641 families participating in the German Health Interview and Examination Survey for Children and Adolescents (KiGGS) conducted by the Robert Koch-Institute (Berlin). The KiGGS and the BELLA survey took place between May 2003 and May 2006 in 167 cities and communities representative of Germany. The overall response rate was 66.6% (KiGGS). A random selection of 4,199 families from the KiGGS sample with children aged 7–17 were asked to participate in the BELLA study. Of these eligible families, 70% agreed to participate and 68% (1,389 girls and 1,474 boys) were surveyed. Of these 2,863 families that participated in the BELLA study, 1,142 had children aged 7–10, 780 had children aged 11–13, and 941 had children aged 14–17 (for this report, the limit was set at 16 years). In each family, one parent was questioned using a standardised computer-assisted telephone interview. Children aged 11 and older were interviewed as well. In addition, the participants were asked to fill in a mailed paper and pencil questionnaire. The participants' social stratum was determined using a multidimensional aggregated index [17] based on net household income, parental level of education, and occupational status, which allowed for a differentiation between lower, middle, and upper

class (Winkler index). It was scaled from 1 = lower SES to 3 = higher SES.

■ Statistical analyses

The statistical analyses are based on the weighted sample data to represent the age, gender, regional, and citizenship structure of the German population (reference data from 31 December 2004). The number of cases reported in tables and in the text refers to weighted data and, thus, might deviate from the number of cases reported in the former description of the sample. Data handling and statistical analyses were carried out using SPSS (Statistical Package for the Social Sciences; release 11.5), LISREL 8 [11], and PRELIS 2 [12] software.

Descriptive statistics (mean and SD) for the SDQ subscales and the total difficulties scores are presented for the total sample and by gender. In addition, gender effects for the SDQ subscales are reported. Cronbach's α coefficients were computed to estimate the internal consistency of the various SDQ subscales. Moreover, correlation between SDQ scores, age, and socioeconomic status are reported.

Using the LISREL 8 software, a confirmatory factor analysis was conducted by specifying a linear structural equation model according to the five-dimensional measurement model of the SDQ. Identifiability of the model parameters was ensured by confirming that each observed variable loaded onto only one latent construct and by fixing the variance of each latent variable to one. The successful complete standardisation of the model enabled correct parameter estimates [13]. The database for the unweighted least squares (UWLS) estimation of the model parameters was the polychoric correlation matrix of the observed indicators. As the UWLS estimation procedure does not require multivariate normal distribution of the data, no a priori normalisation of the observed variables was applied. For cases with less than 20% missing values on the SDQ items, missing values were

replaced by the multiple imputation expected maximisation (EM) procedure of PRELIS 2.

The goodness of fit of the model was assessed by the root mean square residual (RMSEA) and the adjusted goodness of fit index (AGFI). A RMSEA less than 0.6 (0.8) was taken as an indicator of excellent (adequate) fit between the specified model and the data [9]. To account for potential age differences between children aged 7–10 and children and adolescents aged 11–16, a multi-group SEM analysis was conducted. The goodness of fit (GoF) issued from an unrestricted model with separate parameter estimates was compared with the GoF issued from a restricted model. A principal component factor analysis with varimax rotation was performed to test the validity of the internal structure of the SDQ. To allow for a direct comparison with the proposed factorial structure, the number of extracted factors was fixed a priori at five.

Analysis of variance (ANOVA) modelling was performed to determine the effects of socioeconomic status, age group, and gender on the parent-rated SDQ subscale scores and total difficulties score.

Results

■ Basic psychometric properties

Mean scores obtained for parent-ratings in the entire sample are presented in Table 1, which also reports and compares scale means for male and female subsamples. Boys received significantly higher scores than girls on the subscales assessing conduct problems, hyperactivity/inattention, and, to a lesser extent, peer problems. Gender effects on these subscales combined to yield a significantly higher total difficulties score for male children and adolescents. Parent-ratings of their children's emotional symptoms and prosocial behaviour revealed significantly higher scores for the girls than for the boys.

Table 1 Scale means and gender effects for parent-rated SDQ scores (German BELLA sample, age range 7–16 years; earlier normative German sample with age range 6–16 years)

	Normative sample <i>N</i> = 930 Mean (SD)	BELLA sample <i>N</i> = 2,406 Mean (SD)	Boys <i>N</i> = 1,225 Mean (SD)	Girls <i>N</i> = 1,181 Mean (SD)	Gender effects (Two-tailed) <i>t</i>
Total difficulties score	8.1 (5.3)	7.8 (5.2)	8.6 (5.4)	7.4 (4.8)	0.10***
Emotional symptoms	1.5 (1.8)	1.8 (1.8)	1.6 (1.8)	1.9 (1.8)	−0.10***
Conduct problems	1.8 (1.6)	1.9 (1.5)	2.0 (1.6)	1.7 (1.4)	0.09***
Hyperactivity/inattention	3.2 (2.3)	3.0 (2.2)	3.4 (2.4)	2.5 (2.0)	0.21***
Peer problems	1.6 (1.7)	1.4 (1.6)	1.5 (1.7)	1.4 (1.6)	0.05*
Prosocial behaviour	7.6 (1.9)	7.9 (1.7)	7.6 (1.8)	8.2 (1.6)	−0.15**

*** $P \leq 0.001$, ** $P \leq 0.01$, * $P \leq 0.05$ (Student *t* test)

Table 2 Scale properties of the German parent-rated SDQ (normative BELLA sample; Cronbach's α as well as correlations with age and Winkler socioeconomic status)

	Scale homogeneity (α)			Correlation with age	Correlation with W-SES
	BELLA sample N = 2,406	Boys N = 1,225	Girls N = 1,181	r	r
Total difficulties score	0.82	0.83	0.80	-0.08***	-0.24***
Emotional symptoms	0.68	0.69	0.66	-0.07***	-0.14***
Conduct problems	0.58	0.61	0.53	-0.04*	-0.14***
Hyperactivity/inattention	0.79	0.81	0.75	-0.12***	-0.23***
Peer problems	0.62	0.63	0.61	0.04	-0.15***
Prosocial behaviour	0.66	0.66	0.64	0.03	0.06**

*** $P \leq 0.001$; ** $P \leq 0.01$; * $P \leq 0.05$ (Spearman rank correlations, two-tailed)

Mean SDQ subscale scores and the total difficulties score for the BELLA sample only slightly differed from the first representative German normative data, as shown in Table 1. This normative sample consisted of children and adolescents between 6 and 16 years of age whereas this BELLA sample examined children between the ages of 7 and 16 years.

■ Reliability

Internal consistency coefficients (Cronbach's α) for the SDQ subscales are reported in Table 2. Although each subscale consists of only five items, the Cronbach's α coefficients were moderate ($\alpha = 0.58$ – 0.79) in the evaluated sample. The lowest value was found for the subscale measuring conduct problems and the highest α coefficients were found for the hyperactivity/inattention and emotional symptoms subscales. This was fairly consistent for both genders. The internal reliabilities of the conduct problems and hyperactivity/inattention subscales were slightly higher for the male subsample than for the female. The internal consistency of the total score was $\alpha = 0.82$, with only slight differences between the genders. Thus, the data from the parent-rated version of the SDQ in this sample can be considered sufficiently reliable.

The correlation with age showed that, in general, younger children are more impaired than older children on the SDQ subscales, except for the peer problem and the prosocial scale. No age differences were observed for these scales.

A similar picture was seen for the correlation with the SDQ subscales and socioeconomic status (according to the Winkler index). Children and adolescents with a less favourable social and economic background scored significantly higher on all SDQ problem subscales and demonstrated a lower level of prosocial behaviour. The impact of social class on these scales also resulted in a substantial SES effect on the total difficulties score (Table 2).

■ Evaluation of factor structure and factorial validity

Factorial validity (confirmatory)

Several analyses were carried out to verify the proposed five-factor structure of the SDQ. The 25 parent-rated SDQ items were subjected to a confirmatory factor analysis for the entire sample of children and adolescents aged 7–16. The confirmatory factor analysis of the parent-reported SDQ resulted in GoF statistics of RMSEA = 0.10, indicating some deviation of the SDQ measurement model from the data. The AGFI was 0.97, indicating that 96% of the observed variance and covariance could be explained by the model. The estimated loading coefficients ranged between 0.34 and 0.83. The largest cross loading was 0.59. None of the cross loadings exceeded the estimated loading on the domain that the item was intended to measure. A multi-group analysis was conducted to test for statistically significant differences in the pattern coefficients estimated for younger (7–10 years) and older (11–16 years) children and adolescents. The GoF χ^2 value was 8491.9 ($df = 580$) for the model with pattern coefficients restricted to be equal across groups. For an unrestricted model with separate estimation of pattern coefficients, the GoF χ^2 value was 8350.1 ($df = 530$). The resulting GoF χ^2 value for age differences was 141.8 ($df = 50$) ($P = 0.999$), thus indicating statistically non-significant differences in the pattern coefficient estimates for younger and older children.

Factorial validity (exploratory)

In addition, the factor structure of the German parent SDQ was also examined using a total of 2,406 parent-rated SDQs and included in a principal component analysis with subsequent varimax rotation. The five-factor solution explained 46.4% of the total variance. Table 3 shows the high cor-

Table 3 Factor structure and original scales of the German parent-rated SDQ (sample aged 7 to 16 years; $N = 2,406$; five-factor solution; only rotated loadings with absolute values ≥ 0.35 are reported here)

Extracted factor	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Initial Eigenvalue	5.14	2.21	1.84	1.27	1.16
Explained variance (initial)	20.5%	8.9%	7.4%	5.1%	4.6%
Explained variance (rotated)	11.1%	10.1%	9.5%	7.9%	7.8%
"Hyperactivity/inattention"					
2 Restless	0.78				
10 Fidgety	0.76				
15 Distractible	0.72				
21 Reflective ^a	0.52				
25 Persistent ^a	0.69				
"Emotional symptoms"					
3 Somatic complaints		0.51			
8 Worries		0.68			
13 Unhappy		0.65			
16 Clingy		0.61			
24 Fears		0.68			
"Prosocial behaviour"					
1 Considerate			0.52		-0.41
4 Shares			0.61		
9 Caring			0.65		
17 Kind to kids			0.57		
20 Helps out			0.70		
"Peer problems"					
6 Solitary				0.57	
11 Good friend ^a				0.61	
14 Popular ^a				0.58	
19 Picked on, bullied			0.42	0.43	
23 Best with adults				0.63	
"Conduct problems"					
5 Tempers					0.44
7 Obedient ^a		-0.37			0.45
12 Fights					0.53
18 Lies, cheats					0.57
22 Steals					0.64

^aScores on these items were inverted before being entered into the analysis

Table 4 Descriptive measures of the parent SDQ scales for the factors socioeconomic status, age group, and gender

Socioeconomic status	Low				High			
	7-10		11-16		7-10		11-16	
Age group (years)	7-10		11-16		7-10		11-16	
	m	f	m	f	m	f	m	f
Gender	M (SD)		M (SD)		M (SD)		M (SD)	
Total difficulties score	9.6 (5.7)	8.4 (5.3)	8.9 (5.3)	7.6 (4.8)	7.1 (5.0)	6.5 (3.9)	7.2 (5.4)	5.9 (4.4)
Emotional symptoms	1.9 (1.9)	2.1 (1.9)	1.5 (1.8)	2.0 (1.8)	1.4 (1.7)	1.7 (1.7)	1.5 (2.0)	1.5 (1.8)
Conduct problems	2.1 (1.7)	1.8 (1.5)	2.1 (1.7)	1.8 (1.5)	1.9 (1.4)	1.5 (1.2)	1.7 (1.5)	1.4 (1.3)
Hyperactivity/ Inattention	4.0 (2.6)	3.0 (2.2)	3.6 (2.3)	2.4 (1.8)	2.6 (2.2)	2.1 (2.0)	2.6 (2.3)	1.8 (1.9)
Peer problems	1.5 (1.6)	1.4 (1.6)	1.6 (1.7)	1.5 (1.7)	1.2 (1.6)	1.2 (1.3)	1.4 (1.6)	1.1 (1.6)
Prosocial behaviour	7.7 (1.8)	8.2 (1.5)	7.5 (1.7)	8.0 (1.2)	7.8 (1.5)	8.5 (1.5)	7.7 (1.5)	8.5 (1.5)

M mean, *SD* standard deviation (Winkler Index: 1 & 2, low; 3, high)

respondence between the pattern of rotated loadings and the original SDQ subscales. All 25 items had their highest loadings on the extracted factors and identically matched the intended scale structure.

■ Moderating effects

The analysis of the age effects (Table 4, 5) showed that younger children (aged 7-10 years) had significantly higher total difficulties and hyperactivity/inat-

Table 5 2 × 2 × 2 ANOVA of the parent SDQ scales for the factors socioeconomic status, age group, and gender

	Total difficulties score			Emotional symptoms			Conduct problems			Hyperactivity/Inattention			Peer problems			Prosocial behaviour		
	F	P	eta ²	F	P	eta ²	F	P	eta ²	F	P	eta ²	F	P	eta ²	F	P	eta ²
Socioeconomic Status	65.6	***	0.028	16.7	***	0.007	21.2	***	0.009	93.1	***	0.039	12.9	***	0.006	5.6	*	0.002
Age group	4.3	*	0.002	3.1	NS	0.001	0.6	NS	0.001	10.5	***	0.005	0.3	NS	0.001	4.6	*	0.002
Gender	20.9	***	0.009	7.8	**	0.003	21.2	***	0.009	72.3	***	0.031	3.3	NS	0.001	49.3	***	0.021
Status × age	1.1	NS	0.001	2.1	NS	0.001	0.9	NS	0.001	4.4	*	0.002	0.1	NS	0.001	0.1	NS	0.001
Status × gender	0.2	NS	0.001	1.6	NS	0.001	0.1	NS	0.001	5.1	*	0.002	0.1	NS	0.001	1.0	NS	0.001
Age × gender	0.4	NS	0.001	0.1	NS	0.001	0.3	NS	0.004	2.7	NS	0.001	0.7	NS	0.001	0.8	NS	0.001
Status × age × gender	0.3	NS	0.001	1.5	NS	0.001	0.2	NS	0.001	0.1	NS	0.001	0.3	NS	0.001	0.6	NS	0.001

Effects are from 2 × 2 × 2 ANOVA with socioeconomic status, age group, and gender as factors. The effect sizes presented in Table 5 are the partial eta squared produced by the ANOVA. Cohen (1977) provides the following guidelines for interpreting the eta squared (η^2) value: 0.01–0.059 = small effect size, 0.06–0.139 = medium effect size, >0.14 = large effect size. *** $P < 0.001$; ** $P < 0.01$; * $P < 0.05$
NS not significant

Table 6 Recommended bandings of raw scores obtained with the German parent-rated SDQ (BELLA: $N = 2,406$ aged 7–16 years; German Norms: $N = 930$ aged 6–16 years)

	Normal range		Borderline range		Abnormal range	
	German bandings	Norm% (BELLA%)	German bandings	Norm% (BELLA%)	German bandings	Norm% (BELLA%)
Total difficulties score	0–12	81.6 (83.2)	13–15	8.4 (7.4)	16–40	10.0 (9.4)
Emotional symptoms	0–3	86.0 (83.3)	4	6.3 (6.9)	5–10	7.7 (9.8)
Conduct problems	0–3	84.7 (87.2)	4	8.7 (6.7)	5–10	6.6 (6.1)
Hyperactivity / Inattention	0–5	85.3 (87.1)	6	4.9 (5.3)	7–10	9.8 (7.6)
Peer problems	0–3	86.7 (88.7)	4	6.3 (5.8)	5–10	7.0 (5.5)
Prosocial behaviour	6–10	84.4 (89.4)	5	8.5 (7.2)	0–4	7.1 (3.2)

attention problems and lower prosocial behaviour scores than older children (aged 11–16 years).

Moreover, the analysis of the gender effects showed that girls had significantly more emotional symptoms than boys and exhibited significantly more prosocial behaviours than boys. Boys were more affected with conduct problems and hyperactivity/inattention problems than girls. In addition, males had a higher total difficulties score.

Furthermore, it could be shown that children from families with a lower socioeconomic status were more impaired on all SDQ scales than children from families with a higher status.

Table 6 also presents the percentages of participants (girls and boys) who could be classified as borderline or abnormal (based on the German cut-off scores) on each SDQ subscale and the total difficulties score. Compared with the abnormal range of the normative sample described by Woerner et al. [18], emotional symptoms were slightly more prevalent; however, lower percentages were found for the other scales.

Discussion

This study replicated the good psychometric properties of the German parent SDQ [18] in a larger,

representative sample of German children and adolescents aged 7–16. In addition, it shows that (with the exception of emotional symptoms) the mean scores observed in the abnormal range were slightly lower than those reported in the study of Woerner et al. [18]. These differences might be attributable to the fact that the normative sample examined by Woerner et al. [18] was younger in age at the lower end (6–16 years). For younger children, parents tended to report slightly more symptoms than for older ones.

The internal consistency of the total difficulties score was sufficient for group comparisons, even with smaller samples. Individual comparisons are limited due to the large standard error, making it difficult to discriminate between single respondents [15]. The items of the subscales conduct problems and peer problems were answered with a consistency below the threshold of 0.70 that is required for group comparison [15]. The scales emotional symptoms and prosocial behaviour displayed slightly lower reliabilities than required for group comparison. Thus, the use of these subscale scores demands fairly large samples in order to compensate for these partially low reliabilities.

The factorial validity of the five-dimensional measurement model was satisfactory in the exploratory factor analysis. All items loaded highest on factors corresponding to their theoretical measurement do-

main. However, some substantial cross loadings were observed. Within a confirmatory factor analysis, however, slight differences of the specified structural equation model were observed. The assumption of the five latent variables (SDQ dimensions) could not adequately explain the correlation between the items. Yet, the actual GoF values did not indicate essential deviations. The factorial structure was stable for all ages examined; thus, indicating an equal understanding and functioning of the SDQ items across age. However, additional explicit analyses of differential item functioning for age (and for gender and socioeconomic status) are still necessary to thoroughly address this issue.

As expected, low socioeconomic status was associated with more emotional and behavioural problems. These results also hint at the validity of the measurement. The observed gender differences in the

mean subscale scores also resembled a priori expected patterns (see Becker et al. [4]). Girls suffered more from emotional symptoms than boys. Boys had more conduct and attention/hyperactivity problems than girls, a result that has been seen in other epidemiological studies as well [10].

In summary, the results confirmed in a second large, representative German sample that the SDQ met the basic psychometric requirements of a reliable and valid measurement. In this respect, the SDQ is a useful and easy to apply questionnaire for screening purposes even though some psychometric results are not fully satisfying and require additional research, especially in a multicultural setting [1].

■ **Conflict of interest** All authors declare no conflict of interest.

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