Psychometric Properties of the Self-report Strengths and Difficulties Questionnaire (SDQ) in a Nigerian Adolescents Sample

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Authors' contributions

This work was carried out in collaboration between both authors. Author YA designed the study, performed data collection and statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author OO contributed to the study design, data collection and analyses of the study. Author YA managed the literature searches. Both authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Background: In most low-and-middle income countries, more than 50% of the population are children and adolescents. There are very few child and adolescent mental health professionals to attend to the mental health needs of this population. Therefore, screening instruments that are easy to use, and requires little time to complete should be made available to these few and overburdened professionals. Hence, this study aimed at establishing the psychometric properties of the Strengths and Difficulties Questionnaire (SDQ) among adolescents attending a Secondary School in Nigeria.
Methods: The validation was carried out in two stages. In the first stage, one hundred and two adolescents aged 13-16 years completed the self-report version of the SDQ. The second stage involved the administration of the Schedule for Affective Disorders and Schizophrenia for School Age Children, Current and Lifetime Version (K-SADS-PL) to all the 102 participants in the first stage.
Results: The SDQ displayed good internal consistency (Cronbach's α = 0.82). A cut-off of 14 gave the optimal threshold point with a sensitivity of 0.84, specificity of 0.88 and a misclassification rate of 0.19. A factor analysis of the instrument supported the original five-factor hypothesis with items on the pro-social scale loading with the lowest scores.

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Conclusions: The self-report SDQ demonstrated good psychometric properties and confirmed the five-factor hypothesis of the original author. However, future research should establish indigenous meaningful construct within this population and culture with special consideration on the pro-social scale of the instrument.

1. INTRODUCTION

Over 50% of people living in the low and middle countries like Nigerians are below the age of 18 years [1] and studies have shown that about 20% of children and adolescents will have a mental illness at some point in their lifetime [2]. Early identification and intervention can improve the prognosis for psychosocial problems in children [3-5]. However, in low and middle income countries such as Nigeria, there are few mental health professionals to attend to the needs of this population [2,6]. As a result, the few available mental health workers are overburdened and usually do not have sufficient time for an elaborate assessment. Therefore a screening instrument is necessary in order to reach more children and adolescents with mental health problems. In addition, the WHO [7] has encouraged the training of primary health care workers in the recognition and treatment of common mental disorders; therefore there is a need for these workers to have access to validated screening instruments like the Strengths and Difficulties Questionnaire (SDQ).

The SDQ is one of the most widely used screening tools in child and adolescent mental health assessment across the globe. It was originally developed and validated within the United Kingdom by Robert Goodman and its reliability and validity have been replicated in several countries [8,9]. The SDQ is a brief behavioural screening questionnaire that exists in several versions to meet the needs of researchers, clinicians and educationalists. The SDQ provides a valid yet economical screening procedure in child and adolescent mental health practice [10] and diagnostic predictions based on the SDQ have been shown to agree well with clinical diagnosis [8]. Its brevity, ease of administration and short completion time makes the SDQ a useful tool in most settings.

2. MATERIALS AND METHODS

2.1 Participants

The study was carried out among 102 adolescents attending a secondary school in Ibadan South-west of Nigeria. The participants were randomly selected from five arms of the school that consisted a total of about 500 students at the time of the study. The inclusion criteria included age range of between 11 and 16 years; this is the age range that is set by the author for the use of the self-report SDQ. Consent to participate in the study was obtained from the participants' parents/caregivers, the study procedure and purpose were also explained to the adolescents.

2.2 Materials

The Strengths and Difficulties Questionnaire (SDQ) (Goodman, 1997): The SDQ was originally developed and validated within the UK, and its reliability and validity have been replicated in several countries (Goodman, 1997, Goodman, 2001, Muris et al. 2003). The SDQ is a brief behavioural screening questionnaire that exists in parents', teacher' and self-report versions to meet the needs of researchers, clinicians and educationalists. All versions of the SDQ ask about 25 attributes. These 25 items are divided between 5 scales with 5 items each, they are conduct problems, emotional symptoms, hyperactivity/inattention, peer relationship problems and pro-social scales. The scores from the emotional, conduct, hyperactivity/inattention and the peer relationship problem scales are added together to generate a total difficulty score. The pro-social scale provides a strength score.

2.2.1 The schedule for affective disorders and schizophrenia for school age children, current and lifetime version (K-SADS-PL) (Chambers et al.1985)

The K-SADS-PL is a semi-structured diagnostic interview designed to assess current and past episodes of psychopathology in children and adolescents according to the Diagnostic and Statistical Manual of Mental (DSM) Disorders, The instrument is divided into two main parts namely the Screen Interview and the Diagnostic Supplements. The Screen Interview surveys the primary symptoms of the different diagnoses.

Symptoms rated in the screen interview are surveyed for current and most severe past episodes simultaneously. The interview begins by asking if the child had ever experienced the symptom. If the answer is no, the symptom is rated negative for current and past episodes and the interviewer proceeded to the next question. If the answer is in the affirmative, the interviewer finds out when the symptoms are present (for instance, whether the symptom is present at the time of the interview or in the past). The Diagnostic Supplement has a list of symptoms, probes, and criteria to assess current and most severe past episodes of psychiatric disorders. The criteria required for making DSM diagnoses are provided. Subjects who show significant symptom clusters in the screen interview are taken through the diagnostic supplements for confirmation. A psychiatric syndrome is diagnosed when a subject meets the DSM criteria for the syndrome with the Diagnostic Supplement.

2.3 Procedure

Ethical permission to conduct the study was obtained from the University of Ibadan/University College Hospital Research Ethics Committee. Permission to conduct the study was also obtained from the Oyo State Ministry of Education. This study was performed in accordance with the ethical principles enshrined in the Helsinki Declaration and the National Human Research Ethical code. The validation was carried out in a two-stage process. The first stage involved the administration of the self-rated version of the SDQ to all the participants. All the participants in the first stage also took part in the second stage.

The second stage involved the administration of the Schedule for Affective Disorders and Schizophrenia for School Age Children, Current and Lifetime Version (K-SADS-PL) [11] to all the 102 participants in the first stage. The K-SADS-PL is a criterion instrument which gives specific diagnosis for child and adolescent disorders. The scores on the SDQ were subsequently compared to the findings of the K-SADS PL assessment. The administration of the KSADS was done by the investigator who has been trained in the use of the instrument prior to the study and did not have access to the scores of the participants on SDQ. A semi-structured questionnaire was used to collect data on socio-demographic characteristics. Data collected was analysed using the SPSS version 20.

2.4 Validity Coefficient

To determine the validity coefficient for the SDQ, each participants was categorised as either a case or a non-case based on the KSADS-PL. Validity coefficients including the sensitivity, specificity, misclassification rate, positive and negative predictive values, false positive rate and internal consistency were determined for the SDQ using the KSADS as a criterion standard. In addition, the best cut-off point that depicted the relative trade-off between sensitivity and specificity on the SDQ was determined. The ability of the SDQ to discriminate between cases (presence of DSM IV diagnosis) and non-cases (absence of DSM IV diagnosis) was assessed by the application of the receiver operating characteristics (ROC) analysis.

2.5 Receiver Operating Characteristics Analysis

An ROC curve is obtained by plotting sensitivity against the false-positive rate (1-specificity) for all possible cut-off points of the screening instrument. This curve represents the ability of the screening instrument to discriminate between cases and non-cases across the total spectrum of morbidity. The area under the curve (AUC) is an index of the discriminating ability of the instrument. The ROC curve may also assist in the selection of an optimal cut-off point [12]. The point on the ROC curve that is farthest from the diagonal appears to be the best cut-off since equal rates of false-negatives and false-positives are obtained at this point [12,13]. However, other factors that should be considered when determining this point include increases and decreases in prevalence, case definition and financial costs of intervention [12,14].

3. RESULTS

The self-report version of the SDQ was completed by 102 adolescents. The ages of the participants ranged from 13–16 years with a mean age of 15.02 ± 0.97. Table 1 shows the distribution of scores on the SDQ and cases on non-cases on the KSADS; those who met diagnostic criteria for a disorder on the KSADS were classified as cases and those who did not as non-cases. Participants who scored high on the SDQ were more likely to be categorised as cases (i.e meet diagnostic criteria for at least a disorder) on the KSADS.

Table 1. Distribution of the scores on the self-rated SDQ for "cases" and "non-cases"
N=102

Score on SDQ	Cases (KSADS positive)	Non-cases (KSADS negative)
0	--	--
1	--	--
2		2
3		13
4		19
5	--	6
6		12
7		2
8		5
9		1
10	2	1
11	1	--
12	3	2
13	4	--
14	5	--
15	5	--
16	4	--
17	6	--
18	4	--
19	4	--
20-40	1	--
Total	**39**	**63**

Note: Cases: Those who met diagnostic criteria for any psychiatric disorder on the KSADS.
Non cases: Those who did not meet criteria for any psychiatric disorder on the KSADS.

Table 2. Validity coefficients of the SDQ at threshold scores 4 to 10 for the participants.
N=102

Threshold	10	11	12	13	14	15	16
Sensitivity	0.88	0.89	0.87	0.85	**0.84**	0.67	0.61
Specificity	0.74	0.76	0.78	0.85	**0.88**	0.88	0.89
Positive predictive value	0.67	0.82	0.86	0.88	**0.89**	0.86	0.85
Negative predictive value	0.45	0.56	0.60	0.74	**0.76**	0.86	0.89
Misclassification rate	0.49	0.33	0.28	0.18	**0.19**	0.15	0.18
False positive rate	0.26	0.24	0.22	0.15	**0.12**	0.12	0.11

3.1 Reliability and Validity Co-efficient

Using the Spearman- Brown split half formula, a Cronbach's alpha of 0.82 was obtained. A threshold of 14 gave the best trade off between a high sensitivity and a low false positive rate (1-specificity). At this "optimal" threshold, the sensitivity was 0.84 and the specificity was 0.88, with a misclassification rate of 0.19 (Table 2).

3.2 ROC Analysis

The discriminating ability as indicated by the area under the curve was 0.86. The greatest perpendicular distance from the diagonal on the ROC curve was at the threshold of 14 (Fig. 1).

3.3 Factor Analysis

A factor analysis involving main component only and subsequent varimax rotation was carried out to determine the factor structure of the SDQ. The number of extracted factor was specified as five. These five extracted factors account for 73.5% of the overall variance in the participants' score. The five scales of the SDQ were readily conceptualized. Table 3 shows the factors loadings for the items with loadings > 0.40 on the five factors.

The first factor is a conduct problem factor, which consists of items relating to being obedient, fighting, telling lies, stealing and temper tantrum.

Table 3. The Self-rated SDQ- results of principal factor analysis followed by varimax rotation*

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Considerate					0.444
Restless		0.873			
Headache			0.844		
Shares					0.498
Temper	0.873				
Solitary				0.884	
Obedient	0.854				
Worry			0.859		
Helpful					0.779
Fidgety		0.851			
One friend				0.879	
Fights	0.867				
Unhappy			0.905		
Like				0.807	
Distract		0.897			
Nervous			0.866		
Kind					0.610
Lies	0.802				
Bullied				0.847	
Volunteer					0.533
Thinks		0.807			
Steals	0.854				
Gets on				0.853	
Fears			0.943		
Tasks		0.863			
Percent of total variance (rotated)	16.37%	16.18%	15.97%	15.43%	9.51%

Notes: SDQ, Strengths and Difficulties Questionnaire, N==102 adolescents
**Rotated loadings < 0.40 not included in this table*

Factor 2 is a hyperactivity factor that loads highly on restlessness, squirmy and fidgety, easily distracted, ability to complete tasks and think things through. Factor 3 is an emotional factor with items loading on somatic complains, worrying, unhappy, nervous and having many fears. Factor 4 is a peer problem factor with items loading on solitary play, being generally liked, having a good friend, bullying and getting on better with adults. Factor 5 is a pro-social factor that loads highly on being considerate, shares things, helpful, kind and volunteers to help.

4. DISCUSSION

The Strengths and Difficulties Questionnaire (SDQ) demonstrated good psychometric properties in the current study, against the Schedule for Affective Disorders and Schizophrenia for school age children (K-SADS) which was used as the gold standard. The results of this study showed that the internal consistency of the SDQ was good with a Cronbach's alpha of 0.82, comparing favourably with previous studies [15]. In a study by Goodman, the author of the SDQ, in which 10,438 children in Britain were surveyed, 3 versions of the SDQ were used [15]. The results obtained showed that the internal consistency of the SDQ, a measure of how the individual items are related to each other, was generally satisfactory with a Cronbach alpha of 0.73 [15]. However, the Cronbach's alpha obtained in the current study is higher than that found in a Dutch study in which 562 children and adolescents in mainstream schools completed the self-reported version of the screening questionnaire and a Cronbach's alpha of 0.64 was obtained [16]. Similarly, in a two-stage design study in Iran, the teachers and parents' versions of the SDQ were completed for 600 children aged between 6 and 12 years in the first stage [17]. In the second stage of the study, 52 children who scored either above or below the cut-off point reported by the originator of the SDQ were administered the K-SADS. A Cronbach's alpha of 0.73 and 0.69 were obtained for the parents' and teachers' version of the SDQ respectively [16].

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Diagonal segments are produced by ties.
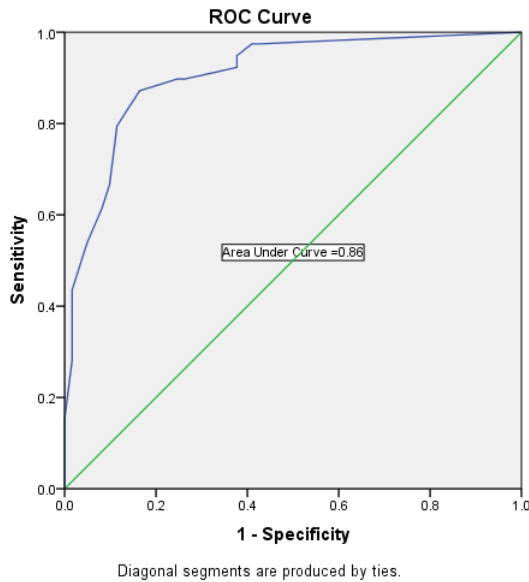
Fig. 1. Receiver Operating Characteristics (ROC) curve for the SDQ

In this present study, a cut–off point of 14 best discriminated between cases and non cases. At this optimal threshold, sensitivity was 0.84 and specificity was 0.88 with a misclassification rate of 0.19. This cut-off point is lower than the cut-off point of 16 reported by the originator of the questionnaire (Goodman et al. 1998) on English adolescents. It has been reported that several factors may influence the establishment of an optimal threshold for a screening instrument. These factors include sample characteristics such as age, sex, clinical state, mode of selection; the diagnostic criteria, structure of the diagnostic interview and the cultural importance of items on the questionnaire [14]. The age range of adolescents (13-16 years) in this study was not much different from the age range of adolescents (11-16 years) studied in the original validation study of the instrument. However, the study setting, the clinical state and the diagnostic criteria were different. In the original validation study, the self-report version of the (SDQ) was administered to two samples of 11-16 year olds: 83 young people in the community and 116 young people attending a mental health clinic in the United Kingdom (Goodman et al. 1998). The authors found that the best discrimination between clinic and non clinic adolescents was a total score of 16 or more. In contrast, the current study involved the screening of adolescents aged 13 to 16 years attending a mainstream school and all the adolescents in the first stage were

interviewed using the K-SADS to make specific diagnosis. In the original validation study, over 50% of the children were attending a mental health clinic [17]. It is likely that the sample population had higher level of psychopathology; therefore, a higher cut-off point was required to discriminate between cases and non-cases. Adolescents in a mainstream school would have less severe psychopathology, as a result; there will be greater overlapping of scores, requiring lower cut-off scores.

However, it has been observed that the cut-off points of the SDQ vary across different countries [18]. One possible explanation for these variations might be that most of these studies were done mainly in Europe where cut-off scores were reportedly higher [16]. A study that compared the results from different studies on the SDQ in southern European countries such as Italy, Spain, Portugal, Croatia and France, found that the scores varied among these countries [18]. Despite these variations, the studies still reported higher scores when compared with studies from other parts of the world [18]. This observation might be due to cross-cultural issues associated with the psychometric properties of rating scales [16], and the different meanings of mental health problems in different cultures. Another explanation for the varying cut-off points is that the age range of the participants differed across the different studies [19]. Younger children have been reported to be more impaired on various SDQ scales than older children [19]. An observation in the current study that might also explain the low cut off is that some items on the questionnaire were consistently not responded to by the participants. Examples include items such as "*Do you steal from home, school or elsewhere*", "*Do you often lie or cheat*". These are externalizing symptoms, and it has been reported that children and adolescents are more likely to report internalising symptoms rather than externalising symptoms [20,21]. Parents and caregivers are better at reporting externalising symptoms. It is important to note that studies in Nigeria that examined psychometric properties of other screening instruments have reported lower cut-off scores compared to studies in the western world. For example, a study that compared the Child Behavioural Checklist (CBQ) and the Reporting Questionnaire for children in a two stage design among children in a primary health care setting, found an optimal threshold that was 6 scores lower than the optimal threshold established by the originator of the CBQ [14]. This finding of

reporting lower cut-off on the CBQ had also been replicated in Ilorin, North central Nigeria [22].

The factor analysis done in this study confirmed the original five-factor hypothesis of the SDQ by the original author (Goodman, 2001). Several studies have supported the five-factor analysis [23-28]. However it is important to note that in the present study, the items on the pro-social scale has the lowest scores, this might be due to socio-cultural peculiarities of the setting where the study was conducted. For example, "*I share readily with others*", is an item on this scale. This might not be an appropriate measure of positive social skill because most children in Nigeria are taught not to accept gifts from people other than their parents or close relatives this in turn affect their sharing habit, therefore sharing readily might not be seen as a pro-social skill. Concepts like appropriate greeting gestures and courtesy for example, prostrating by males and kneeling by females towards older people and caring for the elderly people are likely to be more appropriate as pro-social skills in this setting.

A limitation of the study is the fact that the report were from the adolescents, therefore they might have underreported some of the symptoms. It has been reported that children and adolescents are more likely to report internalising symptoms rather than externalising symptoms. A way forward will be to employ a multi-informant approach involving the adolescents, parents and teachers in future studies.

5. CONCLUSIONS

The results of the present study demonstrate that the SDQ has good psychometric properties. Furthermore, the brevity, self-report design and ease of administration of the instrument without the requirement of any rigorous training or expertise makes it invaluable in a resource-constrained setting like Nigeria, where there is a dearth of mental health professionals. However, cultural consideration and input might improve its use in this setting.

CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. UNICEF. At a Glance: Nigeria; 2012. Available:http://www.unicef.org/infobycountry/nigeria_statistics.html (Accessed 02/07/2014)
2. Patel V, Flisher A, Hetrick S, McGorry P. Mental health of young people: A global public-health challenge. The Lancet. 2007; 369:1302-1313.
3. Newman L. Getting in early Identification of risk in early childhood Australian & New Zealand Journal of Psychiatry. 2012;46: 697-699.
4. Murphy BP, Brewer WJ. Early intervention in psychosis: Strengths and limitations of services. Advances in Psychiatric Treatment. 2011;17:401-407. DOI: 10.1192/apt.bp.110.008573
5. Geeraert L, Van den Noortgate W, Grietens H, Onghena P. The effects of early prevention programs for families with y oung children at risk for physical child abuse and neglect: A meta-analysis. Child Maltreat. 2004;9(3):277–291.
6. Robertson B, Omigbodun O, Gaddour N. Child and adolescent psychiatry in Africa: Luxury or necessity? African Journal of Psychiatry. 2010;13:329-331.
7. World Health Organisation. The world health report 2008: primary health care now more than ever. Geneva, Switzerland: World Health Organization; 2008.
8. Goodman R. The strengths and difficulties questionnaire: A research note. Journal of Child Psychology and Psychiatry. 1997; 38(5):581-586.
9. Muris P, Meesters C, van den Berg F. The strengths and difficulties questionnaire (SDQ): Further evidence for its reliability and validity in a community sample of Dutch children and adolescents. European Child and Adolescent Psychiatry. 2003;12: 1-8.

10. Hintermair M. Socio-emotional problems among hearing-impaired children--initial results of the German version of the Strengths and Difficulties Questionnaire (SDQ-D)]. Z Kinder Jugend psychiatry and Psychotherapy. 2006;34(1):49-61.

11. Chambers WJ, Puig-Antich J, Hirsch M, Paez P, Ambrosini PJ, Tabriz MA, Davies M. The assessment of affective disorders in children and adolescents by semi-structured interview: Test-retest reliability of the K-SADS-P. Archives of General Psychiatry. 1985;42:696-702.

12. Fan J, Upadhye S, Worster A. Understanding receiver operating characteristic (ROC) curves. Pedagogical Tools and Methods. Canadian Journal of Emergency Medicine. 2006;8(1):19-20.

13. Park SH, Goo JM, Jo CH. Receiver operating characteristic (ROC) curve: practical review for radiologists. Korean Journal of Radiology. 2004;5(1):11-8.

14. Omigbodun O, Gureje O, Gater R, Ikuesan B, Adebayo E. Psychiatric morbidity in a Nigerian paediatric primary care service: A comparison of two screening instruments. Social Psychiatry and Psychiatric Epidemiology. 1996;34:186-93.

15. Goodman R. Psychometric properties of the strengths and difficulties questionnaire. Journal of American Academy of Child and Adolescent Psychiatry. 2001;40:1337–1345.
DOI: 10.1097/00004583-200111000-00015

16. Shahrivar Z, Tehrani-Doost M, Azita Rezaie P, Ahmadi F. Normative data and psychometric properties of the parent and teacher versions of the strengths and difficulties questionnaire (SDQ) in an Iranian community sample. Journal of Research in Medical Sciences. 2009; 14(2):69–77.

17. Goodman R, Meltzer H, Bailey V. The strengths and difficulties questionnaire: A pilot study on the validity of the self-report version. European Child and Adolescent Psychiatry. 1998;7:125–130.

18. Marzocchi GM, Capron C, Di Pietro M, Duran Tauleria E, Duyme M, Frigerio A. The use of the strengths and difficulties questionnaire (SDQ) in southern European countries. European Child & Adolescent Psychiatry. 2004;13(suppl 2):ii40–6.

19. Brøndbo PH, Mathiassen B, Martinussen M, Heiervang E, Eriksen M, Moe TF, Kvernmo S. The strengths and difficulties questionnaire as a screening instrument for Norwegian child and adolescent mental health services, application of UK scoring algorithms. Child and Adolescent Psychiatry and Mental Health. 2011;5:32.
DOI: 10.1186/1753-2000-5-32

20. Rothe EM, Lewis J, Castillo-Matos H, Martinez O, Busquets R, Martinez I. Posttraumatic stress disorder among Cuban children and adolescents after release from a refugee camp. Psychiatry Services. 2002;53(8):970-6.

21. Bayer JK, Ukoumunne OC, Mathers M, Wake M, Abdi N, Hiscock H. Development of children's internalising and externalising problems from infancy to five years of age Australian and New Zealand Journal of Psychiatry. 2012;46:659-668.

22. Tunde-Ayinmode MF, Ayinmode BA, Adegunloye OA, Abiodun OA. A comparison of two screening instruments in detecting psychiatric morbidity in a Nigerian pediatric primary care service: Assessing clinical suitability and applicability: Annals of African Medicine. 2012;11(4):203-211.

23. He JP, Burstein M, Schmitz A, Merikangas KR. The strengths and difficulties questionnaire (SDQ): the Factor Structure and Scale Validation in U.S. Adolescents. Journal of Abnormal Child Psychology. 2013;41(4):583-595.
DOI: 10.1007/s10802-012-9696-6.

24. Tobia V, Gabriele MA, Marzocchi GM. The Italian version of the strengths and difficulties questionnaire (SDQ)—teacher psychometric properties. Journal of Psychoeducational Assessment. 2013; 31(5):493-505.

25. Niclasen J, Teasdale TW, Andersen A-MN, Skovgaard AM, Elberling H, et al. Psychometric properties of the danish strength and difficulties questionnaire: The SDQ assessed for more than 70,000 raters in four different cohorts. PLoS ONE. 2012; 7(2):e32025.
DOI: 10.1371/journal.pone.0032025

26. Giannakopoulos G, Tzavara C, Dimitrakaki C, Kolaitis G, Rotsika V, Tountas Y. The factor structure of the strengths and difficulties questionnaire (SDQ) in Greek adolescents. Annals of General Psychiatry. 2009;8:20.
DOI: 10.1186/1744-859X-8-20

27. Van Roy B, Veenstra M, Clench-Aas J. Construct validity of the five

-factor strengths and difficulties questionnaire (SDQ) in pre-, early, and late adolescence. Journal of Child Psychology and Psychiatry. 2008; 49:1304–1312.
DOI: 10.1111/j.1469-7610.2008.01942.x

28. Ruchkin V, Koposov R, Schwab-Stone M. The strength and difficulties questionnaire: Scale validation with Russian adolescents. Journal of Clinical Psychology. 2007; 63:861–869.
DOI: 10.1002/jclp.20401