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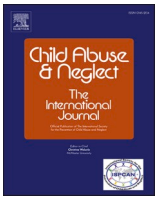
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Factor structure, measurement invariance and correlates of a modified version of the Short Child Maltreatment Questionnaire (SCMQ) among adolescents in England

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ABSTRACT

Background: Population surveys on child wellbeing require a brief, validated tool to measure child and adolescent maltreatment. The 7-item Short Child Maltreatment Questionnaire (SCMQ), developed by a WHO expert committee, has not been psychometrically tested.
Objective: This study aimed to determine the factor structure, measurement invariance and correlates of a modified version of the SCMQ (6 of its 7 items) in a sample of adolescents attending schools in England.
Methods: Data from 15,155 adolescents (aged 11–18 years) in the OxWell School Survey were used to test a modified 6-item version of the SCMQ. Information on depression, anxiety, self-harm, smoking, alcohol use, substance use, bullying victimization, peer victimization/dating abuse was collected using a structured, self-report questionnaire. The factor structure, reliability, and construct validity of the SCMQ was examined, and measurement invariance was tested across gender, age, and ethnicity.
Results: Findings from exploratory factor analyses revealed a stable one-factor model, while two- and three-factor models showed instability, suggesting that a unidimensional solution best represented the data. CFA confirmed a one-factor model [$\chi 2(df) = 92.265(12)$; CFI 0.992 TLI 0.987 RMSEA 0.02 90 % CI [0.020, 0.029]). Around 16.3 % of the sample experienced any form of maltreatment, with exposure rates for specific types of maltreatment ranging from 0.6 to 11.6 %. Full configural, metric, scalar invariance was observed across all groups. Internal consistency (McDonald's omega) was adequate (0.71). The SCMQ demonstrated good construct validity, showing significant associations with health behaviours (substance use, alcohol use, smoking), mental health challenges (self-harm, depression, anxiety) and interpersonal violence (dating abuse, bullying) with effect sizes ranging from small to moderate.
Conclusions: The SCMQ scores demonstrated acceptable reliability and validity among adolescents in England. It can be used to screen for maltreatment in large surveys and across diverse child populations. Opportunities to validate the SCMQ in other contexts would be beneficial.

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1. Background

Violence against children is a major public health issue with significant negative impact on children, families, and societies (Fry et al., 2018; Hillis et al., 2017), which has been further compounded by the varied impacts of the COVID-19 pandemic (Bhatia et al., 2021; Cappa & Jijon, 2021). Child maltreatment (referred to as 'maltreatment'), which forms a subset of violence, is defined as all abuse and neglect that takes place in the context of a relationship of responsibility, trust or power (WHO, 2022). Experiencing violence has negative impacts on multiple adolescent developmental domains, namely behavioural (internalizing and externalizing symptoms); biological (advanced epigenetic age, accelerated puberty, and insomnia); neurological (structural and functional differences in the developing brain), and social (poor school engagement, peer aggression, and low social support) (Jagasia et al., 2024). Meta-analyses demonstrate significant associations between maltreatment and sleep (insomnia, shorter sleep duration, and nightmares) (Schønning et al., 2022), maltreatment and non-suicidal self-injury, especially when experiencing emotional and sexual abuse (Calvo et al., 2024), adverse childhood experiences and body dysmorphic disorder (Longobardi et al., 2022), and experiencing family violence and lower academic achievement (Supol et al., 2021).

Accurate public health surveillance of maltreatment typically makes use of three methods, namely representative population-based surveys, sentinel surveys of professionals who work with children, and administrative data on maltreatment (Meinck et al., 2016). Countries adopt different strategies to collect data on maltreatment, and in recent years, there has been an encouraging increase in the numbers of surveys that ask participants directly about maltreatment (Mathews et al., 2020). These surveys may be cross-sectional (including repeat cross-sectional studies), longitudinal, or multi-component health surveys with a small number of items on maltreatment. Such multi-component health surveys, some of which are conducted across several countries, are particularly advantageous as they contain large and sometimes nationally representative samples, are conducted regularly, and can address multiple topic areas (Meinck et al., 2016). For maltreatment to be best captured in multi-component health surveys, brief measures, with 10 items or fewer, need to be used; however, many self-report measures on maltreatment are often of substantial length.

Several brief measures exist to capture distinct, but related constructs, such as Adverse Childhood Experiences, maltreatment, and violence against children. The ACE Short Form (ACE-ASF), an 8-item version capturing Adverse Childhood Experiences (ACEs) was developed for the Health Behaviour in School-Aged Children (HBSC) study, which uses single items to assess physical, emotional, and sexual abuse, neglect, domestic, community, and peer violence (Currie et al., 2014). Psychometric testing on the ACE-ASF with a representative sample of Romanian adolescents showed a two-factor structure with the following dimensions: physical/emotional abuse and sexual abuse (Meinck et al., 2017). Both sub-scales showed good criterion validity; the ACE-ASF showed full metric invariance across sex but did not show full scalar invariance.

The Juvenile Victimization Questionnaire, another widely used measure, has a Reduced Item version comprising of 12 items capturing youth lifetime experiences of violence (Finkelhor et al., 2005). A 17-item revised version of the JVQ (JVQ-R2 Adapted Version) was recently used in the Australian Child Maltreatment Study, demonstrating high face and conceptual validity, internal consistency, and test-retest reliability (Mathews et al., 2023). The Childhood Trauma Questionnaire (CTQ) (Bernstein et al., 1994) is a 70-item retrospective self-report measure which assesses emotional, physical, and sexual abuse, and emotional and physical neglect. A 28-item short form of the CTQ was developed in 2003 (Bernstein et al., 2003). The Childhood Trauma Questionnaire Short Form (CTQ-SF) was then validated with adult substance-abusing patients, adolescent psychiatric inpatients, and individuals from a normative community sample, confirming five latent factors (physical, emotional, and sexual abuse and physical and emotional neglect) and demonstrating measurement invariance across these samples. All of the above measures have been used in a range of contexts, spanning high-, middle-, and low-income countries (Meinck et al., 2022; Steele et al., 2023).

This evidence on the validity and reliability of existing brief measures that capture violence and adversity is certainly encouraging. However, the evidence base is less established, when seeking to capture the prevalence of maltreatment as part of multi-component, national surveys. It is notable that most of the above measures seek to capture related, but distinct constructs, such as Adverse Childhood Experiences, or are not designed for use in multi-topic surveys. There is arguably a need to direct policy efforts towards preventing and responding to maltreatment as a first step, before considering larger goals of adversity in childhood. This goal would be aided by a brief measure of maltreatment that can be readily used in national multi-component prevalence surveys. In articulating this need, we do remain cognizant of the proliferation of scales in health and behavioural sciences more broadly (Juarros-Basterretxea et al., 2023), as well as the numerous measures which exist to capture violence against children, including maltreatment (Meinck et al., 2022; Steele et al., 2023).

Given the need for an internationally useable, brief measure of maltreatment, the Short Child Maltreatment Questionnaire (SCMQ) was developed by an expert committee convened by the WHO Regional Office for Europe (Meinck et al., 2016). The expert committee had representation from around 14 European middle- and high-income countries. The expert committee reviewed numerous questionnaires on maltreatment in terms of the following criteria: (1) the measure had to be available at no cost; (2) the instrument had to cover all domains of maltreatment – physical, sexual and emotional abuse and neglect, which was informed by ecological-transactional models of maltreatment (Cicchetti et al., 2000); (3) the instrument had to be tested and used in different contexts and deemed suitable by experts from a variety of countries; and (4) some results on reliability and validity had to be available. Finding most of these questionnaires to be excessively lengthy, the WHO expert committee then developed the SCMQ that measures physical, emotional and sexual abuse, and neglect and witnessing parental physical violence, domains which were informed by ecological-transactional models of maltreatment (Cicchetti et al., 2000). The SCMQ comprises of 7 items measuring maltreatment and can be used with adolescents aged 10–18 years (Meinck et al., 2016).

Despite this robust preliminary work, no psychometric testing of the SCMQ was carried out by the WHO expert committee. The

present study therefore aimed to generate empirical evidence of the psychometric properties of the SCMQ, by answering the following research questions: (1) Do the items in the SCMQ reflect a unidimensional construct of maltreatment? (2) What are the reliability and validity properties of the SCMQ?

2. Methods

2.1. Study design

This study uses data from the 2021 OxWell Student Survey. The OxWell Student Survey is a repeated cross-sectional survey of children and adolescents in schools and further education colleges in England. The OxWell Survey asks students aged 9-18 years a range of questions on mental health and wellbeing, demographic characteristics, life experiences, and behaviours, as described in the study protocol (Mansfield et al., 2021). In this study, we report on data provided by adolescents aged 11–18 years. The OxWell study was approved by the University of Oxford Research Ethics Committee (Reference: R62366). Further information, including survey materials and supplementary resources, is available on the OxWell study's OSF repository (https://osf.io/sekhr/).

2.2. Eligibility criteria and participants

Students were eligible to participate in the 2021 OxWell Student Survey (conducted May–June 2021) if they attended state-maintained and independent secondary schools (grades 7–13), and further education colleges (grades 12 and 13) in ten local authority areas in four counties in England (Berkshire, Buckinghamshire, Merseyside, and Oxfordshire). The 2021 OxWell Survey covered a wide range of topics which varied according to student grade and age. For this study, adolescents aged 11–18 years were included as they were administered the SCMQ (n = 15,155; mean age 14.12 SD 1.34, 56 % female).

2.3. Recruitment and study procedures

Local authorities in the participating counties invited schools within their catchment area to participate. Parental opt-out consent and adolescent assent was obtained prior to participation for students aged 11 to 15 years, while students aged 16 years and older gave direct consent to participate. Students completed the survey as part of school activities. All questions on the survey were optional so students could choose not to answer questions and proceed to subsequent sections. At the end of the survey, students were advised on actions they could take if they felt upset, including seeking support from trusted school staff.

The survey itself was entirely non-identifiable, meaning researchers were unable to positively identify a student if the survey raised concerns about participant safety. However, this was mitigated by providing extensive information on appropriate reporting channels and resources for accessing mental health support. Where responses indicated concerns about student safety, schools were notified, along with the year group and gender of the student(s) considered to be at risk.

2.4. Measures

Child maltreatment was measured using a modified version of the SCMQ, a brief maltreatment measure which assesses physical, emotional, and sexual abuse, emotional and physical neglect, and witnessing domestic violence using 7 items (Meinck et al., 2016). Notably, the OxWell survey administered 6 of its 7 items i.e., excluding one of the two sexual abuse items. Each type of maltreatment was measured with one item and participants selected whether they had experienced said behaviours over their lifetime and in the past year. Frequency was measured by asking if participants had experienced the behaviour 'once or twice' or 'many times'. Items in the SCMQ are provided in Table 1.

Participants could record if they had experienced these behaviours by ticking the following response options: 'Yes, it has happened

Table 1
The Short Child Maltreatment Questionnaire (SCMQ).

Domain	Item	Response options
Physical abuse	Did a parent or other adult in the household hit, beat, kick or physically try to hurt you in any way?	Yes, it has happened in my life
Emotional abuse	Did a parent or other adult in the household swear at you, insult you, humiliate you, threaten you or make you feel unwanted?	*Follow-up: Once or twice, Many times*
Sexual abuse	Did someone at least five years older than you or an adult touch or fondle you or have you touch their body in a sexual way?	Yes, it happened in the past 12 months
	Did someone at least five years older than you or an adult attempt or actually have oral, anal or vaginal intercourse with you?[a]	*Follow-up: Once or twice, Many times*
Physical neglect	Did your parent/caregiver for long periods of time not provide you with enough food or drink, clean clothes, or a clean and warm place to live?	No, never[b]
Emotional neglect	Were there times when there was no adult living with you who made you feel loved?	Prefer not to answer[b]
Witnessing domestic violence	Did you see or hear one of your parents/carers being slapped, kicked, punched, beaten or deliberately hurt by a partner or ex-partner in the home?	

[a] Not asked in this study.
[b] Not provided as a response option in this study.

in my life' and 'Yes, it has happened in the past 12 months'. They were not given the response options of 'No' or 'Prefer not to answer'. Therefore, all participants who had not selected 'Yes' were recorded as having answered 'No'. However, it is possible that some participants who were coded as having answered 'No' may have chosen not to answer.

Participant demographic characteristics included gender (male, female, and other/prefer not to answer), age in years, and whether the participant/their parents were born in the UK (e.g., "Were you/your parents born in the UK?" Yes/No/Would rather not say). The survey did not explicitly capture participant ethnicity. Therefore, while imperfect, whether or not the participant and their parent(s) were born in the UK were used as a proxy measure for ethnicity, with those not born in the UK assumed to be in ethnic minority communities.

Mental health difficulties were measured using tools for depression and anxiety, and self-harm. For symptoms of depression and anxiety, we used the Revised Children's Anxiety and Depression Scales (RCADS-25) (Chorpita et al., 2000; Ebesutani et al., 2012). A T-score of 70 or above on the RCADS meets the clinical threshold for depression/anxiety; therefore, participants with a T-score of $\geq$70 were categorised as indicating probable depression/anxiety while a score of $<$70 was categorised as indicating no depression/anxiety (Chorpita et al., 2005, 2015). Lifetime self-harm, defined as an act of non-fatal intentional self-poisoning or self-injury which had occurred at any point prior to the survey, was measured using one item ("Have you ever deliberately self-harmed (for example by taking an overdose or deliberately injuring yourself in some other way)?" Yes/No/Prefer not to say/Not sure what this means). This was based on questions in the Child and Adolescent Self-harm in Europe study (Madge et al., 2008).

Health behaviours were measured using smoking, alcohol use, and substance use. Smoking was measured using one item asking if the participant smoked cigarettes and/or e-cigarettes/vaped (never/not often versus sometimes/quite often/most days). Alcohol use was measured using one item asking if the participant had ever had an alcoholic drink (Never/not often versus sometimes/quite often/most days). Substance use was measured using one item asking if the participant had ever taken something to get high or self-medicated with drugs not prescribed by [their] doctor with examples being illegal drugs, legal highs and prescription medication (Never/not often versus sometimes/quite often/most days).

Other experiences of interpersonal violence were captured by asking questions on dating abuse and bullying. Dating abuse was measured using one item ("Have you ever been a victim of abuse from a friend/peer/boyfriend/girlfriend?" Never/not often/sometimes/quite often/most days). Bullying victimization was measured using one item ("Have you been bullied in the last year?" No/not often/sometimes/quite often/most days).

2.5. Analysis

Analysis followed seven steps. First, missing data on demographic (age, gender) and school characteristics (year group) were examined in R Studio (R Core Team, 2021). Any ineligible participants were removed at this stage, such as students in years 5–7 who were not asked any questions relating to maltreatment. Other incomplete responses (e.g., missing consent, implausible age) were excluded. This resulted in a final sample of n = 15,155 participants. All six SCMQ items were recoded into binary indicators (1 = Yes, 0 = No); non-selected responses were treated as "No," although in some cases this may include skipped items. For respondents endorsing an item, follow-up questions on lifetime and past-year frequency were recoded into categorical variables i.e., "once or twice", and "many times". Demographic variables were harmonized, namely age (aged $\leq$14 years, $\geq$15 years), gender (male, female), and country of birth (UK vs. non-UK). Other experiences of interpersonal violence (e.g., bullying, dating abuse) and health behaviours (e.g., smoking, substance and alcohol use), and self-harm were recoded into categorical variables based on survey categorization used by the OxWell Survey. Responses were then collapsed into binary indicators. Missing data were coded as such and retained during cleaning, but specified as missing in Mplus models and filtered out prior to running non-parametric tests. RCADS anxiety and depression scores were calculated using validated scoring protocols. Lifetime experiences of maltreatment was used in all psychometric analyses.

Second, a cleaned and recoded dataset was imported into MPlus Version 8 (Muthén & Muthén, 2017) for analysis. R Studio was used to clean and recode the data due to its greater ease of use, especially for large datasets, and MPlus was used to conduct psychometric validation analyses due to its robust features.

Third, exploratory factor analyses (EFA) were conducted to examine the dimensionality of the SCMQ. Models specifying one-, two-, and three-factor solutions were tested in Mplus Version 8 using the weighted least square means and variance adjusted (WLSMV) estimator, treating items as categorical. Several oblique rotations (Promax, Oblimin, Geomin) rotations were explored.

Fourth, Confirmatory Factor Analysis (CFA) then tested whether the one-factor structure hypothesized by the developers of the SCMQ fit the data well. In a one-factor model, the general factor of maltreatment loads on all items. Model fit was assessed via multiple goodness-of-fit measures such as both Comparative Fit Index (CFI), Tucker Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA). As data were categorical, the WLSMV estimator was used. Adequate model fit was assumed given the following cut-off values for goodness-of-fit statistics: CFI and TLI are $>$0.95 and RMSEA $<$0.06 (Brown, 2015). CFA models were estimated with Mplus Version 8 (Muthén & Muthén, 2017) using WLSMV estimation, which uses pairwise deletion for missing data.

Fifth, internal consistency was assessed in MPlus using the McDonald's omega (ω) for the one-factor model. A high omega value is indicative of reliability ($>$0.90) with a minimum acceptable value of 0.7 (McDonald, 1999).

Sixth, measurement invariance (configural, metric and scalar) was tested for gender (male and female), age (early and middle stage adolescents), ethnicity proxy (participants born in the UK versus those who were not, and participant parents who were born in the UK versus those who were not) using Multigroup CFA. These groups were selected based on the assumption that questions about maltreatment may be differently understood based on adolescent gender, age, and ethnicity. Measurement invariance tests whether the factor structure of the measure fits well across different groups in the sample; in this case, gender, age, and whether the participant or their parent was born in the UK (i.e., a proxy for ethnicity). Measurement invariance was tested for three types of variance

sequentially: configural, metric, and scalar invariance (Milfont & Fischer, 2010).

Configural, metric and scalar invariance was tested using the following model fit criteria (Chen, 2007; Hu & Bentler, 1999) for four groups: (1) age: younger and older adolescents; (2) gender: males and females; (3) ethnicity proxy: participants born in the UK and those who were not; and (4) ethnicity proxy: parents of participants who were born in the UK and those who were not. The measurement invariance process below is described for age; however, the same process was followed for all other variables of interest.

To test configural invariance for age, the specified model was fit onto younger (11–14 years) and older adolescents (15–18 years), with all factor loadings and item intercepts free to vary for both groups (Lee, 2018). A good model fit (CFI and TLI > 0.95, RMSEA $<$

Table 2
Participant characteristics in this study.

Participant characteristics	Total	
n = 15,155	n	%
Age (proportion)		
11–14 years	10,221	67.4 %
15–19 years	4934	32.5 %
Age (M, SD)	14.1 (1.3)	
Gender		
Male	6630	43.7 %
Female	8515	56.1 %
Prefer not to say/Other	10	0.06 %
Student born in the UK		
Non-UK	1934	12.7 %
UK	13,191	87 %
Rather not say	30	0.19 %
Parent born in the UK		
Non-UK	6016	39.6 %
UK	9096	60 %
Rather not say	43	0.28 %
Year group		
Year group 8–9	9545	62.9 %
Year group 10–11	3954	26 %
Year group 12–13	1656	10.9 %
Child maltreatment (SCMQ)		
Any child maltreatment	2465	16.3 %
Physical abuse (yes)	742	4.9 %
Emotional abuse (yes)	1763	11.6 %
Sexual abuse (yes)	266	1.7 %
Physical neglect (yes)	96	0.6 %
Emotional neglect (yes)	662	4.3 %
Witnessing domestic violence (yes)	590	3.8 %
Depression and anxiety		
Depression RCADS_D (mean, SD)	52.7 (14.6)	
Anxiety RCADS_A (mean, SD)	52.3 (14)	
Depression and anxiety RCADS_T (MEAN, SD & proportion of those who have probable depression and anxiety)	52.7 (15)	
Ever had an alcoholic drink		
No (i.e., never/not often i.e., once or twice)	8207	54.1 %
Yes (i.e., sometimes/quite often/most days)	3014	19.8 %
Not known	3934	25.9 %
Ever taken something to get high or self-medicated with drugs not prescribed by [your] doctor		
No (i.e., never/once or twice)	444	2.9 %
Yes (i.e., more than once)	10,712	70.6 %
Not known	3999	26.3 %
Currently smoke cigarettes (i.e., tobacco, not vaping/e-cigarettes)		
No (i.e., never/not often)	10,471	69.1 %
Yes (i.e., sometimes/quite often, most days)	977	6.4 %
Not known	3707	24.5 %
Ever deliberately self-harmed		
No	7709	50.8 %
Yes	1963	12.9 %
Don't know what this means/rather not say	1592	10.5 %
Not known	3891	25.6 %
Ever been a victim of abuse from a friend/peer/boyfriend/girlfriend		
No	7731	51 %
Yes	3647	24 %
Not known	3777	24.9 %
Bullied in the past year		
No	8422	55.5 %
Yes	5849	38.5 %
Not known	884	5.8 %

0.06) (Hu & Bentler, 1999) across both age groups suggests that the factor structure is confirmed for both younger and older adolescents. Then, to test metric invariance, the specified model was fit onto both age groups, but the factor loadings were constrained to be equivalent across the groups, while the item intercepts varied freely as before. A good multi-group model fit was established if a substantial deterioration of model fit was not observed i.e., if RMSEA did not increase by more than 0.015 and CFI did not decrease by more than 0.010 (Chen, 2007). Metric invariance establishes that "each item loads onto the latent factor in a similar manner and with similar magnitude across groups" (Lee, 2018). Following the establishment of metric invariance, scalar invariance was tested for both age groups by constraining factor loadings and item intercepts across groups. A good model fit was established if RMSEA did not increase by more than 0.015 and CFI did not decrease by more than 0.010 (Chen, 2007). Scalar invariance establishes that for both younger and older adolescents, comparisons of factor means such as *t*-tests or ANOVAs are not due to "differences in scale properties" for different groups (Lee, 2018). If metric or scalar invariance was not established, then constraints may be iteratively released, guided by modification indices and expected parameter changes.

Seventh, construct validity was assessed through non-parametric tests between SCMQ sum scores and correlates identified in prior research (Hughes et al., 2017). Construct validity involves demonstrating that a measure of a given construct relates to measures of other constructs in theoretically predictable ways (Smith, 2005). In this study, we therefore sought to assess the relationship between lifetime experiences of maltreatment and mental health challenges (depression, anxiety, self-harm), health behaviours (alcohol use, substance use, smoking) and other experiences of interpersonal violence (bullying victimization, experiencing dating abuse). As depression and anxiety scores captured using the RCADS-25 were not normally distributed, a Kendall's Tau correlation coefficient was calculated to assess their association with maltreatment sum scores. As maltreatment sum scores were highly skewed, with a large proportion of respondents reporting no maltreatment (i.e., scores of zero), non-parametric tests were used. For binary correlates (e.g., alcohol use, smoking, substance use, bullying, dating abuse), Wilcoxon rank-sum tests were conducted to compare maltreatment sum scores between groups. For categorical variables with more than two groups (e.g., self-harm), Kruskal–Wallis tests were used to evaluate differences in maltreatment sum scores across categories. Reported effect sizes are rank-biserial correlation coefficient (*r*) for Wilcoxon rank-sum tests and eta squared (η2) for Kruskal-Wallis tests.

Table 3
Standardized results of the Exploratory Factor Analysis of the SCMQ.

Model	χ^2(df)	CFI	TLI	RMSEA (90 % CI)	Eigenvalues
One-factor	92.27(9)	0.992	0.986	0.025 [0.020–0.029]	4.002, 0.639, 0.474, 0.445, 0.299, 0.141
Two-factor	12.21(4)	0.999	0.997	0.012 [0.005–0.019]	
Three-factor – inadmissible solution	0.00(0)	1.00	1.00	0.000	

Factor loadings			
Domain/item	Loading		
One-factor model			
Physical abuse	0.817*		
Emotional abuse	0.900*		
Sexual abuse	0.588*		
Physical neglect	0.813*		
Emotional neglect	0.797*		
Witnessing domestic violence	0.736*		
Two-factor model	***Factor 1***	***Factor 2***	
Physical abuse	0.037	0.758*	
Emotional abuse	3.662[a]	0.000 (inadmissible)	
Sexual abuse	0.005	0.602*	
Physical neglect	−0.040	0.892*	
Emotional neglect	0.035	0.749*	
Witnessing domestic violence	−0.007	0.789*	
Three-factor model	***Factor 1***	***Factor 2***	***Factor 3***
Physical abuse	0.853*	0.024	−0.028
Emotional abuse	0.000 (inadmissible)	1.391[a]	0.001
Sexual abuse	0.046	0.096	0.526
Physical neglect	−0.011	−0.022	0.979*
Emotional neglect	0.143	0.200	0.526
Witnessing domestic violence	0.496	−0.015	0.331

Note: Multi-factor solutions were unstable. Eigenvalues are from the sample correlation matrix and were used to guide factor retention.
* $p < .05$.
[a] Loading greater than 1.0 indicates a potential Heywood case.

3. Results

3.1. Sample characteristics

A total of 15,155 respondents aged 11–18 years were eligible for inclusion in analyses. Of the 15,155 participants, 56 % were female, 63 % were students attending school years 8–9, and 67 % were aged 11–14 years. In the sample, 16.3 % of participants reported experiencing any form of maltreatment. The following proportions of respondents reported experiencing specific types of maltreatment: 4.9 % reported lifetime physical abuse, 11.6 % reported lifetime emotional abuse, 1.8 % reported lifetime sexual abuse, 0.6 % reported lifetime physical neglect, 4.4 % reported lifetime emotional neglect, and 3.9 % reported lifetime witnessing of domestic violence. All instances of lifetime maltreatment were reported more commonly by females compared to males, confirmed by a chi-square test of independence, which confirmed a significant relationship between these variables at $p < .01$. Participant characteristics, experiences of lifetime and past year experiences of maltreatment as well as correlates of maltreatment, are described in Table 2.

3.2. Exploratory Factor Analysis (EFA)

We first conducted an EFA on the six items in the SCMQ. A one-factor model indicated an excellent fit ($\chi2(df) = 92.27(9)$ CFI = 0.992 TLI = 0.986 RMSEA = 0.02 90 % CI [0.020, 0.029]). Eigenvalues for the sample correlation matrix were 4.002, 0.639, 0.474, 0.445, 0.299, and 0.141. The scree plot showed a clear break i.e., 'elbow' after the first factor, with all subsequent eigenvalues below 1.0. We then tested two- and three-factor solutions using multiple rotation methods (Geomin, Promax, and Oblimin) to evaluate stability. The two-factor model showed improved fit indices ($\chi2(df) = 12.21(4)$ CFI = 0.999 TLI = 0.997 RMSEA = 0.012 90 % CI [0.005, 0.019]) but the analysis produced estimation problems, namely standard errors could not be computed, and the emotional abuse item produced an implausibly large loading. The three-factor model yielded non-admissible results across rotations, including zero degrees of freedom, negative residual variances (Heywood cases) and implausibly large loadings for the emotional abuse item. These results indicate that the items in the SCMQ may be best represented by a single latent dimension. Full EFA results are presented in Table 3.

3.3. Confirmatory Factor Analysis (CFA)

We next specified a confirmatory one-factor model in which all items load onto a general maltreatment factor. All standardized factor loadings were statistically significant and well above $\lambda > 0.4$ (Bowen & Guo, 2012). Model fit was excellent ($\chi2(df) = 92.265(12)$ CFI = 0.992 TLI = 0.987 RMSEA = 0.025 90 % CI [0.020, 0.029]). Full CFA results are presented in Table 4.

3.4. Measurement invariance

Measurement invariance of the SCMQ was established for the following groups: gender (male and female with the category 'other/prefer not to answer' categorised as missing); age (adolescents aged 11–14 and 15–18 years respectively); and ethnicity (proxy variables of adolescents and caregivers born in the UK versus those who were not). Three levels of invariance testing (i.e., configural, metric and scalar) was established for the SCMQ across age, gender, and ethnicity.

Configural invariance was first tested. Thereafter, factor variance was constrained to one and factor mean was fixed to 0 in each group. Metric invariance constraints were then introduced, namely factor loadings across groups with factor means fixed to zero and residual variances fixed to 1. This allowed us to assess if fit improved or worsened. Finally, scalar invariance was tested, by constraining factor loadings and thresholds across groups with only residual invariance fixed to 1.

For adolescent age (reference group: adolescents aged 11–14 years), gender (reference group: males), ethnicity proxy (reference group: respondents or respondent parents who were born in the UK), configural invariance was excellent according to specified fit

Table 4
Standardized results of the SCMQ one-factor model Confirmatory Factor Analysis among OxWell adolescents with standardized factor loadings (n = 15,155).

Domain	Item	β	SE
Physical abuse	Did a parent or other adult in the household hit, beat, kick or physically try to hurt you in any way?	0.817***	0.013
Emotional abuse	Did a parent or other adult in the household swear at you, insult you, humiliate you, threaten you or make you feel unwanted?	0.900***	0.011
Sexual abuse	Did someone at least five years older than you or an adult touch or fondle you or have you touch their body in a sexual way?	0.588***	0.026
Physical neglect	Did your parent/caregiver for long periods of time not provide you with enough food or drink, clean clothes, or a clean and warm place to live?	0.813***	0.027
Emotional neglect	Were there times when there was no adult living with you who made you feel loved?	0.797***	0.014
Witnessing domestic violence	Did you see or hear one of your parents/carers being slapped, kicked, punched, beaten or deliberately hurt by a partner or ex-partner?	0.736***	0.016

Model fit: RMSEA = 0.025 90 % CI [0.020, 0.029]; CFI = 0.992; TLI = 0.986; $\chi^2(12) = 92.265$***.
*** $p < .001$.

indices. Fit improved when metric constraints were introduced and stayed the same (i.e., did not worsen) when scalar constraints were introduced. Detailed model fit statistics for multi-group confirmatory factor analyses are provided in Table 5.

3.5. Internal consistency

Internal consistency was calculated using the McDonald's omega (ω). The SCMQ had a value (ω_t) of 0.71, which is considered adequate (McDonald, 1999).

3.6. Construct validity

Applying Kendall's tau-b correlation, lifetime experiences of maltreatment were significantly associated with higher depression ($\tau b = 0.268$, $p < .01$) and higher anxiety ($\tau b = 0.227$, $p < .01$). Wilcoxon rank-sum and Kruskal-Wallis tests indicated significant associations between lifetime maltreatment and a range of adverse outcomes. Lifetime maltreatment was significantly associated with lifetime experiences of the following: alcohol use ($W = 119{,}792{,}886$, $p < .001$, $r = 0.13$); smoking ($W = 123{,}655{,}945$, $p < .001$, $r = 0.09$); substance use ($W = 107{,}020{,}072$ $p < .001$, $r = 0.12$); dating abuse ($W = 123{,}125{,}804$, $p < .001$, $r = 0.23$); and bullying ($W = 195{,}961{,}990$ $p < .001$, $r = 0.08$). Similarly, lifetime maltreatment was significantly associated with self-harm ($\eta 2 = 0.15$ $p < .001$). The size of these associations range from small (bullying, smoking), small-to-moderate (alcohol and substance use), to moderate (dating abuse and self-harm) (Cohen, 1988).

4. Discussion

The SCMQ is a brief measure of maltreatment assessing physical, emotional, and sexual abuse, physical and emotional neglect, and witnessing domestic violence, developed by a WHO-convened expert committee (Meinck et al., 2016). This is the first study to establish the factor structure, measurement invariance, and reliability of a modified version of the SCMQ in a sample of adolescents in England. Exploratory and confirmatory factor analyses confirmed that a single-factor structure of maltreatment, demonstrating this as a distinct construct, composed of abuse, neglect and witnessing violence domains. These findings suggest the SCMQ can be validly used to measure maltreatment in surveys with adolescents aged 11–18 years.

The prevalence of maltreatment among adolescents in our sample (16.3 %) is slightly lower compared to UK national estimates; the Crime Survey of England and Wales estimates that one in five adults experienced a form of child abuse before the age of 16 years (20.7 %) (Office for National Statistics [ONS], 2020). The prevalence of maltreatment types among adults aged 18–74 years recalling experiences before the age of 16 was: physical abuse 7.6 %; emotional abuse 9.3 %; physical neglect 1.2 %; and sexual abuse 7.5 %. Another study undertaken with adolescents aged 11–17 years by the National Society for the Prevention of Cruelty to Children estimated the following prevalence: 21.9 % (maltreatment); 6.9 % (emotional abuse); 6.9 % (physical abuse); 13.3 % (neglect); and 0.1 % (sexual abuse) (Radford et al., 2011). Differences between UK national estimates and the OxWell study may be due to variations in sampling strategies, question wording, and questionnaire administration (e.g., self-report or interview). Respondents may also have interpreted or recalled experiences differently based on survey contexts and framing. We note that these estimates are not directly comparable to each other, or to the rates of maltreatment in this study; however, they do enable preliminary comparisons to be made. In addition, we assessed emotional neglect and witnessing domestic violence as types of maltreatment in this study.

Table 5
Results from the measurement invariance test for adolescent self-reported experience of child maltreatment using the SCMQ in the one-dimensional model (estimator = WLSMV).

Robust χ2 goodness of fit for measurement invariance						
Model	Value	df	p	CFI	TLI	RMSEA
Age (11–14 years old or 15–19 years old) n = 15,155						
Configural	111.404	18	.000	0.991	0.985	0.026 90 % CI [0.022, 0.031]
Metric	102.335	23	.000	0.992	0.990	0.021 90 % CI [0.017, 0.026]
Scalar	117.517	28	.000	0.991	0.991	0.021 90 % CI [0.017, 0.024]
Gender (male or female) n = 15,145						
Configural	121.001	18	.000	0.989	0.981	0.027 90 % CI [0.023, 0.032]
Metric	108.404	23	.000	0.990	0.988	0.022 90 % CI [0.018, 0.026]
Scalar	209.724	28	.000	0.980	0.978	0.029 90 % CI [0.026, 0.033]
Student born in the UK (yes or no) n = 15, 125						
Configural	95.666	18	.000	0.992	0.987	0.024 90 % CI [0.019, 0.029]
Metric	84.640	23	.000	0.994	0.992	0.019 90 % CI [0.015, 0.023]
Scalar	104.622	28	.000	0.992	0.991	0.019 90 % CI [0.015, 0.023]
Parent of student born in the UK (yes or no) n = 15,112						
Configural	94.047	18	.000	0.992	0.987	0.024 90 % CI [0.019, 0.028]
Metric	97.078	23	.000	0.993	0.990	0.021 90 % CI [0.017, 0.025]
Scalar	138.335	28	.000	0.989	0.988	0.023 90 % CI [0.019, 0.027]

4.1. Factor structure

Our analysis validly confirms that a common latent variable, namely maltreatment, accounts for the phenomena measured using each item in the SCMQ. To the authors' knowledge, there is no other analysis determining the factor structure of the SCMQ. Exploratory factor analyses indicated that two- and three-factor yielded unstable models, supporting our confirmatory approach for a one-factor solution. The short form of the ACE scale (ACE-ASF) showed a two-factor solution with physical and emotional abuse loading on one factor and sexual abuse on another (Meinck et al., 2017). Validation of the ACE-BRFSS scale in the US revealed a three-factor solution with physical/emotional abuse, sexual abuse, and household dysfunction as the relevant domains (Ford et al., 2014; Mei et al., 2022). The scope and aim of these ACE measures may explain why we established a different one-factor structure for the SCMQ. The ACE-ASF measures lifetime exposure to emotional (2 items), physical (2 items), and sexual abuse (4 items) using a total of eight items. The ACE BRFSS captures parental separation or divorce, parent or caregiver mental illness, and parental substance misuse. This is different to the SCMQ, which captures maltreatment, encompassing only abuse and neglect that take place in a relationship of responsibility, trust, or power. Our one-factor solution for the SCMQ, however, suggests it is suitable for capturing most forms of abuse and neglect occurring within the home (except for the sexual abuse item, which captures behaviours outside the home as well). It is not suitable for capturing broader constructs such as ACEs or violence occurring in the school or community.

Our one-factor solution for the SCMQ is underpinned by a reflective model of psychometric theorising where the underlying attribute is seen as the common cause of observed scores. In reflective models, the item scores are modelled as a function of a common, unobserved variable, and this latent variable accounts for the covariance between indicators (Schmittmann et al., 2013). Correlations between indicators in reflective models may be observed because they share an underlying common cause. On the other hand, in formative models, latent composite variables are modelled as a function of indicators, and indicators are not exchangeable, as they are hypothesized to capture different aspects of the construct (Schmittmann et al., 2013). An example of a formative model is capturing an individual's socioeconomic status which is a combined effect of distinct variables like salary, educational attainment and neighbourhood.

Most maltreatment self-report measures, including the SCMQ, have tended to employ reflective models, although some exceptions exist i.e., validation of the JVQ (Spanish version) using a formative approach (Pereda et al., 2018). There have been studies which have argued for constructs such as adversity to be a fundamentally formative construct; this led to the validation of National Survey of Children's Health-ACE measure using both reflective and formative approaches (Bethell et al., 2017). However, validation using both reflective and formative approaches showed a statistically significant and positive relationship between the latent variable of adversity and hypothesized outcomes. Given that there is no existing validation of the SCMQ, we aimed to validate it as a reflective measure as this enables comparison with most other measures that have used the same approach. While beyond the scope of this study to test the SCMQ as a formative measure, this would be a fruitful area for future research. Network approaches have also been proposed as an alternative where the construct is visualised as a network of variables, and analyses would involve examining the structure and dynamics of the network (Schmittmann et al., 2013).

4.2. Measurement invariance

The SCMQ passed three levels of invariance testing (i.e., configural, metric and scalar) across age, gender, and ethnicity. This shows that the SCMQ is free from measurement bias when used to measure maltreatment with younger and older adolescents, male and female adolescents, and adolescents of varied ethnicities (measured using a proxy indicator of whether adolescents and/or their parents were born in the UK or not). The SCMQ can be used to validly compare prevalence of maltreatment as well as its covariates, predictors and outcomes across these population groups.

4.3. Construct validity

Our findings support the construct validity for the SCMQ with associations largely confirming hypothesized relationships between maltreatment and mental health, health behaviours and other expreinces of interpersonal violence. Correlational and group comparison tests showed significant relationships between a total score on the SCMQ and depression, anxiety, self-harm, bullying, alcohol use, dating abuse, substance use, and smoking. However, the strength of these associations varied.

We found a positive, moderate correlation for depression, and a positive, weak correlation for anxiety, which generally aligns with prior meta-analyses (Gardner et al., 2019). A moderate association between maltreatment and self-harm is similarly consistent with past meta-analyses (Liu et al., 2018). Small to moderate associations between maltreatment and lifetime alcohol use, dating abuse, smoking, and substance use are also broadly consistent with prior meta-analyses (Hughes et al., 2017). A weaker association was present for bullying victimization. This is may be due to the complex and heterogeneous nature of bullying in adolescence, where adolescents may adopt multiple roles (e.g., perpetrator, victim, or both). Person-centred analyses have identified distinct bullying patterns and subgroups, such as four latent classes (non-victimized aggressors, aggressive-victims, predominantly victimized, and well-adjusted youth) (Bettencourt et al., 2013) or five latent classes (victims, aggressors, highly-victimized aggressive-victims, highly-aggressive aggressive-victims, and socially adjusted) (Giang & Graham, 2008). More recent studies have affirmed these diverse pathways, with adolescents in a high-risk sample falling into four classes, namely bully-victim (19.8 %), victim (16.3 %), no bully-victim (38.9 %), and bully (24.9 %) (Yoon et al., 2021). However, all our measures for health behaviours and victimization experiences in this study were single items, and our statistical analyses were limited to bivariate tests. Further research using more robust measurement tools and multivariate methods is needed to more fully establish the construct validity of the SCMQ.

4.4. Reliability (internal consistency)

Internal consistency was adequate using the McDonald's omega. We do not consider it concerning that the reliability of the SCMQ, using the McDonald's omega, was not high, as the utility and relevance of internal consistency has been widely questioned for an instrument that measures life events, such as experiencing violence and maltreatment (Turner & Wheaton, 1997). This is noted in the context of prominent and widely used measures in violence, such as the JVQ, as behaviours or experiences in such measures may not be closely correlated but may nevertheless belong in the same conceptual category (Finkelhor et al., 2005). Generally, this means that certain types of victimization experiences tend to be independent. Recent systematic reviews demonstrate similar reduced internal consistency for measures which captured multiple forms of violence or maltreatment as experiences can vary substantially in severity and children who experience less extreme forms of maltreatment may not also experience more extreme forms (Meinck et al., 2022). Thus, internal consistency values for screening tools such as the SCMQ are not necessarily reflective of its reliability, due to the nature of maltreatment experiences.

4.5. Strengths and limitations

This study is subject to a number of limitations. First, although the OxWell Student Survey 2021, from which the data for this study was drawn, recruited a large participant group from a wide range of schools, it is difficult to say how representative this sample is of either England as a whole, or of individual constituent regions. Data on response rates was only available for one region; in this region, 86.7 % of year 6 students participated compared to only 3 % of year 11, who were absent from in-person school due to the General Certificate of Secondary Education (GCSE) national examination. It is therefore difficult to say how response rates may have varied for other regions. Second, at the time the OxWell Student Survey 2021 took place, there were still intermittent COVID-19 lockdowns in operation, with individual 'student bubbles' who may have needed to isolate at various points in this period. It is not clear what the extent of expected and unexpected absences were at this time. Third, around 5 % of the survey sample did not choose male or female as a response category, either because they fell in the 'other' category or because they may have preferred not to answer. Fourth, the questions from the SCMQ were not presented with 'Yes/No' options – participants were given the option to only choose 'Yes' if they had experienced a particular type of maltreatment – but this means that those who did not select 'Yes' may either not have experienced such behaviours or preferred not to answer. We may have therefore under-estimated experiences of maltreatment. Fifth, self-report data on maltreatment may be impacted by recall bias, social desirability bias, and underreporting due to stigma, or lack of recognition of maltreatment. These factors can affect the accuracy and completeness of the data. However, the study had several strengths which mitigate the above limitations. The study had a large sample size, with a diverse and varied participant pool, and used validated measures for most variables. These factors enhance the reliability of the findings.

4.6. Future research and usage of the SCMQ

The SCMQ is primarily intended to be used as a brief screening tool for maltreatment with adolescents aged 10–18 years. We recommend that future research using the SCMQ offers 'Yes/no/prefer not to answer' response options, to distinguish between non-response rates and those who may not have experienced maltreatment. Future research using the SCMQ may also refer to best practice guidelines for conducting research on violence and maltreatment with children and adolescents (Kyegombe et al., 2019; Neelakantan, Fry, Florian, & Meinck, 2022). Such guidelines emphasize providing accessible information about the scope of research, clarity around measures used, sound ethical procedures relating to confidentiality, distress and disclosure protocols as well as ensuring that sensitive research studies are enjoyable to adolescents.

Scoring the SCMQ depends on the research question and analysis proposed to be conducted. The suggestions offered below are not necessarily based on the findings in this study but are general considerations for future usage. SCMQ items can be treated as binary indicators to understand experiences of abuse, neglect and witnessing domestic violence over the lifetime. While this study only drew on lifetime experiences of maltreatment in its analyses, future research using SCMQ items to capture past year experiences should validate this application. The SCMQ also provides brief frequency options for use, which may be incorporated into scoring, in line with appropriate research questions, to understand the frequency of maltreatment experiences. Individual binary scores may also be added up to yield a total score of maltreatment.

4.7. Implications for policy and practice

Our findings confirm that the SCMQ scores demonstrated acceptable validity and reliability and can be considered for use in large, multi-topic health surveys, including national prevalence studies of maltreatment. There are several advantages for using the SCMQ as a brief maltreatment measure: it comprises only seven items; it can be completed easily and quickly; it captures lifetime and past year prevalence, alongside frequency of experiencing maltreatment behaviours; and is freely available. It is important to emphasize that, in the present study, evidence of the SCMQ's reliability and validity pertains only to a specific application, namely lifetime experiences using binary responses. The empirical support for the SCMQ is therefore currently limited to a particular context.

One of the indicators of Sustainable Development Goal 16.2 (United Nations, 2017) is to establish national data collection systems that capture regular information on various forms of violence against children, including maltreatment. The SCMQ supports this aim by enabling the cost-effective monitoring of prevalence and trends, informing child protection policy at national and regional levels. The SCMQ defines corporal punishment i.e., hitting and spanking, as physical abuse. Users wishing to distinguish between corporal

punishment and other forms of physical abuse, may wish to separate these items. As the SCMQ aims to measure maltreatment, it measures sexual abuse only when the perpetrator is at least five years older than the participant, excluding peer-perpetrated abuse. Studies interested in peer victimization should consider rephrasing this item or adding separate questions.

4.8. Future research

While we established the psychometric properties of the SCMQ in a sample of adolescents in England, research is needed on the SCMQ with adolescents in diverse cultural contexts. Cognitive interviews, which are essential for establishing the content validity of self-report measures, should be undertaken with the SCMQ as well (Neelakantan, Fry, Florian, Silion, et al., 2022). Additionally, future research should use brief, validated tools to assess correlates such as bullying and health behaviours. Novel psychometric approaches such as dynamical network methods (Schmittmann et al., 2013), could provide deeper insights into the measurement of maltreatment.

5. Conclusion

The SCMQ demonstrated valid and reliable measurement properties in a large sample of adolescents in England, and can be used in multi-topic surveys to assess the prevalence of maltreatment. Our findings provide the first evidence of its unidimensional factor structure, measurement invariance across demographic groups, and expected associations with health and behavioural outcomes in a UK adolescent sample. The SCMQ is well-suited for use in large multi-component national surveys to reliably capture data on maltreatment. While the internal consistency of the SCMQ was adequate, this aligns with expectations for screening instruments assessing maltreatment. Future research should explore alternative psychometric frameworks, such as formative and network models, to further refine conceptualisations of maltreatment and to enhance the application of the SCMQ in varied contexts.

CRediT authorship contribution statement

Lakshmi Neelakantan: Writing – review & editing, Writing – original draft, Visualization, Project administration, Formal analysis, Data curation, Conceptualization. **Franziska Meinck:** Writing – review & editing, Supervision, Software, Investigation, Conceptualization. **Mina Fazel:** Writing – review & editing, Supervision, Software, Resources, Methodology, Funding acquisition, Data curation, Conceptualization.

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Declaration of competing interest

FM was part of the expert committee which developed the Short Child Maltreatment Questionnaire. The authors do not have any interests that are directly or indirectly related to the work submitted for publication.

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Data availability

The data that has been used is confidential.

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