**Aus dem Institut für Medizinische Soziologie und Rehabilitationswissenschaft**
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**DISSERTATION**

# Messung von Gesundheitskompetenz (Health Literacy) bei Kindern und Jugendlichen

Entwicklung und Validierung altersspezifischer Befragungsinstrumente

zur Erlangung des akademischen Grades
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## Abbildungsverzeichnis

## Abkürzungsverzeichnis

| | |
|---|---|
| **HLSAC** | Health Literacy for School-Aged Children |
| **HLS-Child-Q15** | Health Literacy Survey Questionnaire for Children |
| **HLS-EU-adolescents-Q12-DE** | Health Literacy Survey Questionnaire for Adolescents (adapted from HLS-EU-Q) |
| **HLS-EU-Q47** | European Health Literacy Survey Questionnaire 47 |
| **HLAT-8** | Health Literacy Assessment Tool |
| **EFA** | Explorative Faktorenanalyse |
| **KFA** | Konfirmatorische Faktorenanalyse |
| **MOHLAA-Q** | Measurement of Health Literacy Among Adolescents Questionnaire |
| **N/A** | Not available (nicht verfügbar) |
| **NVS** | Newest Vital Sign Test |
| **rho** | Spearman-Rangkorrelationskoeffizient |
| **REALM** | Rapid Estimate of Adult Literacy in Medicine |
| **TOFHLA** | Test of Functional Health Literacy in Adults |

## Zusammenfassung

### Hintergrund

Mit dem Begriff Gesundheitskompetenz/Health Literacy werden die Fähigkeiten und Fertigkeiten bezeichnet, Gesundheitsinformationen zu finden, zu verstehen, zu bewerten und diese für gesundheitsbezogene Entscheidungen anzuwenden. Das Konzept der Gesundheitskompetenz wurde bisher vorwiegend bei Erwachsenen erforscht. Bisher liegen für Kinder und Jugendliche kaum geeignete altersgerechte Selbsteinschätzungsinstrumente zur Erfassung generischer Gesundheitskompetenz vor. Zentrale Zielsetzungen der vorliegenden Arbeit sind, zwei Befragungsinstrumente für Grundschulkinder der vierten Klasse (9- bis 10-Jährige) und für Jugendliche (14- bis 17-Jährige) zur Erfassung der selbstberichteten generischen Gesundheitskompetenz zu entwickeln und deren psychometrische Eigenschaften zu evaluieren.

### Methoden

Als Grundlage für die Entwicklung der beiden Instrumente wurde die deutsche Version des European Health Literacy Survey Questionnaire mit 47 Items (HLS-EU-Q47) verwendet. Die Entwicklungsprozesse beider Instrumente waren mehrstufig und beinhalteten vergleichbare empirische Teilstudien, wie den Einsatz von kognitiven Interviews und eines Standard-Pretests (schriftliche Befragung). Bei der Entwicklung des Befragungsinstrumentes für Jugendliche wurden zusätzlich zwei Fokusgruppen und zwei Runden einer Experten-Bewertung durchgeführt. Die psychometrischen Eigenschaften der getesteten Befragungsinstrumente wurden anhand der Daten aus den schriftlichen Befragungen mit 907 Kindern beziehungsweise 625 Jugendlichen überprüft. Die Analysen umfassten Item-, Reliabilitäts-, Faktoren- und Assoziationsanalysen zur Konstrukt- und Kriterium-Validierung.

### Ergebnisse

Der Health Literacy Survey Questionnaire for Children (HLS-Child-Q15) und der Measurement of Health Literacy Among Adolescents Questionnaire (MOHLAA-Q) sind bisher die ersten validierten Instrumente in deutscher Sprache zur Erfassung selbstberichteter generischer Gesundheitskompetenz. Die Ergebnisse der qualitativen Teilstudien bestätigten, dass die meisten Kinder und Jugendlichen wenig Erfahrung in den Bereichen Gesundheitsversorgung und Krankheitsprävention haben. Eltern und Personen aus dem direkten Lebenskontext der Zielgruppen spielen daher eine wichtige Rolle bei der Übermittlung, der kritischen Bewertung und der Anwendung von Gesundheitsinformationen. Die kognitiven Kompetenzen für die Bewältigung bestimmter gesundheitsbezogener Aufgaben befinden sich sowohl bei Kindern als auch Jugendlichen noch im Entwicklungsprozess. Die Studienergebnisse deuten darauf hin, dass Kinder und Jugendliche ihre Fertigkeiten und Fähigkeiten bei der Beantwortung von Selbsteinschätzungsinstrumenten eher überschätzen.

**Diskussion und Implikationen**

Bei der Messinstrumentenentwicklung sind kognitive Fähigkeiten, lebensphasenspezifische Wissensstände, Erfahrungen sowie insbesondere altersspezifische Vorstellungen und die Bedeutung von Gesundheitsinformationen für die Zielgruppe zu berücksichtigen. Da Eltern und der soziale Lebenskontext die gesundheitsbezogenen Entscheidungen von Kindern und Jugendlichen stark beeinflussen und mitbestimmen, sollten sie bei der Messung der Gesundheitskompetenz einbezogen werden. Zur Evaluierung der verschiedenen Dimensionen der generischen Gesundheitskompetenz empfiehlt sich in den erforschten Zielgruppen das gleichzeitige Einsetzen von subjektiven und leistungsbasierten Messinstrumenten. Für das Forschungsfeld wäre es erstrebenswert, die Erkenntnisse aus der Messinstrumentenentwicklung auch in der Konzipierung von Gesundheitskompetenz für das Kindes- und Jugendalter stärker zu berücksichtigen.

## Abstract

### Background

The term health literacy refers to the skills and abilities to find, understand, and assess health information and to apply it when making health-related decisions. The concept of health literacy has been studied so far mainly among adults. To date, there are very few age-appropriate self-assessment instruments to measure generic health literacy among children and adolescents. The main objectives of the work presented here are to develop two survey instruments for primary school children in the fourth grade (9- to 10-year-olds) and for adolescents (14- to 17-year-olds) for the assessment of self-reported generic health literacy and to evaluate their psychometric properties.

### Methods

The German version of the 47-item European Health Literacy Survey Questionnaire (HLS-EU-Q47) was used as the blueprint for the development of both survey instruments. Their development processes were multi-stage and included comparable empirical substudies such as the use of cognitive interviews and a standard pre-test (written survey). In the course of developing the instrument for adolescents, two focus groups and two rounds of expert assessments were also conducted. The psychometric properties of the tested instruments were examined on the basis of data from the written surveys with 907 children and 625 adolescents, respectively. The statistical analyses included item analyses, reliability analyses, factor analyses, and association analyses for testing construct- and criterion-related validity.

### Results

The Health Literacy Survey Questionnaire for Children (HLS-Child-Q15) and the Measurement of Health Literacy Among Adolescents Questionnaire (MOHLAA-Q) are the first validated German language survey instruments to assess self-reported generic health literacy. The results of the qualitative substudies confirmed that most children and adolescents have little experience with health care and disease prevention. Therefore, parents and other adults from the target groups' social contexts play a crucial role for the transmission, critical assessment, and application of health information. The cognitive skills needed to manage certain health-related tasks are still being developed in both children and adolescents. The study findings indicate that children and adolescents tend to overestimate their skills and abilities when using the self-assessment questionnaires.

### Discussion and conclusions

The development of measuring instruments must consider cognitive skills, life-phase-specific knowledge, experience and, in particular, age-specific perceptions and the importance of health information for the target group. Because parents and the social context strongly influence and co-determine children's and adolescents' health-related decisions, they should be included in the measurement of health literacy. To

evaluate the various dimensions of generic health literacy in the target groups, it is recommended to use both subjective and performance-based measuring instruments. For the research field, it would be desirable that the findings from the development of measuring instruments be more strongly considered in the conception of health literacy for children and adolescents.

# 1. Hintergrund

## 1.1. Konstrukt der Gesundheitskompetenz als ein Messparameter

Der zentrale Untersuchungsgegenstand der vorliegenden Arbeit ist die Messung der selbstberichteten generischen Health Literacy von Grundschulkindern und Jugendlichen. Der Health Literacy Begriff stammt aus den USA und wurde in den 1970er Jahren zum ersten Mal im Rahmen der schulischen Gesundheitserziehung verwendet [1]. Er wird im deutschsprachigen Raum meistens mit „Gesundheitskompetenz" bezeichnet, wobei diese Übersetzung nicht unumstritten ist [2], und bedeutet wörtlich „auf Gesundheit bezogene Literalität". Zwecks Vereinfachung wird in der vorliegenden Arbeit nur der deutsche Begriff verwendet.

In den 1990er Jahren wurde das Konzept der Gesundheitskompetenz im angloamerikanischen Raum in der Versorgungsforschung und Medizin aufgegriffen und als ein individuumsbezogener Ansatz zur Verbesserung des Patientenwissens eingeführt [2]. Damals wurde Gesundheitskompetenz im Sinne von basalen Lese- und Schreibfähigkeiten medizinischer Begriffe und von basalem Zahlenverständnis verstanden. Inzwischen hat sich das Verständnis des Begriffes erweitert, Gesundheitskompetenz ist heute zahlreich definiert und vielfach operationalisiert [3, 4]. Es hat eine weitgehende Ausdifferenzierung des Konstruktes und seiner Operationalisierung hinsichtlich der Art der Gesundheitskompetenz (z. B. funktionale, kritische, generische Gesundheitskompetenz), thematischer Schwerpunkte (z. B. Ernährung, körperliche Aktivität, eine bestimmte Erkrankung), der Lebensphasen (Kinder, Jugendliche, Erwachsene) oder spezifischer Aspekte der Gesundheitskompetenz (z. B. mental/digital/media health literacy) stattgefunden [3, 5].

Nach der weitverbreiteten Definition von Sørensen et al. umfasst generische Gesundheitskompetenz die Kompetenzen, das Wissen und die Motivation in Bezug auf das Finden, Verstehen, Bewerten und Anwenden von Gesundheitsinformationen im Bereich der Gesundheitsversorgung, Krankheitsprävention und Gesundheitsförderung, um Entscheidungen zu treffen, die die Lebensqualität im Lebensverlauf erhalten oder verbessern [6]. Gesundheitskompetenz wird einerseits als eine individuelle, persönliche und dynamische Fähigkeit betrachtet, die - wie andere Kompetenzen auch - durch Lernen und infolge gesammelter Lebenserfahrungen erworben werden kann [1]. Andererseits wird sie als ein multidimensionales, soziales und kontextspezifisches Konstrukt betrachtet, welches als Ausdruck des Zusammenspiels von individuellen Fähig- und Fertigkeiten und den Anforderungen der sozialen und natürlichen Umwelt zu begreifen ist [7] .

Das Konzept der Gesundheitskompetenz wurde bis jetzt vorwiegend bei Erwachsenen erforscht. Zahlreiche Studien mit Erwachsenen weisen auf eine Verbindung zwischen Gesundheitskompetenz und verschiedenen gesundheitsbezogen Outcomes wie Gesundheitszustand, Inanspruchnahme von Gesundheitsleistungen oder Mortalität hin [8]. Diese Studien zeigen, dass ein niedrigeres Gesundheitskompetenz-Niveau mit einem schlechteren Gesundheitszustand bzw. einem ungünstigen Gesundheitsverhalten assoziiert ist [8]. Das Konzept der Gesundheitskompetenz wurde mittlerweile im Bildungs-, Public Health- und Gesundheitsförderung-Diskurs aufgegriffen und als ein viel versprechender Ansatz zur Gesundheitsförderung im Kindes- und Jugendalter erkannt [9-11]. Die World Health Organisation (WHO) bezeichnet Gesundheitskompetenz

als eine kritische Gesundheitsdeterminante und postuliert, dass diese über das ganze Leben lang entwickelt und gefördert werden sollte, in erster Linie durch ein schulisches Lehrprogramm [11].

Die Public Health-Relevanz der Erforschung und Förderung der Gesundheitskompetenz von Kindern und Jugendlichen wird mit der Annahme begründet, dass das Kindes- und Jugendalter entscheidend für das erlernte Gesundheitsverhalten ist und sich somit auf den Gesundheitszustand im Erwachsenalter auswirkt. Langfristig wird mit der Verbesserung der Gesundheitskompetenz angestrebt, sowohl die gesundheitlichen Ungleichheiten als auch die Kosten des Gesundheitssystems zu reduzieren [12, 13]. Es gibt bisher allerdings kaum Forschung dazu, wie sich Gesundheitskompetenz im Lebensverlauf entwickelt und inwiefern sich ein bestimmtes Gesundheitskompetenz-Niveau im Kindes- oder Jugendalter auf einen besseren Gesundheitszustand zu einem späteren Lebenszeitpunkt auswirkt. Die bisherige Evidenz beruht lediglich auf vereinzelten Längsschnittstudien bezüglich funktionaler Gesundheitskompetenz [14] oder unterschiedlichen Interventionsstudien mit Erwachsenen [8, 15]. Des Weiteren liegen kaum belastbare Daten zur Gesundheitskompetenz von Kindern und Jugendlichen vor [16]. Dem Mangel an Daten liegt ein fehlender Konsens zugrunde, wie Gesundheitskompetenz im Kindes- und Jugendalter definiert [17] und was genau wie gemessen werden sollte [18, 19]. Bröder et al. identifizieren in einem systematischen Review 12 Definitionen und 21 Modelle, die Gesundheitskompetenz von Kindern und Jugendlichen unter 18 Jahre konzipieren. Dabei wird unter anderem auf eine Fragmentierung, Differenzierung und Heterogenität der konzeptionellen Rahmen hingewiesen [20] und kritisiert, dass in bisherigen Definitionen und Modellen spezifische Bedürfnisse der Zielgruppen und ihre Vulnerabilität sowie die Rolle sozialer Strukturen wenig Beachtung finden [17]. Es mangelt an altersspezifischen und an die Entwicklungsstufen angepassten Modellen [21]. Die konzeptionellen Defizite spiegeln sich in der Heterogenität der Messansätze als auch in der Quantität und Qualität der Erhebungsinstrumente, besonders in Bezug auf jüngere Altersgruppen, wider [18, 19]. Dies betrifft insbesondere Instrumente, die das umfassende Verständnis der Gesundheitskompetenz (generische Gesundheitskompetenz) operationalisieren [22].

Die genannten Probleme des Forschungsfeldes sind in mancher Hinsicht auch in Deutschland vorzufinden. Zwar wurden im deutschsprachigen Raum in den letzten Jahren einige Instrumente für Jugendliche und junge Erwachsene entwickelt und aus anderen Sprachen adaptiert. Diese ermöglichen allerdings nur die Erfassung ausgewählter Aspekte der Gesundheitskompetenz (wie das gesundheitsbezogene Wissen [23], kritische Gesundheitskompetenz [24], digitale Gesundheitskompetenz [25]) oder sie zielen, wenn sie ein umfassendes Konstrukt der Gesundheitskompetenz erfassen, auf bestimmte Altersgruppen ab. Dazu zählen das Health Literacy Assessment Tool (HLAT-8, eingesetzt bei Personen ab 18 Jahren), die Kurzversion des Health Literacy European Survey Questionnaire (HLS-EU-Q16, eingesetzt bei Personen ab 15 Jahren) und das Health Literacy for School-Aged Children Instrument (HLSAC, eingesetzt bei Personen ab 11 Jahren) [26, 27]. Für Kinder, hier definiert als Altersgruppe unter 12 Jahren, sind die Instrumente und die Studien noch rarer. Es wurden nur zwei Instrumente [23, 28] in deutscher Sprache gefunden, die gleichzeitig bei Heranwachsenden in der Pubertät eingesetzt wurden [29]. Insgesamt zeigt sich auch hierzulande ein sehr heterogenes Bild bezüglich der berücksichtigten Altersgruppen, der operationalisierten Dimensionen der

Gesundheitskompetenz, der Messansätze (Erhebung selbst-berichteter Fähigkeiten und Einstellungen, leistungsorientierte Messung oder ein Kombination von beiden) oder eine sehr unterschiedliche psychometrische Qualität der Instrumente [29].

Zusammenfassend besteht die Forschungslücke in einem Mangel an Instrumenten in deutscher Sprache zur Erfassung generischer Gesundheitskompetenz, die messmethodische Gütekriterien weitestgehend erfüllen sowie praktikabel und geeignet für Monitoring und Evaluation der Gesundheitskompetenz-Niveaus in populationsbasierten Studien sind. Dies betrifft speziell Instrumente für bestimmte Altersgruppen wie für Grundschulkinder oder 14- bis 17-Jährige. Die Forschungslücke betrifft generell jene altersspezifischen Instrumente, die die Erfassung der Gesundheitskompetenz, ihren Erwerb und die Entwicklung zu verschiedenen Lebensphasen und -kontexten ermöglichen. Vor diesem Hintergrund wird die Notwendigkeit einer altersspezifischen Konzeptionierung der Gesundheitskompetenz im Kindes- und Jugendalter und dessen Operationalisierung ersichtlich. Nur mit Hilfe von theoriebasierten, psychometrisch starken und empirisch geprüften Instrumenten ist es möglich, die Bedeutung der Gesundheitskompetenz für die Gesundheit im Lebensverlauf zu erforschen und eine Bestandsaufnahe zu machen, um Bedarfe, vulnerable Gruppen und für die Gesundheitskompetenz relevante Settings zu erkennen.

## 1.2. Forschungsfragen und Zielsetzung

Aus dem vorgenannten resultiert die Forschungsfrage der vorliegenden Arbeit: **Wie kann die generische Gesundheitskompetenz von Grundschulkindern der vierten Klasse (9- bis 10-Jährige) und Jugendlichen (14- bis 17-Jährige) mittels Selbstangaben valide gemessen werden?**

Diese Forschungsfrage gliedert sich in folgende Unterfragen auf, die im Rahmen der Dissertation beantwortet werden:

1) Welche Items sollen altersspezifische Instrumente zur Erfassung selbsteingeschätzter generischer Gesundheitskompetenz für Grundschulkinder und Jugendliche beinhalten? Inwiefern unterscheiden sich diese von einem Instrument für Erwachsene?
2) Welche methodischen Schritte sind erforderlich, um reliable und valide Instrumente für Grundschulkinder und Jugendliche zu entwickeln?
3) Was sollte bei der Entwicklung altersspezifischer Instrumente für Grundschulkinder und Jugendliche beachten werden? Welche Erkenntnisse (*lessons learned*) zur Gesundheitskompetenz im Kindes- und Jugendalter lassen sich aus der Instrumentenentwicklung gewinnen?
4) Was sind Herausforderungen und Grenzen bei der Operationalisierung und Messung generischer Gesundheitskompetenz bei Grundschulkindern und Jugendlichen mittels Selbstangaben?

Zentrale Zielsetzungen der vorliegenden Arbeit waren demzufolge, zwei altersgerechte Befragungsinstrumente zur Erfassung generischer Gesundheitskompetenz zu entwickeln und deren psychometrische Gütekriterien (Reliabilität und Validität) zu evaluieren. Die Befragungsinstrumente wurden deutschsprachig für Grundschulkinder der vierten Klasse (9- bis 10-Jährige) und für Jugendliche (14- bis 17-Jährige) konzipiert

und basieren auf Selbstangaben. Die oben genannten Fragestellungen wurden in vier wissenschaftlichen Publikationen mit den folgenden Zielsetzungen bearbeitet [29-32].

**Zielsetzung der Publikation 1**

Adaptierung des HLS-EU-Q47 für 9- bis 10-jährige Grundschulkinder und qualitative Testung des adaptierten HLS-Befragungsinstrumentes zur Erfassung generischer Gesundheitskompetenz.

**Zielsetzung der Publikation 2**

Quantitative Testung des HLS-Befragungsinstrumentes für 9- bis 10-jährige Grundschulkinder in einer schriftlichen Befragung und Evaluation seiner psychometrischen Gütekriterien.

**Zielsetzung der Publikation 3**

Überprüfung der Anwendbarkeit des HLS-EU-Q47 zur Erfassung generischer Gesundheitskompetenz bei 14- bis 17-jährigen Jugendlichen.

**Zielsetzung der Publikation 4**

Entwicklung eines Ergebungsinstrumentes zur Erfassung generischer Gesundheitskompetenz von Jugendlichen (14- bis 17-Jährige) mittels Selbstangaben und Evaluation seiner psychometrischen Gütekriterien.

## 2. Material und Methodik

Das Befragungsinstrument für Grundschulkinder wird im Folgenden als Health Literacy Survey Questionnaire for Children (HLS-Child-Q15) und das Instrument für Jugendliche als Measurement Health Literacy Among Adolescents Questionnaire (MOHLAA-Q) bezeichnet.

### 2.1. Charakteristik der Zielgruppen

Die Instrumente wurden für zwei verschiedene Altersgruppen entwickelt mit unterschiedlichen gesundheitsbezogenen Bedürfnissen und Verhaltensweisen sowie einem unterschiedlichen Niveau sozialer, psychischer und kognitiver Fähigkeiten. Kinder und Jugendliche haben ein im Vergleich zu Erwachsen verschiedenes Konzept von Gesundheit und Krankheit und ein wenig ausgeprägtes Bewusstsein für Gesundheit [33, 34].

**9- bis 10-jährige Grundschulkinder**

Die Zielgruppe befindet sich vor dem Übergang vom primären zum sekundären Bereich (1. Stufe) des deutschen Bildungswesens. Die Begründung für die Wahl dieser Zielgruppe war die Annahme, dass im primären Bereich noch keine großen bildungssystembedingten Unterschiede im Erwerb der Gesundheitskompetenz entstehen und zudem Kinder ab 9 Jahren kognitiv in der Lage sind, einen schriftlichen Fragebogen auszufüllen [30].

Kinder in diesem Alter sind in ihrer Informations- und Entscheidungsfindung vorwiegend auf Eltern und andere Erwachsene angewiesen und ihr Gesundheitsverhalten unterliegt noch stark deren Kontrolle [35], obwohl sie durchaus aktiv auf Informationen zugreifen, diese beurteilen und daraus einen Sinn für sich

erschließen können [36]. Sie sind zwar in der Lage konkrete Probleme zu lösen (logisches Denken), die sich auf gegenwärtige Situation beziehen, bestimmte kognitive Fähigkeiten wie abstraktes Denken (Zusammenhänge verstehen) befinden sich aber noch in der Entwicklung [37].

**14- bis 17-jährige Jugendliche**

Diese Lebensphase, bezeichnet als mittlere Adoleszenz, ist durch kognitive, soziale und emotionale Entwicklungsprozesse geprägt [38]. Gleichzeitig haben die Heranwachsenden verschiedene Entwicklungsaufgaben zu bewältigen wie z. B. die Erreichung zunehmender Unabhängigkeit von den Eltern oder die Entwicklung eines eigenen Lebensstils und Wertsystems [38, 39]. Bei der Bewältigung der Entwicklungsaufgaben setzen die Jugendlichen sowohl ein gesundheitsförderliches (z. B. Sport, Körperpflege) als auch ein riskantes Verhalten (Alkohol- und Drogengebrauch, Missachtung der Straßenverkehrsregeln) ein. Hierbei treten die gesundheitsbezogenen Konsequenzen bzw. die gesundheitsbezogene Motivation oft in den Hintergrund, z. B. unterschätzen Jugendliche, dass sie krank werden und sich verletzen können [35]. In dieser Lebensphase entwickeln sich die kognitiven Fähigkeiten (Arbeitsgedächtnis, Aufmerksamkeit, abstraktes und metakognitives Denken, Handlungsplanung) als eine der Voraussetzungen für das Treffen eigener Entscheidungen, auch bezüglich der Gesundheit, weiter [38].

## 2.2. Gemeinsamkeiten im Ablauf der Instrumentenentwicklung

Die Entwicklungsprozesse beider Instrumente waren mehrstufig und bestanden aus zwei Studienphasen: 1. Phase der Entwicklung und des qualitativen Testens und 2. Phase des quantitativen Testens (Standard-Pretest). Der Ausgangpunkt für die Entwicklung beider Befragungsinstrumente war jeweils eine Literaturübersicht zu theoretischen Konzepten der Gesundheitskompetenz im Kindes- und Jugendalter und zu vorhandenen Messinstrumenten zur Erfassung der generischen Gesundheitskompetenz sowie der HLS-EU-Q47 als Grundlage. Die weiteren vergleichbaren methodischen Schritte waren: Anpassung der HLS-EU-Items für die jeweilige Zielgruppe; die Erstellung eines Itempools und die Auswahl der altersangepassten Items; das qualitative Pretesting der vorläufigen Entwürfe der entwickelten Skalen mittels eines kognitiven Pretests und abschließend die Durchführung eines Standard-Pretests. Den Ablauf der einzelnen Entwicklungsprozesse stellen die Abbildungen 1 und Abbildung 2 dar.

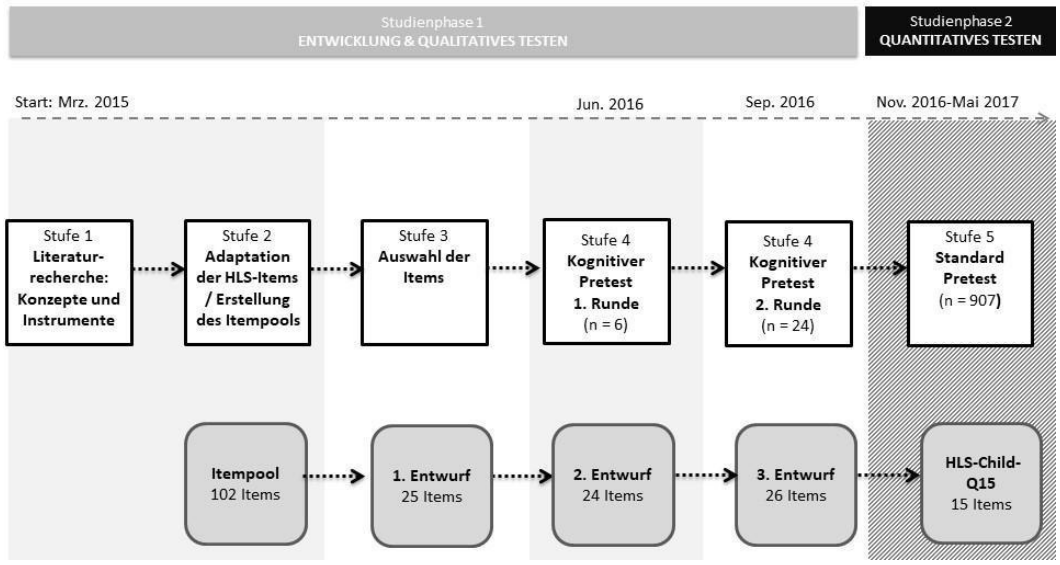
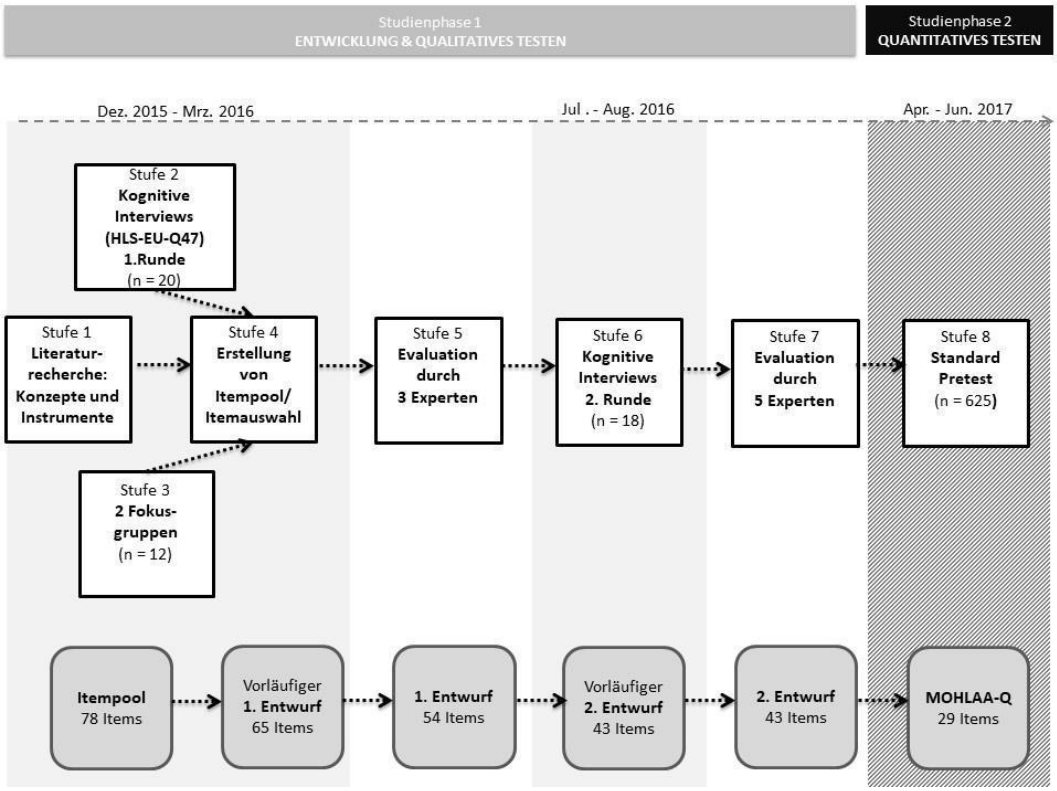



**Abbildung 1 Entwicklungsprozess des Befragungsinstrumentes für Grundschulkinder (HLS-Child-Q15)**




Quelle: Domanska, O.M., Bollweg, T.M., Loer, A.-K., Holmberg, C., Schenk, L. und Jordan, S., *Development and Psychometric Properties of a Questionnaire Assessing Self-Reported Generic Health Literacy in Adolescence*. Int J Environ Res Public Health, 2020. 17(8): S. 3.

**Abbildung 2 Entwicklungsprozess des Befragungsinstrumentes für Jugendliche (MOHLAA-Q)**

Der Methode des kognitiven Pretests von Befragungsskalen liegt die Auffassung zugrunde, dass die Beantwortung von Fragebogen-Fragen in einem komplexen und fehleranfälligen Frage-Antwort Prozess geschieht und die Fragen trotz Verständnisproblemen formal adäquat beantwortet werden. Dieser Frage-Antwort Prozess unterteilt sich wiederum in vier kognitive Schritte: Frageverständnis und Interpretation,

Informationsabruf aus dem Gedächtnis, Entscheidungsprozess und Beantwortungsprozess [40]. Diese werden während eines kognitiven Interviews unter die Lupe genommen, um Verständnisprobleme bei der Beantwortung der Fragen und somit potenzielle Messfehlerquellen zu identifizieren [41]. Das Ziel kognitiver Interviews besteht somit darin, Hinweise darauf zu erhalten, ob eine Frage diejenigen Informationen generiert, die von ihrem Konstrukteur intendiert sind [42]. Der Standard-Pretest wird dafür eingesetzt, um ein Instrument unter realen Feldbedingungen zu testen und um seine psychometrischen Eigenschaften zu evaluieren.

### 2.3. HLS-EU-Q47 als Grundlage

Als Grundlage für die Entwicklung beider Instrumente wurde dasselbe Ausgangsinstrument – die deutsche Version des European Health Literacy Survey Questionnaire mit 47 Items (HLS-EU-Q47) – verwendet. Der HLS-EU-Q47 wurde durch das HLS-EU Konsortium zwecks eines internationalen Vergleichs entwickelt und im European Health Literacy Survey in acht Ländern eingesetzt [43]. Das Instrument wurde für die Erfassung selbstberichteter generischer Gesundheitskompetenz bei Personen ab 15 Jahren konzipiert [44]. Seitdem wurde es in vielen Sprachen validiert und in zahlreichen Studien verwendet [45-48]. Das Befragungsinstrument erfasst auf einer 4-stufigen Skala (1-sehr schwierig, 2-ziemlich schwierig, 3-einfach, 4-sehr einfach) die empfundenen Schwierigkeiten beim Finden, Verstehen, Bewerten und Anwenden (Handlungsbereiche der Gesundheitskompetenz) von Gesundheitsinformationen im Kontext der Gesundheitsversorgung, Krankheitsprävention und Gesundheitsförderung (Domänen). Die Gründe für die wahrgenommenen Schwierigkeiten können sowohl in einer geringen Kompetenzausprägung bei den Befragten als auch an äußeren Umständen liegen (Komplexität des Gesundheitssystems, unverständliche Gesundheitsinformationen etc.).

Die Begründung für die Verwendung des Instrumentes war das Adaptationspotenzial des dem Instrument zugrunde liegenden Konzeptes generischer Gesundheitskompetenz, welches über die Erfassung der Kompetenzen im Bereich der Gesundheitsversorgung hinausgeht, und die Verfügbarkeit des Instrumentes in deutscher Sprache. Ein weiterer Vorteil in Bezug auf die Zielgruppe der Jugendlichen war die Tatsache, dass der HLS-EU-Q47 bereits quantitativ mit Jugendlichen ab 15 Jahren in Irland und in den Niederlanden getestet wurde [44]. Die ursprüngliche Motivation bestand auch darin, möglichst eine methodische Vergleichbarkeit bei der Erhebung der Gesundheitskompetenz in drei verschiedenen Lebensphasen zu gewährleisten: bei Kindern, Jugendlichen und Erwachsenen [29].

### 2.4. Methodische Besonderheiten bei der Entwicklung der einzelnen Befragungsinstrumente

Da bei der Entwicklung der Instrumente zum Teil andere Ziele verfolgt wurden und es sich um Instrumente für unterschiedliche Altersgruppen handelt, wurden dementsprechend auch andere methodische Vorgehensweisen eingesetzt. Die Unterschiede bestehen vor allem in den operationalisierten Definitionen und konzeptionellen Rahmen beider Instrumente.

**Operationalisierte Definition und konzeptioneller Rahmen der Befragungsskalen**

Bei der Entwicklung des Befragungsinstrumentes für Grundschulkinder stand die Adaptation des HLS-EU-Q47 im Vordergrund. Daher wurden die operationalisierte Definition und das theoretische Konzept der Gesundheitskompetenz nach Sørensen et al. [44], die dem HLS-EU-Q47 zugrunde liegen, übernommen. Das latente Konstrukt der Gesundheitskompetenz wird demnach mit vier theoretischen Faktoren entlang der Dimensionen der Gesundheitskompetenz (Finden, Verstehen, Bewerten, Anwenden) und mit drei Faktoren entlang der Domänen der Gesundheitskompetenz (Gesundheitsversorgung, Krankheitsprävention, Gesundheitsförderung) definiert.

Im Fall des Befragungsinstrumentes für Jugendliche legten die Ergebnisse eines systematischen Reviews zu Definitionen und Modellen von Bröder et al. [17] den Grundstein für eine operationalisierte Definition und ein Rahmenkonzept für den Fragenbogen. Gesundheitskompetenz wird hierbei als „*…comprising variables sets of key dimensions, each appearing as a cluster of related abilities, skills, commitments and knowledge that enable a person to approach health information competently and effectively and to derive at health-promotion decisions and actions*. " (S.1) [17] betrachtet. Die Schlüsseldimensionen der Gesundheitskompetenz werden in drei Kategorien individueller Attribute gebündelt: 1. kognitive, 2. behaviorale bzw. operationale und 3. affektive und konative [17]. Diese Kerndimensionen wurden als die theoretischen Faktoren des latenten Konstruktes im Rahmenkonzept für das Befragungsinstrument für Jugendliche festgelegt und mit mehreren Subskalen operationalisiert.

**HLS-Child-Q15**

Die erste Phase des Adaptationsprozesses des HLS-EU-Q47 für Grundschulkinder umfasste: die Adaptation der HLS-EU-Items für die Altersgruppe, die Erstellung eines Itempools und zwei Runden kognitiver Interviews unter Verwendung der Entwürfe des Befragungsinstrumentes. Die detaillierte methodische Vorgehensweise dieser Phase wurde in der Publikation 1 [29] beschrieben. Der anschließende Standard-Pretest wurde als eine schriftliche Klassenzimmerbefragung konzipiert. An der Befragung nahmen 907 Grundschüler*innen aus Nordrhein-Westfalen teil. Außer dem getesteten Befragungsinstrument, bestehend aus 26 adaptieren HLS-EU-Items, beinhaltete der Gesamtfragebogen Fragen zur Soziodemografie und zu Einflussfaktoren der Gesundheitskompetenz. Die Details zu der Sampling-Prozedur, den eingesetzten Messinstrumenten und den durchgeführten Analysen wurden in Publikation 2 berichtet [30].

Die psychometrischen Eigenschaften des getesteten Befragungsinstrumentes wurden mittels Item-, Reliabilitäts-, Faktoren- und Assoziationsanalysen zur Konstrukt-Validierung untersucht. Im Rahmen der Itemanalyse wurden fehlende Werte, Verteilungsparameter, Itemschwierigkeit und Itemtrennschärfe analysiert. Die interne Konsistenz- (Cronbach-$\alpha$) und Spearman-Brown Split-Half Reliabilitätskoeffizienten wurden als Indikatoren der Reliabilität verwendet. Die strukturelle Validität des adaptierten Instrumentes wurde in zwei explorativen Faktorenanalysen (EFA) untersucht. Mit Hilfe einer konfirmatorischen Faktorenanalyse (KFA) wurde überprüft, inwiefern sich eine Anpassung zwischen den mit der adaptierten Skala erhobenen

Daten und dem ihr zugrunde liegenden theoretischen HLS-EU-Konstrukt der Gesundheitskompetenz ergibt. Zur Untersuchung divergenter Validität wurden drei Fragen zur allgemeinen Selbstwirksamkeit verwendet. Um die konvergente Validität zu überprüfen, wurde ein auf dem Test of Functional Health Literacy in Adults (TOFHLA) [49] basierender Lückentest entwickelt und eingesetzt. Mit dem für Kinder angepassten TOFHLA wurde die funktionale Gesundheitskompetenz gemessen. Die Faktorenanalysen wurden mit Hilfe von SPSS-Amos und sonstige Analysen mit SPSS-Statistics, Version 25 durchgeführt.

**MOHLAA-Q**

Bei der Entwicklung des Befragungsinstrumentes für Jugendliche wurde zunächst der HLS-EU-Q47 auf die Anwendbarkeit in der Zielgruppe mit Hilfe von kognitiven Interviews getestet. Die Methodik dieser Teilstudie wurde in der Publikation 3 beschrieben [31]. Darüber hinaus wurden weitere qualitative Teilschritte eingebaut: zwei Fokusgruppen und zwei Runden der Experten-Bewertung der vorläufigen Entwürfe des Instrumentes. Die Fokusgruppe ist eine qualitative Methode [50], die dafür genutzt wurde, die Erfahrungen der Jugendlichen in Bezug auf den Umgang mit Krankheiten (Krankheitsmanagement und Krankheitsprävention), das Navigieren im Gesundheitssystem (Vereinbarung eines Arztbesuches), und die Förderung der eigenen Gesundheit zu explorieren. Die diskutierten Themenbereiche entsprachen den drei Domänen (Gesundheitsversorgung, Krankheitsprävention und Gesundheitsförderung) des theoretischen Konzeptes des HLS-EU-Q47.

Die erstellten Entwürfe des MOHLAA-Q wurden einmal mit drei (1. Runde) und einmal mit fünf (2. Runde) Expert*innen auf den Inhalt, seine Relevanz für das altersspezifische Konzept der Gesundheitskompetenz, auf Verständlichkeit und Angemessenheit der Fragenformulierungen überprüft. Alle beteiligten Personen waren Forscher*innen auf dem Gebiet der Gesundheitskompetenz und hatten verschiedene wissenschaftliche Hintergründe (Medizin, Erziehungswissenschaften, Lehramt, Public Health und Gesundheitswissenschaften).

Das entwickelte Befragungsinstrument, bestehend aus 43 Items, wurde im Anschluss in einer postalischen Befragung in Berlin eingesetzt und auf seine psychometrischen Eigenschaften getestet. Zu diesem Zweck wurde eine stratifizierte Zufallsstichprobe basierend auf Einwohnermeldeamt-Adressen aus Berlin gezogen. An der Befragung nahmen 625 Personen teil. Die psychometrische Evaluation bestand aus Item- und Reliabilitätsanalysen, einer Überprüfung der strukturellen Validität mittels Konfirmatorischer Faktorenanalyse (KFA), Assoziationsanalysen mit Skalen, die verwandte oder ähnliche Konstrukte erfassen oder als ein externes Kriterium der Gesundheitskompetenz (subjektiver Gesundheitsstatus) bestimmt wurden. Die konvergente Validität wurde mit etablierten und validierten Instrumenten überprüft: Newest Vital Sign Test (NVS) [51] und HLAT-8 [52]. Mit dem NVS wurde die konvergente Validität des entwickelten Instrumentes in Bezug auf funktionale Gesundheitskompetenz (Leseverständnis und Rechenfertigkeiten) und mit dem HLAT-8 entsprechend auf die generische Gesundheitskompetenz evaluiert. Die Analysen wurden in Mplus 8 (KFA) und STATA Version 15 durchgeführt.

Die Methodik des gesamten Entwicklungsprozesses wurde in Publikation 4 dargestellt [32] und teilweise bei Jordan et al. beschrieben [53]. Die methodischen Details der qualitativen Teilstudien sind im Supplement der Publikation 4 [32] und bei Firnges et al. zu finden [54].

# 3. Ergebnisse

## 3.1. Zentrale Ergebnisse der einzelnen Publikationen

**Publikation 1: Adaptation und qualitatives Testen des Befragungsinstrumentes für Grundschulkinder**

Basierend auf den HLS-EU-Items wurde ein Itempool aus 102 Items generiert. Die Items bezogen sich auf Erfahrungsbereiche (Ernährung, Bewegung), für Kinder typische Krankheiten (Erkältung, Halsschmerzen, Schnupfen) und Gesundheitsrisiken (Übergewicht oder Untergewicht). Diese wurden weitestgehend in einer kindgerechten Sprache formuliert (kurze und präzise Sätze ohne Konditionalsätze), was sich – wegen des wortreichen und sperrigen Einleitungssatzes und der vorliegenden Frageformulierungen des HLS-EU-Q47 – als schwierig erwies.

Aus dem Itempool wurden 24 Items ausgewählt, die jeweils mit drei Mädchen und Jungen im Alter zwischen 9 und 10 Jahren mit Hilfe persönlicher kognitiver Interviews getestet wurden. In der ersten Runde des kognitiven Pretesting wurden die adaptierten Items durch die Testpersonen als „verständlich“, das Layout und der Aufbau des Befragungsinstrumentes als „gut“ bewertet. Die meisten Kinder waren in der Lage, einen Fragebogen auszufüllen. Sie hatten jedoch in fast der Hälfte der Items Schwierigkeiten bei der Interpretation der einleitenden Teilsätze. Bei den Items, in denen es um wahrgenommene Schwierigkeiten bezüglich des „Herausfindens“ und „Bewertens“ von Informationen ging, reflektierten sie über ihr Wissen oder Alltagsgewohnheiten (ID_1A: „meine Mutter gibt mir immer wenn ich erkältet bin Hühnersuppe“). Generell hatten alle Testpersonen ein großes Vertrauen in die Aussagen der Eltern. Im Anschluss wurden die Items sprachlich und inhaltlich angepasst und diejenigen, die nicht verständlich waren, durch andere geeignete aus dem Itempool ersetzt.

In der zweiten Runde des kognitiven Pretesting bestand die Testgruppe aus fünfzehn Mädchen und neun Jungen und erwies sich als heterogener hinsichtlich ihrer Sprachkompetenzen und kognitiven Fähigkeiten. Nicht alle Kinder füllten den getesteten Fragebogen vollständig aus. Hier wurde bei einigen Testpersonen wieder das Phänomen einer vermutlich altersspezifischen Interpretation der adaptierten Items beobachtet. Die Kinder begründeten die Wahl der Antwortoptionen mit ihrem Wissen und jeglichen Erfahrungen in Bezug auf die Aufgaben oder angefragten Situationen in den Items. Sie gingen nicht auf die Prozesse des Findens, des Verstehens, des Bewertens oder des Anwendens von Gesundheitsinformationen ein. Das finale Ergebnis der qualitativen Teilstudien war der adaptierte HLS-Befragungsinstrument, bestehend aus 26 Items.

**Publikation 2: Quantitatives Testen und psychometrische Evaluation des Befragungsinstrumentes für Grundschulkinder**

Aus dem Instrument wurden aufgrund der schlechten psychometrischen Eigenschaften insgesamt 10 Items entfernt, ein weiteres aufgrund der Ergebnisse der Faktorenanalyse. Der höchste Anteil an fehlenden Werten („Weiß nicht“ oder keine Angabe > 8%) betraf die Items zur Tätigkeit „Bewerten“ von Informationen. Die Mehrheit der Items wies einen hohen Wert des Schwierigkeitsindexes (um 80%) auf, d. h. bei diesen wurden meistens die Antwortoptionen „sehr einfach“ und „einfach“ angekreuzt.

Die Ergebnisse der ersten EFA mit 26 Items zeigten eine 6-faktorielle Lösung (48,18% Varianz erklärend) auf, wobei neun Items eine Faktorladung unter 0,32 hatten und zwei Items jeweils nur auf einen Faktor luden. Die erneute EFA mit dem gekürzten Instrument ergab eine 3-faktorielle Lösung (39,78% Varianz), die allerdings nicht die ursprünglich angenommenen Faktorenstrukturen wie in dem theoretischen Modellkonzept des HLS-EU-Q47 zeigte. Drei identifizierte Faktoren korrespondierten inhaltlich mit den folgenden Themen: Medikation, Impfungen und gesunde Ernährung, wobei der zweite Faktor nur einem Item entsprach und letztlich aus dem finalen Instrument entfernt wurde. Die KFA bestätigte genauso das Ergebnis, dass weder die 3-faktorielle noch die 4-faktiorelle Lösung, wie in dem theoretischen Modell angenommen, eine gute Anpassung zu den Daten aufwies.

Die finale Fassung des HLS-Child-Q15 besteht aus 15 Items. Für sie wurde eine hohe interne Konsistenz der Messung (Cronbach-$\alpha$ = 0,791) festgestellt. HLS-Child-Q15 zeigte eine niedrigere, jedoch statistisch signifikante Korrelation (rho = 0,107, $p < 0,001$) mit dem angepassten TOFHLA und eine moderate Korrelation mit den Indikatoren des Selbstwirksamkeit-Konstruktes (rho = 0,280-0,306, $p < 0,001$).

**Publikation 3: Qualitatives Testen der Anwendbarkeit des HLS-EU-Q47 bei Jugendlichen**

Die Ergebnisse der kognitiven Interviews (1. Runde) zeigten, dass das Ausgangsinstrument (HLS-EU-Q47), ursprünglich für Erwachsene konzipiert, nur eingeschränkt für die Messung generischer Gesundheitskompetenz von 14- bis 17-Jährigen geeignet ist. Insgesamt wurden bei der Mehrheit der Items Schwierigkeiten bezüglich der Fragenverständlichkeit (unbekannte, kognitiv anspruchsvolle und nicht eindeutige Begriffe und Fragenformulierungen) und einige Probleme hinsichtlich der Relevanz von Item-Inhalten für die Zielgruppe festgestellt. Die Jugendlichen berichteten beispielsweise kaum oder keine Erfahrung und wenig Wissen im Bereich der Gesundheitsversorgung („Zweite Meinung“ von anderem Arzt holen, Vor- und Nachteile von verschiedenen Behandlungsmöglichkeiten zu beurteilen) und der Krankheitsprävention (Kenntnisse über Art und Zwecke der Vorsorgeuntersuchungen) zu haben. Sie kreuzten dennoch die Antwortoptionen „ziemlich einfach“ oder „einfach“ im HLS-EU-Q47 an, die als Indikatoren einer hohen Gesundheitskompetenz zu interpretieren sind. Das beobachtete Antwortverhalten lässt eine Diskrepanz zwischen der Selbsteinschätzung und den mit Hilfe konkreten Nachfragens enthüllten Fähigkeiten, Wissen und Erfahrungswerten vermuten, mit einer Tendenz zu Überschätzung.

Darüber hinaus hatten die Jugendlichen Schwierigkeiten, die Vertrauenswürdigkeit von Gesundheitsinformationen in Medien einzuschätzen: Als Entscheidungskriterien bedienten sie sich pauschaler Proxy-

Indikatoren (z. B. Vertrauenswürdigkeit oder ein guter Ruf der Informationsquelle) oder vorgefertigter Meinungen (ID_01: „Ich würde gar nicht im Internet schauen danach […] vielleicht bei etwas Leichtem"; ID_08: „…also jetzt sowas wie Bildzeitung würde ich nicht so glauben...").

Ein weiteres Ergebnis verdeutlicht die Rolle der Eltern (Hauptinformationsquelle) bzw. weiterer erwachsener Bezugspersonen im direkten Lebensumfeld für die Informationsbeschaffung und für das Treffen von gesundheitsbezogenen Entscheidungen (Ernährung, Impfungen). Jugendliche vertrauen auf das Wissen und die Fähigkeiten der Eltern.

Zusammenfassend deuteten die Ergebnisse darauf hin, dass die Items inhaltlich angepasst und die Komplexität der Fragenformulierungen sowie des gesamten Instrumentes reduziert werden müssten. Die Ergebnisse bekräftigten die Notwendigkeit einer altersspezifischen Konzipierung und Operationalisierung der Gesundheitskompetenz.

**Publikation 4: Entwicklung und psychometrische Evaluation des Befragungsinstrumentes für Jugendliche**

Die Ergebnisse der Publikation 4 setzen sich aus den Ergebnissen mehrerer qualitativer Teilstudien und des quantitativen Standard-Pretests zusammen. Die detaillierten Ergebnisse aus den qualitativen Teilstudien werden im Supplement der Publikation 4 berichtet [32]. Die Teilergebnisse sind bereits bei Firnges et al. [54] und Jordan et al. [53] veröffentlicht.

Das Kernergebnis der ersten Studienphase war die Festlegung des konzeptionellen Rahmens, der Arbeitsdefinition der Gesundheitskompetenz im Jugendalter und die Entwicklung des entsprechenden Befragungsinstrumentes für Jugendliche. Das Instrument hat zum Ziel kognitive, behaviorale, konative und affektive Komponenten des multidimensionalen Konstruktes generischer Gesundheitskompetenz zu messen. Die iterative Operationalisierung und Spezifizierung des Rahmenkonzeptes basierte auf den Ergebnissen der qualitativen Teilstudien, infolgedessen die adaptierten HLS-EU-Items (im Folgenden: Subskala A) mit vier Subskalen (B-E) erweitert wurden.

In den qualitativen Teilstudien stellte sich heraus, dass Kommunikation und Interaktion mit Erwachsenen ein bedeutsamer Aspekt der Gesundheitskompetenz im Jugendalter sind. Daher wurden zwei Subskalen zur Kommunikation (im Folgenden Subskala B und E) entwickelt. Subskala B erfragt, wie zutreffend für Jugendliche bestimmte Aussagen sind, z. B. während des letzten Arztbesuchs Fragen gestellt oder mit Eltern über Themen rund um Gesundheit gesprochen zu haben. In der Subskala E sollen die Befragten die wahrgenommenen Fertigkeiten der Personen einschätzen, von denen sie Gesundheitsinformationen und Hilfe erhalten haben, z. B. "Wenn du an deinen letzten Arztbesuch denkst: Hat dein Arzt/deine Ärztin alles so erklärt, dass du es verstanden hast?". Mit dieser Subskala wurde intendiert, die Anforderungen und Umstände des Lebenskontexts (kontextueller Faktor der Gesundheitskompetenz) aus der Perspektive der Jugendlichen zu erfassen. Mit der Subskala C sollten affektive und konative Komponenten der Gesundheitskompetenz operationalisiert werden, wozu Gesundheitsbewusstsein, gesundheitsbezogene Selbstwirksamkeit, Kontrollüberzeugung und Interesse an Themen rund um Gesundheit zählen.

In den Fokusgruppen und der zweiten Runde der kognitiven Interviews ergaben sich erneut Hinweise, dass die Jugendlichen dazu tendierten, ihre Fähigkeiten zu überschätzten. Diese Beobachtung hat dazu beigeführt, eine Subskala mit zehn gesundheitsbezogenen Wissensfragen (Subskala D) ins Kerninstrument zu integrieren, als eine leistungsbasierte Messung der kognitiven Komponente der generischen Gesundheitskompetenz. Darüber hinaus wird aus theoretischer Sicht gesundheitsbezogenes Wissen [6, 17] als ein Kernbestandteil der Gesundheitskompetenz betrachtet.

Mit Hilfe der zweiten Runde von kognitiven Interviews gelang es, die Items dem Sprachlevel der Zielgruppe besser anzupassen sowie die Item-Inhalte verständlicher, geschlechtsspezifisch und lebenskontextspezifischer zu gestalten. Es wurden z. B. Beispiele für schwierige Begriffe eingeführt oder ein Item jeweils für Jungen und Mädchen entwickelt. Die meisten altersangepassten Items wurden von den Jugendlichen als verständlich und adäquat bewertet, was in erster Linie die Augenscheinvalidität des Befragungsinstrumentes stützte.

Zwei strukturierte Evaluationsrunden durch Gesundheitskompetenz-Expert*innen zu den jeweiligen Entwürfen des Befragungsinstrumentes bekräftigten deren Inhaltsvalidität und erzielten eine Verbesserung der Fragenformulierungen. Die Anzahl der Items wurde von 65 Items (1. Entwurf) auf 43 Items (2. Entwurf) reduziert. Diese Version wurde an einer umfassenden Zufallsstichprobe mit 625 Jugendlichen getestet. 58,7% der Studienteilnehmer*innen waren Mädchen, fast 94% aller Befragten besuchten noch eine Schule. Die wichtigsten Ergebnisse des Standard-Pretests bezogen sich auf die psychometrischen Eigenschaften des entwickelten Befragungsinstrumentes:

- Die Reliabilität der Messung für die Subskalen A-C, ermittelt anhand des Koeffizienten für interne Konsistenz (Cronbach-$\alpha$), war unterschiedlich ausgeprägt (0,54 – 0,77). Nur Subskala A (adaptierte HLS-EU-Items) erfüllte den angestrebten Wert des Cronbach-$\alpha > 0{,}7$. Subskala E wurde aufgrund eines niedrigen Wertes des Cronbach-$\alpha$ (0,34) verworfen.
- Für Subskala A konnte die Annahme über konvergente Validität bestätigt werden. Es wurde eine moderate Assoziation ($rho = 0{,}528$, $p < 0{,}001$) mit dem HLAT-8 gefunden. Für Subskala B und C waren die Korrelationskoeffizienten mit den Validierungsskalen vergleichbar hoch. Die Subskala D (Wissensfragen) korrelierte moderat mit dem NVS ($rho = 0{,}352$, $p < 0{,}001$).
- Die Prüfung der strukturellen Validität mittels KFA ergab nicht die angestrebten Werte für eine „gute“ Anpassung der Daten an die vier theoretischen Faktoren des Gesamtmodells. Die Werte der berücksichtigten Anpassung-Indizes erreichten allerdings annähernd die vorgegebenen Cut-offs. Sie waren zudem eindeutig besser bei der 4-faktoriellen als bei der 1-faktoriellen Lösung, wodurch die Annahme der Mehrdimensionalität des Konstruktes generischer Gesundheitskompetenz erstmals untermauert wird.

Im Anschluss an die quantitative Evaluierung wurde das Befragungsinstrument auf 29 Items reduziert und die Formulierungen von vier Items mit unzureichenden psychometrischen Eigenschaften modifiziert. Die aktuelle Version des MOHLAA-Q besteht aus 4 Subskalen: Subskala A „Umgang mit gesundheitsbezogen

Informationen“ (HLS-EU-Q12-adolescents-DE, 12 Items), Subskala B „Kommunizieren über Gesundheit“ (4 Items), Subskala C „Einstellung zur Gesundheit und Gesundheitsinformationen“ (5 Items) und Subskala D „Gesundheitsbezogenes Wissen“ (8 Items).

### 3.2. Zusammenfassende Erkenntnisse aus der Instrumentenentwicklung für beide Altersgruppen

Aus den vier Teilstudien lassen sich die folgenden Erkenntnisse zusammenfassen:

- Die meisten Kinder und Jugendliche haben im Unterschied zu Erwachsenen wenig Erfahrung in den Bereichen Gesundheitsversorgung und Krankheitsprävention. Ihre Erfahrungsbereiche, über die sie durchaus zuverlässig Auskunft geben können, beziehen sich auf alltagsnahe Bereiche, z. B. die Ernährung, den eigenen Körper, Bewegung und, im Falle Jugendlicher, die sexuelle Gesundheit.
- Eltern und Personen aus deren direktem Lebenskontext haben eine entscheidende Funktion bei der Beschaffung, der Bewertung und der Anwendung von Gesundheitsinformationen.
- Die kognitiven Kompetenzen für die Bewältigung bestimmter gesundheitsbezogener Aufgaben hängen von der altersspezifischen und individuellen Entwicklungsphase ab.
- Die Limitationen der entwickelten Befragungsskalen zeigen die Grenzen bei der Operationalisierung des Konstrukts generischer Gesundheitskompetenz auf.
- Kinder und Jugendliche überschätzen bei Selbsteinschätzungsinstrumenten ihre eigenen Fertigkeiten und Fähigkeiten.

Die Erkenntnisse der Teilstudien werden im folgenden Kapitel aufgegriffen und in den aktuellen Forschungsstand eingebettet.

## 4. Diskussion

Mit den entwickelten Befragungsinstrumenten – HLS-Child-Q15 für 9- bis 10-jährige Grundschulkinder und MOHLAA-Q für 14- bis 17-jährige Jugendliche – liegen die ersten validierten Instrumente in deutscher Sprache vor, die generische Gesundheitskompetenz mittels Selbstangaben erfassen. Beide Instrumente knüpfen an den HLS-EU-Q47 an und weisen dadurch einige messmethodische Gemeinsamkeiten (Einleitungssätze, Fragen- und teilweise Antwortformate) auf. Die spezifischen Anforderungen der Zielgruppen und die unterschiedlichen konzeptionellen und methodischen Herangehensweisen bei der Entwicklung der Instrumente führten jedoch zu einer unterschiedlichen thematischen Gestaltung und verschiedenem Aufbau der Befragungsinstrumente. Der MOHLAA-Q besteht aus 29 Items in vier Subskalen. In drei Subskalen werden der Schwierigkeitsgrad im Umgang mit Gesundheitsinformationen, kommunikative Fähigkeiten und Einstellungen zu gesundheitsbezogenen Informationen und zu der eigenen Gesundheit durch Jugendliche subjektiv eingeschätzt. Die letzte Subskala enthält Wissensfragen und zielt somit auf eine objektive Messung ab. Der HLS-Child-Q15 besteht ausschließlich aus 15 adaptierten HLS-EU-Items. Er erfasst,

ähnlich wie bei Subskala A des MOHLAA-Q und bei dem HLS-EU-Q47, den wahrgenommenen Schwierigkeitsgrad beim Finden, Verstehen, Bewerten und Anwenden von Gesundheitsinformation in den Bereichen der Gesundheitsversorgung, Krankheitsprävention und Gesundheitsförderung. Der HLS-Child-Q15 ist die erste Adaptation des HLS-EU-Q47 für Kinder. Mit diesen Befragungsinstrumenten ist erstmals eine Erhebung der Daten zu generischer Gesundheitskompetenz bei den bisher kaum erforschten Altersgruppen und zur Identifizierung entsprechender Förderungsbedarfe möglich.

### 4.1. Einordnung der Ergebnisse in den Forschungskontext

Es ist gelungen, Instrumente zu entwickeln, die den wesentlichen Gütekriterien der Reliabilität und der Konstrukt- und Kriteriumsvalidität genügen. Diese sind allerdings nicht frei von diversen psychometrischen Schwächen. Ihre Limitationen wurden sehr ausführlich in den Originalpublikationen (Publikation 2 und Publikation 4) diskutiert [29, 32]. Beide Instrumente sind dadurch gekennzeichnet, dass sie zu wenig Items beinhalten, die „schwierig“ sind und damit eine exakte Differenzierung zwischen Personen in höheren Kompetenzbereichen (zwischen hohem und mittlerem Bereich) erzielen. Dieses Problem wurde bereits in einigen Studien mit dem HLS-EU-Q mit Erwachsenen beobachtet [45, 47, 55]. Dieser Nachteil wird jedoch in Kauf genommen, da für die Zwecke der Gesundheitsförderung bzw. Gesundheitskompetenzförderung das Aufdecken von Personen in niedrigeren Kompetenzbereichen das entscheidende Zielkriterium ist. Ein weiterer methodischer Einwand betrifft die strukturelle Validität der Instrumente, was wiederum ihre Konstruktvalidität teilweise einschränkt. Im Fall von beiden Befragungsinstrumenten konnten die angenommenen theoretischen Faktorenstrukturen nicht vollständig bestätigt werden.

Neben der theoretischen Fundierung und der angestrebten psychometrischen Stärke der Instrumente [56, 57] wurden in der Literatur weitere Empfehlungen bzw. Kriterien formuliert, die Messinstrumente zur Erfassung von Gesundheitskompetenz für Kinder und Jugendliche erfüllen sollen [58]. Zu diesen, eher allgemein geltenden, Kriterien gehört unter anderem die Fähigkeit eines Messinstrumentes, Veränderungen des zu messenden Parameters über einen Zeitraum hinweg oder aufgrund einer Intervention sensitiv abzubilden, die Anwendbarkeit in verschiedenen Settings und eine einfache Interpretierbarkeit der Ergebnisse anhand der Bewertungskriterien [58]. Diese Anwendungsmöglichkeiten müssen für den MOHLAA-Q und den HLS-Child-Q15 noch ausgearbeitet werden und bestätigen somit die Notwendigkeit der Weiterentwicklung der Instrumente. Über die Testung an weiteren Stichproben, eine erneute Überprüfung der strukturellen Validität (einschließlich der Messinvarianz in verschiedenen Gruppen und Stichproben) und im Fall des MOHLAA-Q die Messungsreliabilität der einzelnen Skalen hinaus, sollte in einem Längsschnitt-Design die Sensitivität für die genannten Veränderungen geprüft werden.

Die qualitativen Ergebnisse der Publikation 1 und Publikation 3 bestätigen, dass – im Gegensatz zu Erwachsenen – die meisten Kinder und Jugendlichen wenig Erfahrung im Bereich der Gesundheitsversorgung und der Krankheitsprävention haben [29, 31]. Grundschulkinder und Jugendliche sind eine vergleichsweise gesunde Population, wie Daten zur Inanspruchnahme bestätigen [59]. Sie werden dementsprechend seltener im Vergleich zu Erwachsenen und aufgrund anderer gesundheitlicher Probleme mit den Anforderungen des

Gesundheitssystems und der Gesundheitsversorgung konfrontiert [20]. So sind bestimmte Aufgaben, die zentral in der Gesundheitskompetenz von Erwachsenen sein mögen, kaum für die Zielgruppe relevant [60], da sie von den erwachsenen Bezugspersonen übernommen werden (z. B. Entscheidungen über Behandlungsmöglichkeiten, Impfungen und Vorsorgeuntersuchung). Die geringe Erfahrung in diesem Lebensbereich wird durch die wenigen dazu bekannten Studien mit Jugendlichen bestätigt [61, 62]. Dabei zeigte sich eine entscheidende Funktion der Eltern/Erziehungsberechtigten in Zusammenhang mit Fragen und Entscheidungen zur Gesundheit. Die Rolle der Gesundheitskompetenz der Eltern für die Gesundheitskompetenz ihrer (chronisch erkrankten) Kinder wurde teilweise empirisch belegt [63-66]. Bei Kindern und Jugendlichen stellt sich eher die Frage, wie ihre gesundheitsrelevante Entscheidungen getroffen werden, wer sie beeinflusst bzw. wer diese für sie trifft [60]. Aber auch die Bedeutung der gesamten sozialen Umgebung (Lehrer*innen, Erzieher*innen, Trainer*innen, Verwandte, Peer-Groups) und deren Gesundheitskompetenz sollten stärker in den Fokus der Forschung rücken. Gesundheitskompetenz ist als eine „soziale kontextabhängige Praxis“ und nicht nur als „eine individuelle Fähigkeit“ zu verstehen [67, 68], was bei der Operationalisierung, Messung und Interpretation der Ergebnisse stärker bedacht werden sollte.

Ferner zeigten sich bei der Instrumentenentwicklung deutlich die altersspezifischen Unterschiede in den (kognitiven) Kompetenzen zwischen den betrachteten Zielgruppen, aber auch zwischen den Personen innerhalb einer Zielgruppe. Dies verweist auf einen deutlichen Bedarf an qualitativer Forschung. Diese entwicklungspsychologisch bedingten Unterschiede sind besonders bei der Operationalisierung der Gesundheitskompetenzmessung im Kindesalter zu berücksichtigen. Die Ergebnisse der kognitiven Pretests mit Grundschulkindern zeigten, dass die Kinder auf bestimmte Inhalte der Fragen nicht eingehen (Finden und Bewerten von Gesundheitsinformationen) und bei der Fragenbeantwortung diese Prozesse nicht reflektieren [29]. Der Standard-Pretest mit Grundschulkindern bestätigte dieses Ergebnis, indem der höchste Anteil an „Weiß nicht“ Antworten bei all denjenigen Items gefunden wurde, in denen es um die Bewertung von diversen Gesundheitsinformationen ging. Das Ergebnis lässt sich aus entwicklungspsychologischer Sicht gut begründen. Die erforderlichen kognitiven Fähigkeiten wie Sprachkompetenzen (Leseverstehen), kritisches Denken, und Verständnis von komplexen Zusammenhängen befinden sich bei Kindern aus der Zielgruppe in der Entwicklung und variieren besonders in dieser Lebensphase von Individuum zu Individuum [69]. Der Befund der vorliegenden Arbeit steht teilweise im Widerspruch zu den Ergebnissen der qualitativen Studie von Fairbrother et al., die herausfand, dass 9- bis 10-jährige Kinder durchaus kompetent Widersprüche und Inkonsistenzen bei erhaltenen Informationen bezüglich Ernährung (Konsum von Obst und Gemüse) aufspüren können und kritische Urteile treffen [36]. Das unterschiedliche Ergebnis der Studie von Fairbrother et al. weist darauf hin, dass es an dem Thema liegen könnte, ob Kinder bestimmte Sachverhalte abwägen und bewerten. Daher sollte mit einer weiteren Forschung geklärt werden, welche spezifischen Faktoren das Bewerten von Informationen bedingen und wie alltagsrelevant dieser Handlungsbereich der Gesundheitskompetenz im Kindesalter ist.

Des Weiteren ist die Kernkompetenz – die gezielte Suche nach Informationen und Informationsquellen – bei gesundheitlichen Beschwerden, abgesehen von den Fragen an ihre Eltern/Erziehungsberechtigten, bei

Kindern dieser Altersgruppe noch wenig ausgeprägt. Bei Jugendlichen hängt hingegen dieser Handlungsbereich der Gesundheitskompetenz vom Thema ab, zu dem die Suche geführt wird. Dies ist aus anderen Studien bekannt [70-72]. Die Recherche nach Informationen unter den 14- bis 17-Jährigen wird wegen des einfachen Zugriffs auf das Internet als etwas „Selbstverständliches" und „Einfaches" empfunden. Dafür fehlen den Jugendlichen entsprechende Kompetenzen, die Vertrauenswürdigkeit der Informationen und der Quellen in den Medien/Internet kritisch zu beurteilen, wie in früheren Studien auch beobachtet wurde [71, 73, 74]. Auf der anderen Seite zeigten die Ergebnisse, dass die Kinder in der Lage waren, über ihr Alltagswissen, gesundheitsrelevante Gewohnheiten (Ernährung, Körperpflege, Bewegung, Einnahme von Medikamenten) und Erfahrungen in konkreten Situationen (im Fall einer Erkältung oder bei Schulstress) eine valide und differenzierte Auskunft zu geben. Die Jugendlichen waren zudem fähig, über eigene kognitive Grenzen und Erfahrungsbereiche zu reflektieren (d. h. was sie nicht konnten bzw. worüber sie sich noch keine Gedanken machten). Das bedeutet, dass bei der Entwicklung von Instrumenten so früh wie möglich die Perspektive von Kindern und Jugendlichen einzubeziehen ist, um zu verstehen, welchen spezifischen Sinn die jeweiligen Altersgruppen aus Gesundheitsinformationen erschließen und in welche Handlungen diese konkret umgesetzt werden [75].

Die Komplexität und Multidimensionalität des Konstruktes generischer Gesundheitskompetenz bedeutet schließlich für die Operationalisierung, dass die Instrumente lang und komplex werden, damit die relevanten Dimensionen das gesamte Spektrum des Konstruktes abdecken. Ein umfassendes Befragungsinstrument bedeutet einen höheren Aufwand für die Befragten und höhere Kosten (bei der Durchführung und Auswertung solcher Instrumente) für die Befragenden. Darüber hinaus werden bei der Operationalisierung der einzelnen Dimensionen teilweise verschiedene Sub-Konstrukte miterfasst. Diese angestrebte konzeptionelle Komplexität und bisherige Flexibilität des Konstruktes wirken sich aus dem messmethodischen Blickwinkel auf die interne Konsistenz der Instrumente aus, was man am Beispiel des MOHLAA-Q feststellen konnte. Es liegt nahe, dass die bisherige theoretische Definition generischer Gesundheitskompetenz nur schwer bzw. eingeschränkt mit einem Instrument operationalisierbar ist. Hier stellt sich erneut die Frage nach dem messbaren Kern des Konstruktes generischer Gesundheitskompetenz, seiner konzeptionellen Trennschärfe und zuletzt nach der operationalisierbaren empirisch fundierten Definition von Gesundheitskompetenz. Pleasant et al. rufen in diesem Zusammenhang zu einem iterativen und kontinuierlichen Diskurs auf: „*Definition should be the basis of measurement, but of course, measurement should continually inform definition (...)"*(S.67) [76]. Dabei wird bei der Evaluierung der Gesundheitskompetenz angestrebt, nicht zu erfassen, welche Fähigkeiten Individuen haben, sondern wie sie ihre Fähigkeiten einsetzen. Damit sollte ein eindeutiger Bezug der Gesundheitskompetenz zum Gesundheitsverhalten und zum Gesundheitszustand hergestellt werden können [77].

Abschließend bleibt kritisch anzumerken, dass mit der Evaluierung der Gesundheitskompetenz mittels Selbstangaben diverse Probleme einhergehen, welche bereits bei Studien mit Erwachsenen zur Diskussion standen [77]. Bei der selbstberichteten Gesundheitskompetenz ordnen sich die Befragten generell eher im höheren Kompetenzbereich ein. In diesem Zusammenhang wird auch kritisiert, dass statt

Gesundheitskompetenz eher die Selbstwirksamkeit gemessen wird [64, 78]. Ferner stellt die Studie von Gerich et al. fest, dass Personen mit weniger Erfahrung im Navigieren innerhalb des Gesundheitssystems oder mit einem großen Vertrauen in das Gesundheitssystem potenzielle Schwierigkeiten nicht kennen bzw. unterschätzen [79]. Dadurch schätzen sie auch ihre Fähigkeiten weniger realistisch, sprich höher, ein. Die Ergebnisse der Publikation 3 und Publikation 4 weisen darauf hin, dass das Phänomen der Überschätzung stärker bei Jugendlichen als bei Erwachsenen zum Ausdruck kommt [31, 32]. Dies könnte im Jugendalter mit dem Streben nach einem positiven „Selbstkonzept" zusammenhängen [54]. Noch weniger stabile Resultate bei Selbstauskünften sind bei Kindern zu erwarten, die noch stärker als Erwachsene dazu neigen, Antworten zu geben, die ihren eigenen Wünschen entsprechen oder die als sozial erwünscht interpretieren werden [80]. Es ist also anzunehmen, dass Verzerrungseffekte (aufgrund der Fragenformulierung, der Reihenfolge der Fragen und Antwortoptionen, der Anzahl und Spannweite der Antwortoptionen) bei Selbstangaben stärker zum Vorschein kommen, je jünger die Befragten sind [80, 81]. Bei Jugendlichen ist zudem der Befragungskontext sehr wichtig: Peers, Geschwister und das Setting Schule können die Beantwortung der Fragen stark beeinflussen. Von daher kann das Erhebungssetting (z. B. eine Online-Befragung), welches die Anonymität gewährleistet, helfen, in der Zielgruppe der Jugendlichen aussagkräftige Antworten zu sichern [82]. Hier sollte das Setting Schule, welches stark mit Leistungserwartungen bzw. Prüfungssituationen assoziiert wird, bei Selbsteinschätzungsinstrumenten zur Gesundheitskompetenz eher vermieden werden.

### 4.2. Methodische Stärken und Schwächen

Beide Instrumente wurden stufenweise quantitativ und qualitativ mit Personen aus den Zielgruppen getestet, was aus messmethodischer Sicht als eine große Stärke des Adaptions- und Entwicklungsprozesses zu bewerten ist. Der Einsatz kognitiver Interviews in beiden Zielgruppen erwies sich als eine effektive Methodik zur Verbesserung der Qualität und Akzeptanz der Befragungsinstrumente. Die Standard-Pretests wurden mit umfangreichen Stichproben durchgeführt. Bei dem MOHLAA-Q handelte es sich sogar um eine Validierungsstudie an einer Einwohnermeldeamt-basierten Zufallsstichprobe.

Verschiedene Limitationen in Bezug auf die methodischen Vorgehensweisen schränken jedoch die Aussagekraft der Instrumente ein. Eine wichtige gemeinsame Limitation ist, dass die Zielgruppen bei der thematischen Konzeption, bei der Ausformulierung und der Selektion der Items [19] nicht einbezogen wurden, sondern erst in den späteren Phasen der Testung. Mit der Einbeziehung der Zielgruppen in den früheren Phasen könnte ihr Verständnis von Gesundheitsinformationen und deren Bedeutung, ihre Lebensinhalte und die Relevanz der operationalisierten Themen stärker berücksichtigt werden [19, 75, 83]. Zudem wurde in den kognitiven Pretests nicht ausdrücklich untersucht, inwiefern die gestellten Fragen der soziokulturellen Diversität der Altersgruppen Rechnung tragen.

Des Weiteren wurde bei beiden Instrumenten keine Schätzung der Retest-Reliabilität vorgenommen, welche die Stabilität der Messung in einem zeitlichen Abstand testet [84]. Bei dem MOHLAA-Q wurde die externe Kriteriumsvalidität nicht ausreichend untersucht: Der subjektiv eingeschätzte Gesundheitsstatus

wurde als einziges Außenkriterium betrachtet. Die Befragungsinstrumente wurden zudem nach der Klassischen Testtheorie [84] entwickelt. Hier könnte man alternativ bzw. ergänzend auf die Probabilistische Testtheorie mit ihren entsprechenden Modellen der Item-Response-Theory zurückgreifen, wie in Bezug auf Instrumente zur Gesundheitskompetenzerfassung ausdrücklich empfohlen wird [58, 85]. Diese moderne Testtheorie hat zahlreiche Vorteile im Vergleich zur Klassischen Testtheorie, z. B. ermöglicht eine präzisere Feststellung, welche Items mit welchen psychometrischen Eigenschaften benötigt werden, um zwischen Personen mit verschiedenen Gesundheitskompetenz-Niveaus zu differenzieren [85].

Weiterhin erfordert die Fragebogenentwicklung ein konsentiertes theoretisches Rahmenkonzept der Gesundheitskompetenz, welches auf die jeweilige Altersgruppe und Entwicklungsstufe zugeschnitten ist. In dem HLS-Child-Q15 wurde das theoretische Konzept der Gesundheitskompetenz von Erwachsenen übernommen, dabei deuteten die explorativen Faktorenanalysen definitiv auf eine andere als die theoretisch angenommene Faktorenstruktur hin.

Ferner wurden mit dem Ausgangsinstrument (HLS-EU-Q47) möglicherweise auch seine Schwächen übernommen wie die Diskrepanz zwischen dem theoretischen und operationalisierten Konstrukt, die sperrigen und kognitiv anspruchsvollen Fragenformate oder ein intentionaler ambiguer Charakter einzelner Items. Mittlerweile steht die Anwendung des HLS-EU-Q47 auch bei Erwachsenen in der Kritik [86-88].

Abschließend ist kritisch anzumerken, dass unklar bleibt, inwiefern die Ergebnisse aus den entwickelten Befragungsinstrumenten mit dem Instrument für Erwachsene vergleichbar sind. Falls die Gesundheitskompetenz im Lebensverlauf gemessen werden sollte, müsste zunächst geprüft werden, ob es Kompetenzbereiche gibt, die für alle Lebensphasen relevant sind oder welche Kompetenzen nur für eine bestimmte Lebensphase erforderlich wären.

### 4.3. Implikationen für die Forschungspraxis

Der Mehrwert der vorliegenden Arbeit liegt in der Zusammenführung der methodischen Anforderungen, die bei der Operationalisierung und Messung des Konzeptes der Gesundheitskompetenz in verschieden Altersgruppen zu beachten sind. Die erstmals erstellte Synopse der messmethodischen und inhaltlichen Ergebnisse aus der Instrumentenentwicklung leistet einen Beitrag zur Erforschung und zu einem besseren Verständnis der Gesundheitskompetenz im Kindes- und Jugendalter. Anhand der gewonnenen Erfahrungen aus beiden Studien lassen sich drei Implikationen formulieren, die bei der Entwicklung von Erhebungsinstrumenten für weitere Altersgruppen (z. B. 12- bis 13-Jährige) oder spezifische Bereiche der Gesundheitskompetenz (z. B. zur Erfassung von Food Health Literacy) im Kindes- und Jugendalter von Bedeutung sein könnten.

Erstens zeigte sich, dass bei der Anpassung der für Erwachsene konzipierten Instrumente für jüngere Altersgruppen die Gefahr besteht das Gesundheitskompetenz-Konstrukt im Erwachsenenalter zu übernehmen. Die konzeptionellen Schwächen solcher Instrumente lassen sich mit Hilfe altersgerechter Formulierungen nur bedingt ausbessern. Erhebungsinstrumente für Kinder und Jugendliche sollen zum einen abfragen, was die Zielgruppe aus entwicklungspsychologischer Sicht (entsprechend ihrer Erfahrungsbereiche,

Sprach- und Verständniskompetenzen) in der Lage ist, valide zu beantworten; zum anderen, was Kinder und Jugendliche aus ihrer Perspektive als Gesundheitskompetenz auffassen [75]. Die Erhebungsinstrumente sollten daher von Anfang an partizipativ mit Kindern und Jugendlichen entwickelt und nicht nur mit ihnen getestet werden.

Zweitens sollten der Lebenskontext und die Rolle Erwachsener für die Zielgruppe in den Frageformulierungen berücksichtigt werden. Die Erfassung der Gesundheitskompetenz der Eltern und des Lebenskontextes (Schule-Setting, Schulhort, Sportvereine) bei der Bewertung der Gesundheitskompetenz von Kindern und Jugendlichen komplementiert das Erkennen systembedingter Förderbedarfe [16].

Drittens empfiehlt es sich, zur Evaluierung der verschiedenen Dimensionen der generischen Gesundheitskompetenz bei den betrachteten Zielgruppen das gleichzeitige Einsetzen von subjektiven und leistungsbasierten Messinstrumenten. Auch die Nutzung qualitativer Methoden, wie Beobachtungen bei der Ausführung diverser Aufgaben, Interviews oder PhotoVoice, könnten weitere Erkenntnisse über das Spektrum der Fähigkeiten erbringen.

Mit dem HLS-Child-Q15 und dem MOHLAA-Q wurden die Grundsteine für die Messung der generischen Gesundheitskompetenz in den Bevölkerungsgruppen der Grundschulkinder und der Jugendlichen gelegt. Die erste deutschlandweite Erhebung zur Gesundheitskompetenz von Jugendlichen, in der der MOHLAA-Q zum Einsatz kam, fand bereits statt [89]. Eine ähnliche Studie mit Grundschulkindern ist in Vorbereitung. Die Testung der Instrumente in anderen Anwendungssettings und die Weiterentwicklung sollen an den identifizierten Limitationen der Instrumente anknüpfen. Zudem wäre es erstrebenswert, die Erkenntnisse aus der Messinstrumentenentwicklung auch in der Konzipierung von Gesundheitskompetenz für das Kindes- und Jugendalter stärker zu berücksichtigen.

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## Eidesstattliche Versicherung und Anteilerklärung

### Eidesstattliche Versicherung

„Ich, Olga Maria Domańska, versichere an Eides statt durch meine eigenhändige Unterschrift, dass ich die vorgelegte Dissertation mit dem Thema: „Messung von Gesundheitskompetenz (Health Literacy) bei Kindern und Jugendlichen. Entwicklung und Validierung altersspezifischer Befragungsinstrumente“ [*Measuring health literacy of children and adolescents. Development and validiation of the age-specific survey instruments*] selbstständig und ohne nicht offengelegte Hilfe Dritter verfasst und keine anderen als die angegebenen Quellen und Hilfsmittel genutzt habe.

Alle Stellen, die wörtlich oder dem Sinne nach auf Publikationen oder Vorträgen anderer Autoren/innen beruhen, sind als solche in korrekter Zitierung kenntlich gemacht. Die Abschnitte zu Methodik (insbesondere praktische Arbeiten, statistische Aufarbeitung) und Resultaten (insbesondere Abbildungen, Graphiken und Tabellen) werden von mir verantwortet.

Meine Anteile an etwaigen Publikationen zu dieser Dissertation entsprechen denen, die in der untenstehenden gemeinsamen Erklärung mit der Erstbetreuerin, angegeben sind. Für sämtliche im Rahmen der Dissertation entstandenen Publikationen wurden die Richtlinien des ICMJE (International Committee of Medical Journal Editors; www.icmje.og) zur Autorenschaft eingehalten. Ich erkläre ferner, dass ich mich zur Einhaltung der Satzung der Charité – Universitätsmedizin Berlin zur Sicherung Guter Wissenschaftlicher Praxis verpflichte.

Weiterhin versichere ich, dass ich diese Dissertation weder in gleicher noch in ähnlicher Form bereits an einer anderen Fakultät eingereicht habe.

Die Bedeutung dieser eidesstattlichen Versicherung und die strafrechtlichen Folgen einer unwahren eidesstattlichen Versicherung (§§156, 161 des Strafgesetzbuches) sind mir bekannt und bewusst.“

Datum_____ Unterschrift_____

**Anteilserklärung an den erfolgten Publikationen**

Die Anteile von **Olga Maria Domańska** an den eingebundenen Publikationen verteilen sich wie folgt**:**

**Publikation 1**:

Bollweg, T.M., Okan, O., Pinheiro, P., Broder, J., Bruland, D., Fretian, A.M., **Domanska, O.M**., Jordan, S. und Bauer, U., Adapting the European Health Literacy Survey for Fourth-Grade Students in Germany: Questionnaire Development and Qualitative Pretest. Health Lit Res Pract, 2020. 4(2): S. e119-e128.

**Impact-Factor**: N/A

***Beitrag im Einzelnen:***

- Mitentwicklung des HLS-Befragungsinstrumentes für Kinder: Überprüfung seiner Inhaltsvalidität, Mitarbeit an Fragenformulierungen
- Interpretation der Ergebnisse der kognitiven Pretests in Zusammenarbeit mit dem Erstautor und weiteren Mitautor*innen
- Mitverfassen der ersten und der überarbeiteten Versionen des Manuskriptes: Mitarbeit an dem Kapitel Diskussion, redaktionelle Überarbeitung des Point-by-point Response Letters

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**Publikation 2:**

Bollweg, T.M., Okan, O., Freţian, A.M., Bröder, J., **Domanska, O.M.,** Jordan, S., Bruland, D., Pinheiro, P. und Bauer, U., *Adapting the European Health Literacy Survey Questionnaire for Fourth-Grade Students in Germany: Validation and Psychometric Analysis.* Health Lit Res Pract, 2020. 4(3): S. e144-e159.

**Impact-Factor**: N/A

***Beitrag im Einzelnen:***

- Mitkonzeption der statistischen Analysen zur Fragebogenvalidierung
- Interpretation der Ergebnisse psychometrischer Evaluation des Befragungsinstrumentes für Kinder (HLS-Child-Q15) in Zusammenarbeit mit dem Erstautor und weiteren Mitautor*innen
- Mitverfassen der ersten und der überarbeiteten Versionen des Manuskriptes: Mitarbeit an den Kapiteln Methoden und Ergebnisse, redaktionelle Überarbeitung des Point-by-point Response Letters.

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**Publikation 3**:

**Domanska, O.,** Firnges, C., Bollweg, T.M., Sørensen, K., Holmberg, C. und Jordan, S., *Do adolescents understand the items of the European Health Literacy Survey Questionnaire (HLS-EU-Q47) - German version? Findings from cognitive interviews of the project "Measurement of Health Literacy Among Adolescents" (MOHLAA) in Germany*. Arch Public Health, 2018. 76(1): S. 1-14.

**Impact-Factor:** N/A (2018)

***Beitrag im Einzelnen:***

- Federführung bei der Konzeption des Studiendesigns (Stichprobe, Rekrutierungsstrategie, Methodik)
- Eigenständige Durchführung der Literaturrecherche und Auswahl der relevanten Literatur
- Miterstellung des Interview-Leitfadens für kognitive Interviews mit der Zweitautorin
- Schulung der Interviewer*innen und Qualitätssicherung des transkribierten Materials

- Eigenverantwortliche Erstellung des Datenauswertungskonzeptes und die Abstimmung des Konzeptes mit zwei Mitautor*innen
- Eigenverantwortliche Datenauswertung von 20 kognitiven Interviews, Vorbereitung und Darstellung der Ergebnisse
- Eigenständige Erstellung aller Tabellen (Tab. 1-3, Tab. S1-S3)
- Federführung beim Verfassen der Publikation: Erstellung der ersten kompletten Manuskriptversion, redaktionelle Überarbeitung des Beitrags nach den Hinweisen durch die Mitautor*innen, federführende Überarbeitung des Manuskripts nach dem Reviewprozess

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**Publikation 4**:

**Domanska, O.M.**, Bollweg, T.M., Loer, A.K., Holmberg, C., Schenk, L. und Jordan, S., *Development and Psychometric Properties of a Questionnaire Assessing Self-Reported Generic Health Literacy in Adolescence.* Int J Environ Res Public Health, 2020. 17(8): S. 1-26.

**Impact-Factor:** 2,849 (2019)

***Beitrag im Einzelnen:***

- Federführung bei der Entwicklung des Studiendesigns für die qualitativen Teilstudien (Auswahl der Methoden, Design der Stichprobe, Leitfäden, Studienunterlagen)
- Federführung bei der Entwicklung des Studiendesigns für die schriftliche Befragung (Design der Stichprobe, Studienunterlagen, Zusammenstellung des Gesamtfragebogens)
- Durchführung der Literaturrecherche und Auswahl der relevanten Literatur
- Koordination der Durchführung und Mitauswertung 18 kognitiver Interviews
- Federführung bei der Entwicklung des Befragungsinstrumentes (MOHLAA-Q) für Jugendliche mit den Mitautor*innen
- Eigenständige Datenaufbereitung der schriftlichen Befragung
- Eigenständige Konzipierung und Durchführung aller statistischen Analysen
- Federführung bei der Interpretation der Ergebnisse
- Eigenständige Erstellung von allen Grafiken (Abb. 1-2, Abb. S1-S2) und Tabellen (Tab. 1-5, Tab. S1-S2) im Manuskript
- Federführung beim Verfassen der Publikation: Erstellung der ersten kompletten Manuskriptversion, redaktionelle Überarbeitung des Beitrags nach den Hinweisen durch die Mitautor*innen, federführende Überarbeitung des Manuskripts nach dem Reviewprozess

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## Originalarbeiten als Promotionsleistung

### Adapting the European Health Literacy Survey for Fourth-Grade Students in Germany: Questionnaire Development and Qualitative Pretest

**Publikation 1**

Bollweg, T.M., Okan, O., Pinheiro, P., Broder, J., Bruland, D., Fretian, A.M., **Domanska, O.M**., Jordan, S. und Bauer, U., *Adapting the European Health Literacy Survey for Fourth-Grade Students in Germany: Questionnaire Development and Qualitative Pretest*. Health Lit Res Pract, 2020. 4(2): S. e119-e128.

**Impact-Factor**: N/A

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# Adapting the European Health Literacy Survey for Fourth-Grade Students in Germany: Questionnaire Development and Qualitative Pretest

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**ABSTRACT**

**Background:** Promoting health literacy in early life is regarded as an important means of sustaining health literacy and health over the life course. However, little evidence is available on children's health literacy, partly due to a scarcity of suitable measurement tools. Although there are 18 tools to measure specific items of health literacy for people younger than age 13 years, there is a lack of comparable, valid, and age-appropriate measures of generic health literacy. **Objective:** This study aimed to develop and qualitatively test an age-adapted version of the European Health Literacy Survey Questionnaire (HLS-EU-Q) for German-speaking children age 9 and 10 years. Although validated for adults and adolescents, the HLS-EU-Q has never been age-adapted or used with children. **Methods:** The content and language of HLS-EU-Q items were adapted for this age range. The literature was consulted to inform this process, and adaptations were developed and selected based on consensus among authors. From an item pool of 102 adapted items, 37 were given to 30 fourth-grade students in a cognitive pretest, which is a standard procedure in questionnaire development aiming to explore how items are interpreted. Participants (18 girls, 12 boys) were mostly age 9 or 10 years (range, 9-11 years). **Key Results:** Problems with misinterpretation were identified for some items and participants (e.g., items designed to assess participants' perceived difficulty in accessing and appraising health information were partly answered on the basis of knowledge and experience). A final selection of 26 well-performing items corresponded to the underlying HLS-EU-Q framework. **Conclusions:** This is the first age-adapted version of the HLS-EU-Q. A preliminary 26-item questionnaire was successfully developed that performed well in a cognitive pretest. However, further research needs to verify its validity and reliability. The present findings help to advance the measurement of generic self-reported health literacy in children and highlight the need for cognitive pretesting as an essential part of questionnaire development. **[*HLRP: Health Literacy Research and Practice*. 2020;4(2):e119-e128.]**

**Plain Language Summary**: The European Health Literacy Survey Questionnaire is used for testing adults' health literacy. It was adapted for German-speaking children age 9 and 10 years. Based on a review of the original items and the literature, 26 questionnaire items were developed and tested in interviews with 30 children. Although problems with understanding could be identified, the questionnaire was mostly well understood.

Both researchers and policymakers agree on the importance of promoting health literacy at an early age for empowerment, long-term health, and quality of life throughout the life course (Borzekowski, 2009; Public Health England, 2015). In particular, the World Health Organization (WHO) has recognized health literacy as "a critical determinant of health," stating that health literacy "must be an integral part of the skills and competencies developed over a lifetime, first and foremost through the school curriculum." (World Health Organization, 2017, p. 8) Such propositions, which may potentially determine the kind of skills conveyed to young people and how these are conveyed through the school system, need to be based on solid evidence. However, at present, there are hardly any reliable or comparable data on the devel-

opment and distribution of children's health literacy in different age groups, settings, and countries (Okan et al., 2018).

## MEASURING CHILDREN'S HEALTH LITERACY: STATE OF RESEARCH

Three systematic reviews (Guo et al., 2018; Okan et al., 2018; Ormshaw, Paakkari, & Kannas, 2013) have identified 18 measurement tools used to study health literacy in children (defined here as people younger than age 13 years). These tools differ greatly because they cover a broad range of measurement approaches (self-report, performance test, mixed), of components of health literacy (health knowledge, health-related beliefs, communication, self-management, critical thinking, access to health information, service navigation), and of health areas (general health, oral health, mental health, diabetes, nutrition) (Bollweg & Okan, 2019). Even those tools designed to measure "general" or "generic" health literacy (i.e., health literacy that is not specific for certain diseases or health areas) are hardly comparable due to their focus on different components or topics. Some are tailored for a narrow age range, whereas others were designed originally for adults but are applied to children without any age-related adaptation. Furthermore, some of the identified measurement tools either lack or fail to report any assessment of psychometric properties (Bollweg & Okan, 2019). Hence, there is a need for comparable and validated tools designed to assess health literacy in specific age groups. This applies particularly to Germany, because only two of the identified measurement tools are available in German (Schmidt et al., 2010; Wallmann, Gierschner, & Froböse, 2012). This study addresses this research gap by developing and testing a measurement tool to assess generic health literacy in fourth-grade elementary school children in Germany.

## ADAPTING THE HLS-EU-Q: RATIONALE AND CHALLENGES

We chose the European Health Literacy Survey Questionnaire (HLS-EU-Q) (Sørensen et al., 2013) as the starting point for questionnaire development because its validity and reliability been confirmed in a range of studies in different countries and different settings (Amoah, Phillips, Gyasi, Koduah, & Edusei, 2017; Duong et al., 2017; Nakayama et al., 2015; Pelikan & Ganahl, 2017; Sørensen et al., 2015; Toçi, Burazeri, Sørensen, Kamberi, & Brand, 2015). Furthermore,

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it is built on a comprehensive definition of generic health literacy that goes beyond health care navigation and addresses how people use health information in everyday life (Sørensen et al., 2012). Moreover, a German adaptation of the HLS-EU-Q was already available at the start of this study. Although used with adults and even adolescents, the HLS-EU-Q has never been used with children (Pelikan & Ganahl, 2017). In the interest of comparability and of assessing health literacy across the lifespan, it seems particularly useful to adapt this measurement tool for a younger age group. Although children might have only a limited ability to make their own health-related decisions, assessing health literacy at an early age will make it possible to explore both the emergence of disparities in health literacy and the determinants of health literacy in childhood.

Nonetheless, several critical aspects emerge when adapting the HLS-EU-Q for children. First, it was developed for adults and addresses health-related topics that might not be relevant in children's everyday lives; thus, content-wise adaptations might be necessary. These could relate to, for example, age-specific disease patterns, aspects of dependency, or limited participation in health-related decision making (Okan, Bröder, Pinheiro, & Bauer, 2017). Second, the HLS-EU-Q might be too difficult for fourth-grade students to understand. A study of 14- to 17-year-old adolescents, for instance, revealed that some terms in the questionnaire were not well understood or were even misinterpreted (Domanska et al., 2018). Such problems can be expected to be even more prevalent in younger age groups. Accordingly, extensive adaptations of language and item complexity are necessary to ensure the appropriateness of the questionnaire for children age 9 and 10 years.

## METHODS

### Study Design

We conducted a questionnaire development study to adapt and test HLS-EU-Q items. We carried out two phases of cognitive pretesting to guide the item adaptation and to test its comprehensibility. We also conducted a subsequent quantitative validation study that is reported elsewhere (Bollweg et al., in press).

### Using the HLS-EU-Q

The HLS-EU-Q assesses participants' perceived difficulty in accessing, understanding, appraising, and applying health information in the contexts of health care, disease prevention, and health promotion. Thus, the questionnaire is not a performance test, but assesses "subjective health literacy" or "self-reported health literacy." The HLS-EU-Q has been used in different versions with varying numbers of items, although the 47-item version is in most common use (Pelikan & Ganahl, 2017). We retained the original HLS-EU-Q item format and response categories; hence, each item is phrased: "How easy or difficult is it for you to . . . ?" and answered on 4-point scales ranging from 1 (*very difficult*) to 4 (*very easy*). The HLS-EU-Q is usually administered as a (computer-assisted) personal interview using the aforementioned four response options along with a "don't know" option if participants express this response (Sørensen et al., 2013). In this study, we used the HLS-EU-Q in a paper-and-pencil format and provided "don't know" as an additional response category to avoid arbitrary or unidentified missing responses. We also tested an alternative item format using statements (e.g., "It is easy for me to understand . . .") and a 5-point agreement scale ranging from 1 (*not true at all*) to 5 (*absolutely true*).

### Item Adaptation

We assessed the adaptability of all HLS-EU-Q47 items by examining their content and language. To determine the appropriateness of each item's content, we examined German health reporting and health-related studies. Specifically, we collected information on diseases prevalent among 9- and 10-year-old children, on vaccination status, interactions with health care professionals, medication intake, body perception, and school-related stress. Based on this information, we evaluated whether the items address topics that are important for children's health in the given age group (e.g., a "cold" instead of "high blood pressure"). To rate the appropriateness of each item's language, we screened the literature on child research and the recommendations on item development in certain age groups. We also consulted existing questionnaires used with children in other studies and used this information to further inform the adaptation of HLS-EU-Q items to develop items with a language and grammatical structure that are easier to understand, more concrete, and simpler than that in the original items. However, it was also important to preserve the meaning of the original items and the inherent structure of the questionnaire (accessing, understanding, appraising, and applying health information in the contexts of health care, disease prevention, and health promotion).

We developed adaptations for each HLS-EU-Q item, and three researchers (T.M.B., O.O., P.P.) compared the content, language, and fit of the adapted items with the underlying model (Sørensen et al., 2012). We selected items for each phase of the cognitive pretest, and these items were subsequently re-evaluated and modified. We made our final selection of items after the second cognitive pretest. Decisions were based on a consensus among all authors whose research

backgrounds covered education, medicine, public health, sociology, psychology, and epidemiology.

We embedded the adapted health literacy items in a broader questionnaire that we developed simultaneously. **Table A** presents the different item areas of the overall questionnaire. This article focuses only on the development of the health literacy scale.

### Sample

A convenience sample of 30 children attending 4th grade (age 9 to 11 years) was recruited from two elementary schools in a northern German city. We chose fourth-grade students for this study because in most German federal states, this is the last year before students are allocated to different school tracks. Hence, we could assume that the influence of the school system on the development of students' skills and knowledge in relation to health literacy would still be comparable, because different school tracks had not yet started to influence the acquisition and development of health literacy. Moreover, we could expect children of this age to have sufficiently developed language skills to participate in a written standardized survey.

### Cognitive Pretests

Cognitive interviewing, or cognitive pretesting, is a method commonly used in questionnaire development "to understand how respondents perceive and interpret questions and to identify potential problems that may arise" when using a newly developed questionnaire (Drennan, 2003, p. 57). To verify the comprehensibility of adapted health literacy items, we conducted two cognitive pretests in June and September of 2016. To gain in-depth feedback on a broad range of items, we conducted two phases instead of testing a final selection of items in only one session. In both pretests, participants filled in the questionnaire and were interviewed face-to-face using both general and specific probing questions. General probing questions were, for example, "Did you know right away how to fill out the questionnaire?" or "Was there anything you didn't understand?" (all questions were posed and answered in German; the original German versions of these translations are available from the authors on request). Specific probing questions were related to individual items. For instance, the item ". . . how easy or difficult is it for you to understand why you sometimes need to see the doctor even though you are not ill?" was accompanied by the questions "Did any of you ever need to go to the doctor even though you weren't ill? Why did you need to go?" All interviews were audiotaped and analyzed anonymously. Interviews were conducted by trained staff employed by the cooperation partner responsible for data collection, the Social Sciences Service Centre SUZ (Duisburg, Germany). SUZ staff compiled findings from cognitive interviews in a report that not only summarized individual feedback on specific items but also gave an overall assessment of the performance of the questionnaire.

In the first phase of the cognitive pretest, we gave two different sets of adapted HLS-EU-Q items (12 items, and 13 items, respectively) to three girls and three boys age 9 and 10 years in one-on-one interviews ($n = 6$ in total). We used only the alternative item format in this phase (items formulated as statements with corresponding agreement scale).

Twenty-four participants age 9 to 11 years (15 girls, 9 boys) took part in the second cognitive pretest. In this phase, 24 health literacy items were tested, consisting of 12 well-performing items from the first phase and 12 further items from the item pool. All 24 items were tested in both item formats (original and alternative, 48 items total). We gave 12 of these items to each of four groups of six participants. In this pretest phase, we examined not only health literacy items but also the complete questionnaire (116 items). Due to time constraints, cognitive interviews were also conducted with groups of six children.

### Ethics Approval, Consent for Participation, and Funding

This study was approved by the Bielefeld University Ethics Board (Reference No 2016-141-R), as well as the University Data Protection Officer. Parents or legal guardians provided informed written consent for all participants. Participation was voluntary and participants were informed that all information would be treated with full confidentiality. No incentives were used. This work was carried out within the Health Literacy in Childhood and Adolescence (HLCA) Consortium (www.hlca-consortium.com), funded by the German Federal Ministry of Education and Research.

## RESULTS

### Item Development

We adapted HLS-EU-Q items to better reflect children's health-related experience. We will illustrate this process with two examples: First, based on the fact that a common cold is among the most prevalent diseases in 7- to 10-year-old children (Kamtsiuris, Atzpodien, Ellert, Schlack, & Schlaud, 2007), we changed the item ". . . find information on treatments of illnesses that concern you?" (HLS-EU-Q item 1) to ". . . find information on how to recover quickly when you have a cold?" (all German-language items used in the test are reported in **Table A**). Second, the literature reports that a significant proportion of 11-year-old children in Germany consider themselves to be "too fat" or "too skinny" (HBSC-

Studienverbund Deutschland, 2015). Thus, the item ". . . find information on how to prevent or manage conditions like being overweight, high blood pressure, or high cholesterol?" (HLS-EU-Q item 20) was changed to ". . . find out what you can do so that you don't get too fat or too skinny." All items were adapted in a similar manner to better reflect health areas relevant for children of this age while preserving the original meaning of the item.

The literature reveals only rather vague recommendations and no concrete evidence on language, item complexity, and wording (Vogl, 2012). Comparisons with other questionnaires for 9- and 10-year-old children showed that common practice is to use short and concise items and hardly any conditional clauses (cf. Rees & Main, 2015). Accordingly, we aimed for short and concise items. However, the HLS-EU-Q uses a rather wordy format ("On a scale from very easy to very difficult, how easy would you say it is to . . ."), which is why items could be shortened only to a limited extent.

Several alternative adaptations were developed for most HLS-EU-Q items, and the initial item pool consisted of 102 items. The best adaptation for each item was chosen, aiming for an optimal trade-off between congruence with the original item, target group relevance, and easy language. It needs to be noted, however, that the development of items that address the perceived difficulty of appraising health information was particularly challenging because no data were available on specific instances in which children perform such tasks.

## COGNITIVE PRETEST

### First Phase

Filling in the questionnaires took between 4 and 9 minutes, and consecutive cognitive interviews took between 16 and 33 minutes. Overall, it was easy for participants to fill in the questionnaire, and interviewers noted that the interviewed children's reading ability seemed adequate for the questionnaire content. Some participants were familiar with filling in questionnaires, but those who lacked such familiarity were able to understand the questionnaire instructions. The alternative response format (statements and 5-point agreement scale) was well understood, with all response categories being used. Children reported that it was easy for them to choose an answer, but that they sometimes had to recall memories of specific situations to reply to an item. The structure and layout of the questionnaire were rated positively.

However, specific probing revealed that some items were not understood as intended. For instance, participants were asked to elaborate on their response to the item "It is easy for me to find out how to recover quickly when I have a cold." One participant responded with "my mother usually makes chicken soup for me when I have a cold"; another participant responded "sometimes I know right away, sometimes I don't"; and a third respondent replied by saying "I would ask the doctor first, because he's informed best. Sometimes, I also look up things on the Internet or ask my parents" (all statements were translated from German by the authors). In two of three cases, the term "to find out" was not reflected in the respective responses, implying that these children considered important parts of the item ("recover from a cold"), but also neglected other important parts ("to find out"). This phenomenon was observed in 12 of 25 items. Specifically, items assessing the perceived difficulty of accessing and appraising health information were often misinterpreted as items about knowledge and habits. Nonetheless, one-half of the items (13 of 25) were interpreted as intended. For example, the item "I understand when and how to take my medicine" was commented on with "the doctor prescribed the medicine and told me when to take it. When the doctor tells me to take one in the morning, I'll do that when I wake up."

### Second Phase

In the second pretest phase, filling in the questionnaire (116 items) took between 22 and 45 minutes, and the subsequent group interviews took between 31 and 45 minutes. It was observed that the group of participants was more heterogeneous in this pretest, and two participants were unable to finish the questionnaire within one "school hour" (i.e, 45 minutes). Again, the structure and layout of the questionnaire were rated positively, and most items were understood as intended. For instance, the item ". . . to understand what the doctor tells you" was commented on with "difficult . . . doctors talk so quickly," or "I don't get anything, I can't understand that language." However, once again, we found that some items were not interpreted as intended. For instance, the item ". . . to find out what you can do so you don't get too fat or too skinny" was commented with "I know what I need to do so I don't get too fat: exercise a lot, eat healthy." As this example illustrates, the aspect of "finding out" or "accessing information" was not reflected in the participant's comment. This was the case for some participants whose answers were based on their knowledge and experience regarding the tasks or situations described in each item rather than on the processes of accessing, understanding, appraising, or applying health information.

We revised the items and made a final selection of 26 items that performed best in the cognitive pretests and mirror the different action areas and health domains of the HLS-EU

definition of health literacy. This means that we also included items addressing the perceived difficulty in accessing and appraising information, although we identified these domains as being prone to misinterpretation for some participants. Nonetheless, they were included to allow for statistical analyses in a subsequent quantitative pilot study. **Figure A** presents the items used for the quantitative pilot study together with English translations.

In the second pretest phase, we found no significant differences in how participants responded to either the original or the alternative item format; therefore, we selected the original HLS-EU-Q item format to allow for maximum comparability.

## DISCUSSION

This is the first study to develop an age-adapted version of the HLS-EU-Q. A preliminary 26-item adaptation of the questionnaire was developed for German-speaking children age 9 and 10 years and tested qualitatively. The resulting questionnaire was geared toward the life experience of children at this particular age by taking into consideration both epidemiological data and knowledge gained from childhood studies. Researchers with a range of different professional backgrounds were involved in the development process. This made the process discursive, allowed a critical review of the drafting of an item pool, and permitted a final selection of well-performing items.

The questionnaire developed in this study provides a preliminary tool that draws on previous research and focuses on an age group that has yet to receive much attention in this field. It addresses children's perceived difficulty in accessing, understanding, appraising, and applying health-related information in the contexts of health care, disease prevention, and health promotion. It is also a measure of generic health literacy because it does not focus on just one health topic but addresses multiple topics such as "health-related communication," "nutrition," "health care," and "medication adherence."

This study was also able to highlight some critical aspects when using a version of the HLS-EU-Q adapted for children. Cognitive pretests demonstrated that items that theoretically address four different action areas (i.e., accessing, understanding, appraising, and applying health information) are not identified as such by a portion of the participants. In particular, items designed to assess participants' perceived difficulty in accessing and appraising health information were often answered on the basis of knowledge and habits. In these cases, the respective items did not assess participants' assessment of their capacity to engage successfully in such actions as accessing or appraising health information, but rather their assessment of how knowledgeable they were about the health topic at hand. This relates directly to issues of content and construct validity; when there is ambiguity regarding what is actually being measured (perceived difficulty or knowledge), validity is at stake. Future studies will need to investigate which cognitive processes participants use when responding to individual items and will also need to develop alternatives for specific items that are interpreted in different ways. Nonetheless, these considerations do not compromise the validity of the instrument as a whole because the cognitive pretest has shown that the majority of items are indeed interpreted as intended.

Lastly, it will also be important to investigate whether problems of misinterpretation can also be observed in qualitative tests of the original HLS-EU-Q on adults and adolescents. This will help clarify whether the findings reported here are specific to the target group of 4th-grade students or the particular selection of adapted items presented, or whether they point to more general problems when operationalizing the HLS-EU framework of health literacy. Although the HLS-EU-Q has been used in a notable number of studies (for an overview see Pelikan & Ganahl, 2017), cognitive testing does not seem to be a regular feature in this research. To the best of our knowledge, only three studies give detailed reports on the qualitative testing of the questionnaire (Domanska et al., 2018; Gerich & Moosbrugger, 2018; Storms, Claes, Aertgeerts, & Van den Broucke, 2017). These studies explored how HLS-EU-Q scores interrelate with health knowledge and attitudes (Gerich & Moosbrugger, 2018), and they identified problems due to a misunderstanding of terms (Domanska et al., 2018). They also found that participants with a low level of education had difficulties in indicating which answer applies to them due to abstraction problems and problems in distinguishing between the dimensions "appraising" and "applying" health information (Storms et al., 2017).

## STUDY LIMITATIONS

The first limitation to the present findings is that the reported compilation of items represents one selected portion of a larger pool of items based on the HLS-EU-Q and the framework of health literacy. Although the item selection process was informed by the literature and by cognitive testing, other adaptations of items are possible for certain health topics or in the wording. Future research and further adaptations of the HLS-EU-Q will need to scrutinize the advantages and disadvantages of each approach.

Second, no members of the target group (i.e., children age 9 and 10 years) participated in drafting and selecting items.

Target group participation might have improved the acceptability and relevance of the resulting questionnaire for the target group. However, this could not be carried out due to financial and time constraints.

Third, the psychometric properties of the questionnaire have yet to be investigated. Although the data presented here provide first hints on its dimensionality and reliability, a thorough examination of its validity and reliability is still necessary. This can be conducted only in a quantitative survey, which has also been carried out within the frame of this project. However, due to the limited scope of this article, psychometric properties and validation results are not reported here, but they will be reported in a forthcoming article (Bollweg et al., in press).

Fourth, the HLS-EU-Q, and thus the adaptation that we have developed are self-report questionnaires. As such, they do not provide an assessment of abilities but instead reflect respondents' subjective evaluation of perceived difficulty in dealing with health information. Such subjective evaluation might be based on several factors, including, but not limited to, self-efficacy, knowledge, empowerment, or trust in the health care system (Gerich & Moosbrugger, 2018). Also, such measurement might be prone to self-report bias. However, self-report measures have proven useful in addressing a more comprehensive definition of health literacy (Sørensen et al., 2012) that goes beyond the scope of the most common performance-based health literacy measures: health literacy does not only come into action when patients try to pronounce medical terms (cf. Rapid Estimate of Adult Literacy in Medicine; Davis et al., 1993) or extract information from a nutrition label (cf. Newest Vital Sign; Weiss et al., 2005), but it is used to deal with health information in a variety of situations in everyday life (Sørensen et al., 2012). Unless performance tests are capable of assessing different health literacy skills in everyday situations (e.g., finding, understanding, appraising, or applying health-related information), it has to be acknowledged that "[self-report] approaches to testing the definitions of health literacy in the general public may be an economically and ethically feasible approach that can be built upon" (Pleasant, 2014, p. 1498). Furthermore, self-report and performance-based measures are not necessarily mutually exclusive but instead may be different ways of looking at different aspects of health literacy. In this light, the combined assessment of both self-report and performance-based health literacy seems particularly fruitful.

Finally, it has to be stressed that the items presented here have been investigated only in the German language. The English translations by the authors are only illustrative and have not been subjected to the necessary professional back-translation process when applying English translations to studies of English-speaking children. Also, cultural adaptation and pretesting might be necessary when using the questionnaire in different languages and settings to determine whether all items are appropriate for the respective target groups.

## CONCLUSIONS

This is the first study to deliver an age-adapted version of the HLS-EU-Q. A preliminary 26-item questionnaire was successfully developed that performed well in a qualitative pretest. However, further quantitative and qualitative studies of different samples are needed to verify the questionnaire's validity and reliability. The present findings provide information on advances in the measurement of generic self-reported HL in children and highlight the need for cognitive pretesting as an essential part of questionnaire development.

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*Adapted German items based on the HLS-EU-Q and English translations*

| # | **Wie einfach oder schwierig ist es für dich. . .**<br>(*How easy or difficult is it for you to. . .*) | Domain | Action area | Corresponding HLS-EU-Q item |
|---|---|---|---|---|
| 1 | . . . herauszufinden, wie du bei einer Erkältung schnell wieder gesund wirst?<br>. . . *find out how to recover quickly when you have a cold?* | HC | Access | 2 |
| 2 | . . . etwas über Schnupfen, Halsweh und Husten herauszufinden?<br>. . . *find information about a cold, sore throat, or coughing?* | | | 1 |
| 3 | . . . herauszufinden, was du tun kannst, damit du nicht zu dick oder zu dünn wirst?<br>. . . *find out what you can do so that you don't get too fat or too thin?* | DP | | 20 |
| 4 | . . . herauszufinden, wie du dich im Winter vor einer Erkältung schützen kannst?<br>. . . *find out what you can do to avoid getting a cold in winter?* | | | - |
| 5 | . . . herausfinden, wie du dich am besten entspannen kannst?<br>. . . *find out how you can best relax?* | HP | | 33 |
| 6 | . . . herauszufinden, welches Essen für dich gesund ist?<br>. . . *find out which food is healthy for you?* | | | 32 |
| 7 | . . . zu verstehen, wann und wie du deine Medikamente nehmen sollst, wenn du krank bist?<br>. . . *understand when and how you should take your medicine when you are ill?* | HC | Understand | 8 |
| 8 | . . . zu verstehen, was der Arzt dir sagt?<br>. . . *understand what your doctor says to you?* | | | 5 |
| 9 | . . . zu verstehen, warum du manchmal zum Arzt musst, auch wenn du gar nicht krank bist?<br>. . . *understand why you sometimes need to see the doctor even though you are not ill?* | DP | | 23 |
| 10 | . . . zu verstehen, warum du Impfungen brauchst?<br>. . . *understand why you need vaccinations?* | | | 22 |
| 11 | . . . zu verstehen, was dir deine Eltern über deine Gesundheit erklären?<br>. . . *understand what your parents tell you about your health?* | HP | | 37 |
| 12 | . . . zu verstehen, warum du dich auch manchmal ausruhen musst?<br>. . . *understand why you need to relax sometimes?* | | | 40 |

| # | **Wie einfach oder schwierig ist es für dich. . .**<br>(*How easy or difficult is it for you to. . .*) | Domain | Action area | Corresponding HLS-EU-Q item |
|---|---|---|---|---|
| 13 | . . . zu beurteilen, was gut und was schlecht ist, um eine Erkältung loszuwerden?<br>. . . *judge what helps or does not help to get rid of a cold?* | HC | Appraise | 10 |
| 14 | . . . zu beurteilen, ob es stimmt, was der Arzt dir sagt, damit du wieder gesund wirst?<br>. . . *judge the truth of what the doctor tells you in order for you can get well again?* | | | 9 |
| 15 | . . . zu beurteilen, ob du Medien glauben kannst, wenn sie dich vor Gefahren für deine Gesundheit warnen?<br>. . . *judge whether you can trust the media when they warn you about risks to your health?* | DP | | 28 |
| 16 | . . . zu beurteilen, ob es stimmt, was mit dir später einmal passieren kann, wenn du mit dem Rauchen anfängst?<br>. . . *judge whether what may happen to you later if you start smoking is true?* | | | 24 |
| 17 | . . . zu beurteilen, was viel und was wenig hilft, damit du gesund bleibst?<br>. . . *judge what helps a lot for you to stay healthy and what does not help much?* | HP | | - |
| 18 | . . . zu beurteilen, wie dein Wohngebiet (Nachbarschaft, Stadtteile, Straße) mit deiner Gesundheit zusammenhängt?<br>. . . *judge how where you live (neighborhood, district, street) is connected to your health?* | | | 41 |
| 19 | . . . zu beurteilen, wie dein Verhalten (Bewegung und Ernährung) mit deiner Gesundheit zusammenhängt?<br>. . . *judge how your behavior (exercise and diet) is connected to your health?* | | | 43 |
| 20 | . . . zu tun, was deine Eltern dir sagen, um wieder gesund zu werden?<br>. . . *do what your parents tell you to do so that you can get well again?* | HC | Apply | 13 |
| 21 | . . . deine Medizin so einzunehmen, wie man es dir gesagt hat?<br>. . . *take your medicine in the way you're told to?* | | | 14 |
| 22 | . . . im Notfall einen Krankenwagen zu rufen?<br>. . . *call an ambulance in an emergency?* | | | 15 |
| 23 | . . . dich daran zu halten, was du im Verkehrsunterricht gelernt hast?<br>. . . *stick to what you have learned in road safety lessons?* | DP | | - |
| 24 | . . . zu entscheiden, wann du dir die Hände waschen musst?<br>. . . *decide when you need to wash your hands?* | | | - |
| 25 | . . . dich gesund zu ernähren?<br>. . . *have a healthy diet?* | HP | | - |
| 26 | . . . mitzubestimmen, ob es in der Schule gesundes Essen gibt?<br>. . . *take part in deciding whether healthy food is served at school?* | | | - |

Figure A. English translations are for illustrative purposes only. DP = disease prevention; HC = health care; HLS-EU-Q = European Health Literacy Survey Questionnaire; HP = health promotion.

**TABLE A**

## Topics Assessed in the "Overall Questionnaire" (*N* = 116 items)

| Area | Number of Items | Example |
|---|---|---|
| Sources of health information | 9 | How much do you learn about health from? |
| Seal-reported health literacy | 26 | How easy or difficult is it for you to eat healthy? |
| Dealing with health information | 4 | When you hear something about health, how often do you ask yourself if it is true? |
| Age, sex, language spoken at home, family affluence | 11 | What language do you speak to your mother most of the time?<br>How many bathrooms are there at home? |
| Parental health orientation | 3 | My parents make sure that I eat healthy. |
| Parental health behavior | 2 | How often does your father work out? |
| Health autonomy | 2 | I decide on my own how many sweets I eat. |
| Health knowledge | 5 | If the label on a drink states "less calories," is it healthy? |
| Functional health literacy | 15 | Cloze deletion test for reading and a numeracy test. |
| Health behavior | 4 | How many times a day do you brush your teeth? |
| Cultural capital | 3 | How often do you go to a museum or to an exhibition? |
| Attitudes | 5 | I can do a lot to become a healthy adult. |
| Self-efficacy | 3 | I can find a solution to most problems. |
| Self-reported health status | 4 | How healthy are you? |
| Milieu-related attitudes | 14 | Everybody should have the same opportunities in life. |
| Other | 6 | Please write down the time. |

## Adapting the European Health Literacy Survey Questionnaire for Fourth-Grade Students in Germany: Validation and Psychometric Analysis

**Publikation 2**

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# Adapting the European Health Literacy Survey Questionnaire for Fourth-Grade Students in Germany: Validation and Psychometric Analysis

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**ABSTRACT**

**Background:** Until now, children younger than age 13 years have received little attention in research on health literacy. Although some tools assess children's health literacy, no validated tool is available that assesses self-reported health literacy in a systematic and comparable way. The European Health Literacy Survey Questionnaire (HLS-EU-Q) is a valid and reliable measure of adults' self-reported health literacy. It has also been used among adolescents, but it has never been adapted for use with children. We believe it would be worth adapting for younger age groups so that self-reported health literacy could be assessed continuously. **Objective:** This study aimed to quantitatively test an adapted scale based on the HLS-EU-Q developed for German-speaking children age 9 and 10 years. **Methods:** An adapted 26-item HLS-EU-Q scale was given in a paper-and-pencil survey to 907 fourth-grade students in North Rhine-Westphalia, Germany. The psychometric properties of the scale were investigated with item analysis and factor analyses, and both convergent and discriminant validity were assessed. **Key Results:** Of the 26 tested items, 9 were discarded due to poor performance in terms of missing values, item difficulty, and factor structure. This left a 15-item scale with a high internal consistency ($\alpha = .791$) that takes only a short time to administer. The scale, called the HLS-Child-Q15, had a low correlation with functional health literacy ($r = .107$, $p < .001$), and a moderate correlation with indicators of self-efficacy ($\rho = .280$ to $.306$, $p < .001$). The latter indicates adequate discriminant validity, whereas the former points to a need to further investigate convergent validity. **Conclusions:** This is the first study to apply an age-adapted version of the HLS-EU-Q to children. Statistical analyses indicated the successful development of a promising instrument, but further research is needed on its factor structure and validity. This study contributes significantly to the comparative assessment of health literacy across the life course by providing a measurement tool for children age 9 and 10 years. **[*HLRP: Health Literacy Research and Practice*. 2020;4(3):e144-e159.]**

**Plain Language Summary:** The European Health Literacy Survey Questionnaire was adapted for German-speaking 9- and 10-year-old children, and 26 adapted items were tested in a written survey of 907 children. Item analysis resulted in a 15-item scale with satisfactory psychometric properties. This scale, the HLS-Child-Q15, shows high internal consistency and can be used to assess self-reported health literacy in German-speaking 9- and 10-year-old children. Nonetheless, further studies are needed to validate these results.

There is consensus among researchers and policymakers that the promotion of health literacy (HL) at an early age could be foundational for health literacy, overall health, and quality of life throughout the life course (Borzekowski, 2009; Paakkari & Paakkari, 2012; Public Health England, 2015; Schaeffer, Hurrelmann, Bauer, & Kolpatzik, 2018). In particular, the World Health Organization (WHO) has recognized HL as "a critical determinant of health" and stated that HL "must be an integral part of the skills, and competencies developed over a lifetime, first and foremost through the school curriculum." (WHO, 2017). It could be argued that HL is not important

for children, as it mainly concerns the ability of (adult) patients to understand health care instructions, make appropriate health decisions, and navigate the health care system (Kickbusch & Ratzan, 2001; Ratzan & Parker, 2000). However, in recent years, a public health perspective has been gaining traction in HL research that emphasizes the importance of HL beyond the health care setting. According to a more recent definition, for instance, "health literacy […] entails people's knowledge, motivation and competences to access, understand, appraise, and apply health information in order to make judgments and take decisions in everyday life […]" (Sørensen et al., 2012). Although the scope of health-related decisions that are taken by children may be somewhat limited, it has been shown that children do actively access and appraise health information (Fairbrother, Curtis, & Goyder, 2016). Also, even at a young age, children are able to make health decisions that might affect their health: "A 7-year-old may or may not put on a helmet when riding his or her scooter to school. An 11-year-old has a choice when offered to try a cigarette." (Borzekowski, 2009, p. 287). Accordingly, the promotion of HL early in the life course, as suggested by the WHO, holds the potential to empower children regarding their health and build a foundation for good HL throughout life.

## STATE OF RESEARCH

The promotion of HL should be informed by evidence, so there is a need for appropriate measurement tools to monitor and evaluate interventions (McCormack, Haun, Sørensen, & Valerio, 2013). Currently, however, there is hardly any reliable or comparable data on the development and distribution of HL among children (defined here as people younger than age 13 years). Although three systematic reviews have identified 18 measurement tools that assess HL in this age group (Guo et al., 2018; Okan et al., 2018; Ormshaw, Paakkari, & Kannas, 2013), these tools differ vastly in their measurement approaches, the components of HL they measure, and the health areas they address (Bollweg & Okan, 2019). Most tools have not been developed specifically for children, and some either lack or do not report adequate psychometric properties (Bollweg & Okan, 2019). Accordingly, there is a need for comparable and validated tools designed to assess children's HL. This applies particularly to the context of this

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study (i.e., Germany), because only two of the identified measurement tools are available in German (Schmidt et al., 2010; Wallmann, Gierschner, & Froböse, 2012). This study was conducted to address this gap in research by developing and testing a measurement tool that assesses generic HL in fourth-grade elementary school students in Germany.

## ADAPTING THE HLS-EU-Q

We chose the European Health Literacy Survey Questionnaire (HLS-EU-Q) as the starting point for questionnaire development because its validity and reliability has been confirmed in a range of studies in different countries and different settings (Amoah, Phillips, Gyasi, Koduah, & Edusei, 2017; Duong et al., 2017; Nakayama et al., 2015; Pelikan & Ganahl, 2017; Sørensen et al., 2015; Toçi, Burazeri, Sørensen, Kamberi, & Brand, 2015). The HLS-EU-Q is a measure of self-reported general HL that assesses participants' perceived difficulty in accessing, understanding, appraising, and applying health information in the contexts of health care, disease prevention, and health promotion (Sørensen et al., 2012). As such, it permits a broad measurement of different aspects related to HL instead of just measuring specific HL-related skills in specific contexts only, such as reading comprehension in medical contexts (Sharif & Blank, 2010). However, it needs to be stressed that self-reported general HL is a subjective indicator and does not assess actual skills. Instead, the scope of this measurement covers the perceived ease or difficulty in dealing with health information. This can indicate perceived (individual and system-related) barriers and actual problems in accessing, understanding, or using health information, but it can also indicate in-depth knowledge and an awareness of the ambiguities and lack of evidence to be found in certain health topics.

The HLS-EU-Q has been used with both adults and adolescents but never with children (Pelikan & Ganahl, 2017); therefore, it seems particularly advantageous to adapt this measurement tool for a younger age group in order to obtain comparable and continuous assessments of HL across the lifespan.

## METHOD

### Study Design

We conducted a questionnaire development and validation study, including cognitive pretests, and a quantitative pilot study. This article focuses only on the quantitative study and explores the quality of the instrument regarding its psychometric properties. The questionnaire development process as well as the results of cognitive testing are reported elsewhere (Bollweg et al., 2020). The pilot study was carried out as a cross-sectional survey in school classes using a written, self-administered questionnaire.

### Sample and Data Collection

The target group consisted of children in fourth-grade attending elementary school in North Rhine-Westphalia, Germany, and data were collected only from children. Fourth grade is usually the last year of elementary education in Germany, and the children are age 9 and 10 years. We chose this age group because at this age children can be expected to have the necessary language skills to participate in a written survey, and they also represent an under-researched group with regard to HL. Moreover, starting mostly in fifth grade, children are allocated to the different tracks of the German school system, each featuring specific curricula and areas of focus. Thus, one aim of this study was to perform a baseline measure of children's HL before differences in educational tracks affect the acquisition of HL.

Participants were recruited via schools in an area of about 100 km (roughly 62 miles) around the city of Duisburg, North Rhine-Westphalia, Germany. Data were collected between November 2016 and May 2017. Our cooperation partner, the Social Sciences Survey Center (SUZ, Duisburg, Germany), was responsible for data collection and data entry. Both trained staff and classroom teachers were present during the survey, and the children received standardized instructions. The study was conducted over the course of two school lessons (90 minutes in total).

### Measures

Self-reported HL as measured by an adapted HLS-EU-Q scale constitutes the key focus of this study. Additional indicators of functional HL and self-efficacy were assessed to determine the convergent and discriminant validity of the HL scale. The scales described here were embedded in a larger questionnaire containing a total of 116 items addressing the determinants and outcomes of HL.

### Self-Reported Health Literacy

We measured self-reported HL, operationalized as the perceived difficulty in accessing, understanding, appraising, and applying health-related information in the contexts of health care, disease prevention, and health promotion (Sørensen et al., 2012), with adapted HLS-EU-Q items (see HLS-EU Consortium, 2012, for the original items). We had developed 26 adapted items in a previous phase of this study, described in greater detail in Bollweg et al. (2020). The original HLS-EU-Q

item format and response categories were retained with slight changes in wording. Thus, each item is worded: "How easy or difficult is it for you to . . . ?" and rated on a 4-point scale with the points being 1 (*very difficult*), 2 (*fairly difficult*), 3 (*fairly easy*), and 4 (*very easy*). We added "don't know" as an additional response category, because this option can also be recorded when using the original HLS-EU-Q in personal interviews, although this category is usually not offered explicitly (Sørensen et al., 2013).

### Functional Health Literacy

We assessed functional HL (FHL) in order to determine the convergent validity of HL by developing a 12-item, cloze procedure reading comprehension test based on the Test of FHL in Adults (TOFHLA; Parker, Baker, Williams, & Nurss, 1995). This test was based on an informational text on vaccination published specifically for children age 8 to 13 years (Zentrum für Kinder- und Jugendmedizin Heidelberg, 2011). In line with the TOFHLA, words in the text were replaced by blanks and participants had to fill in the blank by picking out one of four options **(Figure A)**.

### Self-Efficacy

We assessed the discriminant validity of the HL scale by measuring self-efficacy with three items: "I can trust in my knowledge and abilities," "I can find a solution for most problems," and "If I make an effort, I will succeed" on 4-point scales ranging from 1 (*not true at all*) to 4 (*absolutely true*) (all translated from German). Items were selected to indicate different aspects of self-efficacy and were based on scales developed by Reinders, Mangold, and Varadi (2005) and Schwarzer and Jerusalem (1999).

### Demographic Variables

Data were collected from children only, which is why standard indicators of socioeconomic status (i.e., parents' education level, income, and occupation) could not be recorded reliably. Thus, we assessed socioeconomic status with the latest version of the Family Affluence Scale (FAS-III) (Torsheim et al., 2016), a self-report screener developed for the Health Behaviour in School-Aged Children study. The FAS includes six items on material assets at home, such as "does your family own a car, van or truck?" (*no*, *yes*, *one*, or *yes, two or more*), or "how many bathrooms are in your home?" (*none*, *one*, *two*, or *more than two*). Further, we assessed migration background indirectly as the language spoken with both parents, aggregated as "only German with both parents," "German and other language," and "no German at all." We asked for age (years of life) and sex (female/male) with single items.

### Administration Time

Participants were asked to write down the current time at several points in the questionnaire to allow an estimation of administration time.

### Statistical Analysis

We subjected all items to an item analysis (i.e., an evaluation of missing values, item difficulty, variance, and discrimination). Missing values occur when participants do not give a valid answer, such as when they skip a questionnaire item or select *don't know* instead of selecting one of the valid response options that are provided (e.g., *very difficult* or *fully agree*). A low frequency of missing values is desirable, as this indicates that participants understand the question and are able to respond using the options that are provided. Although the literature provides no hard cut-offs for missing values, we took a value of more than 8% as an indicator of comprehension problems. Item difficulty refers to the percentage of participants choosing the correct response, whereby an item difficulty parameter of 100% indicates that each and every participant picked the correct response. However, when applying rating scales (such as for agreement), there is no correct response. Thus, item difficulty in this context refers to the percentage of participants that choose the maximum possible response option (e.g., *fully agree*, *very easy*, *all of the time*). Item difficulty parameters between 20% and 80% are recommended to identify items that are able to discriminate between people with differing levels of the respective trait (Schinka, Velicer, & Weiner, 2003, p. 431). Item variance, too, is concerned with how well an item can differentiate between different respondents. If item variance is zero, all respondents chose the same (not necessarily the maximum or minimum) response, and no differences in the trait under investigation can be observed. Although no hard cut-offs for item variance have been suggested, one recommendation is to select items with higher variance (Kelava & Moosbrugger, 2008). Item discrimination (corrected item-total correlation) relates to whether scores on an individual item correspond to scores on an overall scale. For instance, participants that score highly on the overall HL scale should also score highly on all individual HL items. If this is the case, the individual HL items were able to discriminate between participants with a high and low overall level of HL. For item discrimination, a value of at least .300 is suggested (Streiner, Norman, & Cairney, 2015, p. 84).

We investigated the factor structure of the HL instrument (i.e. the underlying common themes) and different contents (i.e., factors) reflected by its items with exploratory factor analysis (EFA). We extracted factors with principal axis factoring to uncover the underlying latent constructs. We also chose

oblique rotation (oblimin) to allow correlations between factors. Rotation is a standard procedure used to make differences between factors more prominent and to highlight which items belong to which factor. We used Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) test of sampling adequacy to verify that the data were adequate for conducting EFA. We chose a $p$ value of less than .05 and a KMO coefficient of more than .50 to indicate meaningful relationships between the variables of interest (Kline, 1994). We suppressed factor loading coefficients of less than .32 to allow for an easier interpretation of factors (Costello & Osborne, 2005).

We examined internal consistency (i.e. the degree of similarity between the HL items) with Cronbach's alpha and the Spearman–Brown split-half reliability coefficient. Values of .700 or higher indicate sufficient internal consistency (Streiner, 2003), indicating that the individual items measure the same construct. We tested the factor structure implied by the underlying theoretical model with confirmatory factor analysis (CFA), and we evaluated the model fit with the following indices: the relative chi-squared degree of freedom ($\chi^2$/df), the normed-fit index (NFI), the relative fit index (RFI), the incremental fit index (IFI), the comparative fit index (CFI), the Tucker–Lewis index (TLI), and the root–mean-square error of approximation (RMSEA). In essence, CFA tests whether our assumptions about which items belong to which factors are probable or not. Thresholds for acceptable model fit were 5 (upper bound) for $\chi^2$/df, .07 (upper bound) for RMSEA, and .900 to .950 (lower bound) for NFI, RFI, IFI, CFI, and TLI (Hooper, Coughlan, & Mullen, 2008). CFA was carried out in SPSS Amos, version 25 (Arbuckle, 2017); all other analyses were carried out using SPSS Statistics, version 25. We could not calculate the standardized root–mean-square residual (SRMR) in SPSS Amos due to missing data. For correlations between metric variables, we calculated Pearson's correlation coefficient (denoted as $r$); and for correlations between ordinal variables, Spearman's rank correlation coefficient (denoted as ρ). We removed no cases from the dataset, and we did not impute missing values because we used the frequency of missing values as an indicator of item comprehensibility.

### Ethics Approval, Consent for Participation, and Funding

This study was approved by the Bielefeld University Ethics Board (Reference No 2016-141-R), as well as the Data Protection Officer at Bielefeld University. Parents or legal guardians provided informed written consent for all participants. Participation was voluntary and participants were informed that all information would be treated confidentially. No incentives were used.

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## RESULTS

### Sample

A total of 200 schools were invited to participate, of which 32 accepted (16%). Schools had between one and four fourth-grade classes, and the number of students in fourth grade ranged from 19 to 100 (mean = 47.13; standard deviation [*SD*] = 16.73) per school. Of the 1,537 fourth-grade students attending the participating schools, parental consent was obtained for 907 students (59%). About one-half of the sample were girls (53.5%), and most respondents were age 9 (47.3%) or 10 (45.5%) years. Two-thirds of the sample (63.8%) reported speaking only German with their parents. The FAS mean score was 8.64 (range: 0-13; *SD*: 2.35). **Table 1** reports the sample characteristics.

### Item Analysis

**Table 2** presents an overview of the 26 items tested in this survey and the statistics from the item analysis.

***Missing values.*** The frequency of missing values ranged from 3.1% (items 20 and 24) to 20.2% (item 18), with a mean of 7.68% (*SD* = 11.79%) per item. Missing values include "don't know" as well as nonresponse (i.e., item skipped). On average, 1.5% (*SD* = 6%) of responses to the 26-item HL scale were nonresponses, and 6.2% (*SD* = 10.19%) were "don't know." Nine items had a missing rate greater than 8%. These items are marked in **Table 2**. Notably, six of the items with more than 8% missing values assessed the dimension "appraising health information."

***Item difficulty.*** Item difficulty parameters ranged between 58.7% (item 18) and 88.66% (item 24). Eleven items had an item difficulty parameter above 80%. No items were observed in the "difficult" answer spectrum (item difficulty parameter < 20%). Accordingly, 15 items had "medium" difficulty. However, in general, items tended toward the "easy" response spectrum, with an average item difficulty of 76.06%.

***Variance.*** Standard deviations ranged from .597 (item 24) to .897 (item 18) (response range, 1-4), whereas the average *SD* for all items was .755. One item had an *SD* below .6, three items had an *SD* between .6 and .7, 14 items had an *SD* between .7 and .8, and 8 items had an *SD* above .8.

***Discrimination.*** Item discrimination indices (corrected item–total correlations [ITC]) ranged between .255 and .654, with an average ITC of .446. Only one item showed an ITC below .3. Seven items showed an ITC between .3 and .4, 14 items showed an ITC between .4 and .5; and four items showed an ITC greater than .5.

### Exploratory Factor Analysis

We performed EFA to evaluate the latent factor structure of the adapted HLS-EU-Q items. Bartlett's test of sphericity indicated significant correlations, $\chi^2(325) = 2320.34$, $p < .001$, and a KMO coefficient of .915 indicated high strength of relationships between variables. Six factors with eigenvalues greater than 1.0 were extracted that accounted for 48.18% of the variance. In the rotated model, 9 of 26 items did not show factor loadings greater than .32 on any factor, and two factors were defined by one item only. Because it was eventually impossible to interpret factors, we fixed the number of factors to three and four, respectively, in line with the underlying conceptual model encompassing three health domains and four action areas (Sørensen et al., 2012). However, both solutions were unsatisfactory because the hypothesized factors did not correspond with the respective items.

### Item Selection

In our first step, we excluded nine items with more than 8% missing values. These items are noted in **Table 2**. In our second step, we inspected item difficulty parameters and excluded one item (item 24) for being too easy (difficulty: 88.66%) and having the lowest variance of all items (*SD* = .597). However, we retained other items that exceeded the recommended maximum item difficulty of .80 because they otherwise performed reasonably well. We re-examined ITC after item selection, and all items had an ITC above .300 (range: .314 to .555). In total, we excluded 10 items in the item analysis.

### Second Exploratory Factor Analysis

We re-examined the factor structure of the shortened adapted HL scale in a second EFA. Bartlett's test of sphericity indicated significant correlations, $\chi^2(120) = 1441.413$ and $p < .001$, and a KMO coefficient of .870 indicated a high strength of relationships between variables. Three factors were extracted, explaining 39.78% of variance. The factor structure computed without any constraints is displayed in **Table 3**. The three factors had eigenvalues of 4.09, 1.22, and 1.06, and explained 25.6%, 7.62%, and 6.6% of variance, respectively. It should be noted that the three extracted factors did not correspond to the three theoretical factors (health care, disease prevention, and health promotion). Also, fixing the number of factors to four did not yield a factor structure resembling the four action areas of the underlying theoretical model (access, understand, appraise, and apply health information).

Whereas Factor 3 seemed to circle around the topics of medication and vaccination, Factor 1 was defined most strongly by items on healthy nutrition. However, the remaining items loading on Factor 1 pointed to a broader construct than nutrition alone by also addressing such topics as traffic education or communication with parents. Factor 2 is defined by only one item (item 3). Correlations were $r = .232$ between Factors 1 and 2; $r = .592$ between Factors 1 and 3; and $r = .272$ between Factors 2 and 3. The low correlations with Factor 2 point to the multidimensionality of the scale.

**TABLE 1**

**Sample Characteristics (*N* = 907)**

| Characteristic | *N* (%) |
|---|---|
| Sex | |
| Female | 483 (53.3) |
| Male | 408 (45.0) |
| Missing | 16 (1.8) |
| Age (years) | |
| 8 | 6 (0.7) |
| 9 | 429 (47.3) |
| 10 | 413 (45.5) |
| 11 | 44 (4.9) |
| 12 | 5 (0.6) |
| Missing | 10 (1.1) |
| Language spoken with parents | |
| Only German | 579 (63.8) |
| German and other languages | 226 (24.9) |
| No German at all | 82 (9.0) |
| Missing | 20 (2.2) |
| Family affluence scale | |
| 0-5 | 86 (9.5) |
| 6 | 81 (8.9) |
| 7 | 93 (10.3) |
| 8 | 140 (15.4) |
| 9 | 144 (15.9) |
| 10 | 142 (15.7) |
| 11 | 103 (11.4) |
| 12 | 70 (7.7) |
| 13 | 27 (3.0) |
| Missing | 21 (2.3) |

TABLE 2

## Item Analysis

| Question | "How easy or difficult is it for you to…" | Don't know (%) | Nonreponse (%) | Missing total (%) | Mean | Difficulty (%) | *SD* | Variance | Excluded in step | ITC |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | find out how to recover quickly when you have a cold? | 5.5 | 0.9 | 6.4 | 2.95 | 65.06 | .791 | .626 | | .383 |
| 2 | find information about a cold, sore throat, or coughing? | 8.9 | 0.9 | 9.8[a] | 2.91 | 63.57 | .806 | .650 | 1 | .445 |
| 3 | find out what you can do so that you don't get too fat or too thin? | 6.3 | 1.1 | 7.4 | 3.39 | 79.80 | .810 | .656 | | .377 |
| 4 | find out what you can do to avoid getting a cold in the winter? | 2.2 | 1.4 | 3.6 | 3.42 | 80.56 | .707 | .500 | | .419 |
| 5 | find out how you can best relax? | 4.1 | 1.5 | 5.6 | 3.39 | 79.75 | .748 | .559 | | .242 |
| 6 | find out which food is healthy for you? | 3.1 | 1.4 | 4.5 | 3.42 | 80.56 | .707 | .500 | | .419 |
| 7 | understand when and how you should take your medicine when you are ill? | 5.2 | 0.8 | 6.0 | 3.10 | 69.95 | .849 | .729 | | .447 |
| 8 | understand what your doctor says to you? | 2.4 | 1.2 | 3.6 | 3.28 | 75.93 | .730 | .533 | | .430 |
| 9 | understand why you sometimes need to see the doctor even though you are not ill? | 4.1 | 1.3 | 5.4 | 3.54 | 84.62 | .738 | .545 | | .397 |
| 10 | understand why you need vaccinations? | 3.3 | 1.0 | 4.3 | 3.46 | 82.03 | .787 | .620 | | .386 |
| 11 | understand what your parents tell you about your health? | 3.6 | 1.4 | 5.0 | 3.24 | 74.83 | .678 | .459 | | .474 |
| 12 | understand why you need to relax sometimes? | 3.7 | 1.2 | 4.9 | 3.43 | 81.15 | .749 | .562 | | .509 |
| 13 | judge what helps or does not help to get rid of a cold? | 10.0 | 1.4 | 11.4[a] | 2.91 | 63.60 | .761 | .579 | 1 | .588 |
| 14 | judge the truth of what the doctor tells you in order for you to get well again? | 7.1 | 1.7 | 8.8[a] | 3.32 | 77.47 | .727 | .529 | 1 | .431 |
| 15 | judge whether you can trust the media when they warn you about risks to your health? | 16.6 | 1.6 | 18.2[a] | 2.82 | 60.60 | .832 | .692 | 1 | .388 |

**TABLE 2** (*continued*)

## Item Analysis

| Question | "How easy or difficult is it for you to…" | Don't know (%) | Nonreponse (%) | Missing total (%) | Mean | Difficulty (%) | *SD* | Variance | Excluded in step | ITC |
|---|---|---|---|---|---|---|---|---|---|---|
| 16 | judge whether what may happen to you later if you start smoking is true? | 9.6 | 1.8 | 11.4[a] | 3.57 | 85.53 | .800 | .639 | 1 | .451 |
| 17 | judge what helps a lot for you to stay healthy and what does not help much? | 5.8 | 1.7 | 7.5 | 3.15 | 71.63 | .723 | .523 | | .646 |
| 18 | judge how where you live (neighborhood, district, street) is connected to your health? | 18.1 | 2.1 | 20.2[a] | 2.76 | 58.70 | .897 | .805 | 1 | .438 |
| 19 | judge how your behavior (exercise and diet) is connected to your health? | 7.5 | 2.1 | 9.6[a] | 3.35 | 78.33 | .756 | .572 | 1 | .541 |
| 20 | do what your parents tell you to do so that you can get well again? | 1.9 | 1.2 | 3.1 | 3.43 | 81.11 | .654 | .428 | | .385 |
| 21 | take your medicine in the way you're told to? | 2.9 | 1.3 | 4.2 | 3.40 | 80.02 | .744 | .554 | | .477 |
| 22 | call an ambulance in an emergency? | 6.7 | 1.6 | 8.3[a] | 3.33 | 77.56 | .859 | .738 | 1 | .470 |
| 23 | stick to what you have learned in road safety lessons? | 6.1 | 1.6 | 7.7 | 3.48 | 82.52 | .633 | .400 | | .479 |
| 24 | decide when you need to wash your hands? | 1.1 | 2.0 | 3.1 | 3.66 | 88.66 | .597 | .357 | 2 | .382 |
| 25 | have a healthy diet? | 2.2 | 2.1 | 4.3 | 5.41 | 80.34 | .701 | .491 | | .482 |
| 26 | take part in deciding whether healthy food is served at school? | 13.3 | 2.4 | 15.7[a] | 3.21 | 73.73 | .812 | .659 | 1 | .381 |

Note. All items translated from German. [a]More than 8% missing. ITC = item-total correlation.

**TABLE 3**

## Exploratory Factor Analysis

| Question | How easy or difficult is it for you to… | Factor | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| 16 | have a healthy diet? | .701 | - | - |
| 5 | find out which food is healthy for you? | .613 | - | - |
| 15 | stick to what you have learned in road safety lessons? | .433 | - | - |
| 10 | understand what your parents tell you about your health? | .427 | - | - |
| 13 | do what your parents tell you to do so that you can get well again? | .409 | - | - |
| 11 | understand why you need to relax sometimes? | .399 | - | - |
| 12 | judge what helps a lot for you to stay healthy and what does not help much? | .344 | - | .309 |
| 7 | understand what your doctor says to you? | .331 | - | - |
| 4 | find out how you can best relax? | .287 | - | - |
| 2 | find out what you can do so that you don't get too fat or too thin? | .264 | - | - |
| 3 | find out what you can do to avoid getting a cold in winter? | - | .752 | - |
| 6 | understand when and how you should take your medicine when you are ill? | - | - | .532 |
| 9 | understand why you need vaccinations? | - | - | .459 |
| 8 | understand why you sometimes need to see the doctor even though you are not ill? | - | - | .407 |
| 1 | find out how to recover quickly when you have a cold? | - | - | .362 |
| 14 | take your medicine in the way you're told to? | - | - | .338 |

Note. Coefficients smaller than .250 were suppressed for illustrative purposes. Items translated from German.

Therefore, we dropped item 3, and thus also Factor 2, from the scale. **Table 4** presents the final selection of items and also reports the original HLS-EU-Q items on which the adapted items were based.

### Confirmatory Factor Analysis

We retested the factor structure with CFA because we expected, in line with the HLS-EU-Q framework (Sørensen et al., 2012), that the items would assess the perceived difficulty of accessing, understanding, appraising, and applying health information (four factors) in the contexts of health care, disease prevention, and health promotion (three factors). Accordingly, we tested a four- and a three-factor model. However, we could not estimate the parameters of the four-factor model because it was underspecified due to the "appraise" factor being reflected by only one item. Thus, *post hoc* modifications had to be made, and the single "appraise" item was assigned to the most closely related factor, which was "understand." **Table 5** reports the fit indices for all models.

We found no consistently satisfactory fit for either of the models. Although the fit indices $\chi^2$/df and RMSEA indicated an acceptable model fit for all three models, no acceptable values were observed for NFI, RFI, or TLI. The best model fit indices were obtained for Model 2, which assumed that the 15 selected items reflect three different action areas (access, understand, apply health information). This model scored best in all model fit indices. It needs to be noted, however, that the values for NFI, RFI, and TLI were too low to indicate an adequate fit for this model. Moreover, the values for IFI and CFI indicated a sufficient model fit (≥ .9) but fell short of indicating an excellent one (≥ .95).

### Internal Consistency

An alpha coefficient of .791 indicated a satisfactory internal consistency for the 15-item HL scale. Additionally, the split-half reliability was high ($r$ = .771).

### HL Scores

We computed HL mean scores for participants who gave valid responses to at least 12 of the 15 items, which corresponds to a maximum missing rate of 20%. Accordingly, we calculated a mean score for 819 of the 907 participants (90.3%). We did not follow the usual practice in studies using the HLS-EU-Q of transforming scores. This made it easier to interpret mean scores because they related directly to the response format of

**TABLE 4**

## Final Selection of Items for the HLS-Child-Q15

| Question | How easy or difficult is it for you to . . . | Adapted HLS-EU-Q item | Mean | SD | Missing (%) | ITC |
|---|---|---|---|---|---|---|
| 1 | find out how to recover quickly when you have a cold? | 2 | 2.95 | .791 | 6.4 | .357 |
| 2 | find out what you can do so that you don't get too fat or too thin? | 20 | 3.39 | .810 | 7.4 | .341 |
| 3 | find out how you can best relax? | 33 | 3.39 | .748 | 5.6 | .319 |
| 4 | find out which food is healthy for you? | 32 | 3.42 | .707 | 4.5 | .407 |
| 5 | understand when and how you should take your medicine when you are ill? | 8 | 3.10 | .849 | 6.0 | .418 |
| 6 | understand what your doctor says to you? | 5 | 3.28 | .730 | 3.6 | .355 |
| 7 | understand why you sometimes need to see the doctor even though you are not ill? | 23 | 3.54 | .738 | 5.4 | .343 |
| 8 | understand why you need vaccinations? | 22 | 3.46 | .787 | 4.3 | .323 |
| 9 | understand what your parents tell you about your health? | 37 | 3.24 | .678 | 5.0 | .431 |
| 10 | understand why you need to relax sometimes? | 40 | 3.43 | .749 | 4.9 | .452 |
| 11 | judge what helps a lot for you to stay healthy and what does not help much? | - | 3.15 | .723 | 7.5 | .541 |
| 12 | do what your parents tell you to do so that you can get well again? | 13 | 3.43 | .654 | 3.1 | .379 |
| 13 | take your medicine in the way you're told to? | 14 | 3.40 | .744 | 4.2 | .430 |
| 14 | stick to what you have learned in road safety lessons? | - | 3.48 | .633 | 7.7 | .434 |
| 15 | have a healthy diet? | - | 3.41 | .701 | 4.3 | .466 |

*Note.* Items translated from German. HLS-Child-Q15 = Health Literacy Survey Questionnaire for Children.

**TABLE 5**

## Confirmatory Factor Analysis

| Model | Items | Factors | $X^2$/df | NFI | RFI | IFI | TLI | CFI | RMSEA |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1-15 | 1 | 2.933 | .857 | .810 | .901 | .866 | .899 | .046 (95% CI [.040, .053]) |
| 2 | 1-4<br>5-11<br>12-15 | Access<br>Understand<br>Apply | 2.789 | .869 | .819 | .912 | .867 | .910 | .044 (95% CI [.038, .051]) |
| 3 | 1, 5, 6, 12, 13<br>2, 7, 8, 11, 14<br>3, 4, 9, 10, 15 | HC<br>DP<br>HP | 2.882 | .865 | .812 | .907 | .869 | .905 | .046 (95% CI [.039, .052]) |

Note. CFI = comparative fit index; CI = confidence interval; df = degrees of freedom; DP = disease prevention; HC = health care; HP = health promotion; IFI = incremental fit index; NFI = normed-fit index; RFI = relative fit index; RMSEA = root mean square error of approximation; TLI = Tucker–Lewis index; $X^2$/df = relative chi-square.

1 (*very difficult*) to 4 (*very easy*). These mean scores revealed that participants used most of the response range (from 1.86 to 4.00). The resulting frequency distribution was negatively skewed (skewness = –.639; standard error of skewness = .084), and a Kolmogorov–Smirnov one-sample test indicated that scores were not normally distributed ($p < .001$). The mean

score for the whole sample was 3.34 ($SD$ = .37). The correlation between the 15-item scale and the original 26-item set was very high ($r$ = .948, $p$ < .01).

### Convergent Validity

We examined the correlation between HL and FHL to determine the convergent validity. For the newly developed cloze procedure reading comprehension test, we obtained scores of 0 to 12. The distribution of FHL scores was negatively skewed (skewness = -1.52; standard error of skewness = .084). There was also a ceiling effect with 16.3% of participants achieving the maximum score. A correlation coefficient of $r$ = .107 ($p$ < .001) indicated a small but significant statistical relationship between HL and FHL. This supported the assumption that FHL and self-reported HL are related but distinct components of HL.

### Discriminant Validity

We assessed discriminant validity by inspecting the correlation between HL mean scores and self-efficacy scores. For the individual self-efficacy indicators items, we found moderate correlations (ρ = .280 to .306, $p$ < .001). This finding does not support the assumption of discriminant validity, because we hypothesized that HL would be less strongly correlated with self-efficacy than with FHL.

### Administration Time

It took participants 10 minutes ($SD$ = 4 minutes) to fill out the first two sections of the questionnaire containing 9 items on "sources of health information" and the 26 described HL items. Hence, we assumed that the 15-item HL scale could be administered in under 10 minutes.

## DISCUSSION

In this study, a German-language 15-item scale based on HLS-EU-Q items, the HLS-Child-Q15, was developed and tested on fourth-grade students in North Rhine-Westphalia, Germany. It is the first study to explore the feasibility of adapting the HLS-EU-Q for children. The questionnaire developed in this study provides a novel tool that links up with previous research efforts and focuses on an age group that has not yet received much attention in this field of research. The HLS-Child-Q15 is multidimensional in that it captures different health-related topics such as "health-related communication," "nutrition," "health care," and "medication adherence." However, at the same time, it is, statistically speaking, internally consistent because it regards these topics as indicators of just one construct: children's perceived difficulty in dealing with health information. The questionnaire shows a high internal consistency, takes only a short time to administer, and allows an evaluation of the self-reported HL of children age 9 and 10 years. By providing a feasible tool, this study facilitates the building of an evidence base on children's HL, which will enable the development of targeted interventions to improve HL and to mitigate disparities in HL at an early age. However, this study was also able to highlight critical aspects regarding the use of an adapted version of the HLS-EU-Q among children, which we hope will inform further advancements in the measurement of children's HL. In the following text we will discuss our findings regarding item analysis, factor structure, and validity.

### Item Analysis

Item analysis showed that several items led to a rather high number of missing values—in one case up to 20.2%. In our understanding, this points to problems of understanding and helps identify those items that might be unsuitable for the target group. For instance, it seems that items such as "judge how where you live (neighborhood, district, street) is connected to your health?" or "judge how your behavior (exercise and diet) is connected to your health?" might be too complex and abstract. Also, we identified items that do not seem excessively complex or abstract, but still led to a high number of missing values. One example is "find information about a cold, sore throat, or coughing?" In this case, we think that children understand the item but cannot relate to it. In other words, finding information on this topic is not relevant to children's everyday lives because it is most probably something that parents deal with.

Interestingly, all but one item from the area "appraise health information" were discarded in the item selection process due to poor performance. Hence, this area is not reflected adequately in the HLS-Child-Q15. Hence, future studies will need to investigate whether and how this action area can be covered by satisfactorily performing items. Our experience during the item development process indicated that developing items within the domain of appraising health information is particularly challenging because hardly any insights are published on the instances in which children engage in critically appraising health information. Accordingly, our findings highlight that further studies are needed to explore in what everyday situations children critically appraise what specific health information. Such studies will be particularly helpful to enable the development of tools aiming to assess and promote critical HL among children.

We also found that some items were too easy (item difficulty ≥80%), which means that participants often used the high end of the response spectrum (*fairly easy* or *very easy*) instead of using the whole range of response options. This resulted in a negatively skewed distribution of HL mean scores, meaning that the HL scale does not differentiate well in the upper spectrum of HL mean scores. Thus, more difficult items need to be developed to assess the whole range of levels of HL. However, we think that the present HL scale sufficiently captures the variability in HL scores because we observed no significant ceiling effect, and most studies focus on the effects and emergence of limited HL (i.e., scores at the lower end of the spectrum). We found a rather high mean score of 3.34 in this study, which translates to a perceived ease of dealing with health-related information among participants. Although this score is higher than mean scores in other studies, the general trend is comparable to reports on using different versions of the original HLS-EU-Q in different samples (e.g., Berens, Vogt, Messer, Hurrelmann, & Schaeffer, 2016; Duong et al., 2017; Levin-Zamir, Baron-Epel, Cohen, & Elhayany, 2016; Sørensen et al., 2015; Sukys, Cesnaitiene, & Ossowsky, 2017).

### Factor Structure

In this study, we have examined whether the items of the questionnaire that we have developed reflect just one underlying construct (i.e., if the scale is unidimensional), or if they reflect multiple different constructs (i.e., if it is multidimensional). Cronbach's alpha and the split-half reliability coefficient both indicate that the 15-item HL scale has a high consistency, which is associated with unidimensionality. It has to be noted, however, that ITCs are mostly in the moderate range (.300 to .500). This might imply that although the scale is sufficiently consistent, it is not necessarily unidimensional. This is also indicated by EFA and CFA that both suggest at least two latent factors within the HL scale. Future studies should investigate how far these latent factors conform to the factors outlined in the theoretical model of HL, as described by Sørensen et al. (2012), or whether they suggest a different theoretical model. Although, to a certain extent, CFA supports the assumption that different action areas are addressed by the items (i.e., accessing, understanding, and applying health information), EFA indicates a different factor structure that is related to health topics (e.g., vaccination/medication and nutrition) rather than action areas.

In this study, all HL items were considered to be part of one scale, although three or four subscales are usually reported in studies using the original HLS-EU-Q. As we have shown, the "usual" HLS-EU-Q factor structure could not be fully replicated in our adaptation of the questionnaire. This might be due partly to the low number of items used, which is why no subscales could be derived that were internally consistent on their own. However, it is also plausible that the individual items actually do address a very similar construct and not several distinct domains of HL. This, again, is supported by the finding that the model fit indices for the one-factor CFA model are similar to those for the three-factor model. In a similar vein, Paakkari, Torppa, Kannas, and Paakkari (2016) developed a questionnaire to assess HL among adolescents based on five domains of HL that, nonetheless, were summarized under one factor in the final questionnaire (Paakkari et al., 2016). In summary, more research is needed on the factor structure of the HLS-Child-Q15, and also on the HLS-EU-Q and HL in general. We hope that our findings on the factor structure of the HL scale will stimulate further research on the relationship between the different components of HL while also providing impulses for the development of a theory of HL in childhood.

### Validity

In this study, we assessed convergent and discriminant validity by comparing the HL scale with measures of FHL and self-efficacy. Although we hypothesized that HL would relate more strongly to FHL than to self-efficacy, we observed the opposite. This indicates that the operationalization of self-rated HL we applied relates more closely to self-efficacy than previously assumed. This might be due to the notion of "perceived difficulty" inherent in every item of the HL scale, which is why it seems reasonable to control for self-efficacy when applying this scale. We were unable to confirm convergent validity through comparisons with the applied measure of FHL. However, we do not attribute this to shortfalls in questionnaire development but rather to a content-wise and conceptual mismatch between our measure of generic self-reported HL and the chosen indicator. Whereas generic HL and FHL are often referred to in the same context (Nutbeam, 2000; Sørensen et al., 2012), they constitute different aspects of a broader model of HL that are not equivalent. In our case, it seems plausible in hindsight that the perceived difficulty in using health information (self-reported HL), and health-related reading comprehension skills (FHL as measured by the adapted TOFHLA used here) do not correlate highly. Accordingly, it seems fruitful to explore convergent validity with more similar tools. One promising approach might be to test the questionnaire presented here against other questionnaires developed specifically to assess generic HL among young

people (e.g. Brown, Teufel, & Birch, 2007; Paakkari et al., 2016; Schmidt et al., 2010; Teufl, Vrtis, & Felder-Puig, 2019; Yu, Yang, Wang, & Zhang, 2012). Further, the presented findings suggest that it might be worthwhile scrutinizing existing definitions and concepts of HL regarding a more pronounced separation of FHL and self-reported HL. Lastly, it will be important for future studies to examine to what extent self-report HL measures are able to predict health-related outcomes (i.e., if they have predictive validity) when compared to performance-based measures.

## STUDY LIMITATIONS

There are several limitations to this study. For instance, the present questionnaire is an age-adapted version of the HLS-EU-Q that was developed originally for use in adults. Although we have adapted the questionnaire specifically for the target group of fourth-grade students in Germany (for more details on the development process see Bollweg et al. (2020), it was developed neither from scratch to meet their specific needs and idiosyncrasies, nor with their active participation. Accordingly, the questionnaire might be appropriate but not necessarily optimal for use in this age range. This indicates a potential for future studies on the development of HL questionnaires not only for, but also with, children. Moreover, there was little margin for item exclusion because of the rather low number of HL items ($n = 26$) included in the quantitative pilot study. This was because the HL scale was included in a broader questionnaire containing 116 items. Accordingly, there was limited space for including a broader item pool. However, more leeway with respect to item exclusion and scale development could have been achieved by including a larger number of items reflecting the different dimensions of self-reported generic HL.

Moreover, social desirability may have distorted participants' responses, particularly because the survey was conducted within the classroom in the presence of the class teacher. Future research should investigate whether and to what extent the HLS-Child-Q15 scale is prone to social desirability bias. Another limitation is the use of unvalidated measures. Specifically, we used indicators of FHL and self-efficacy that have not been validated in the target group. Although validated, sophisticated assessments of reading skills are available for students in Germany, none were appropriate for use in this study because they either require a long administration time or can be used only in a fee-based license system. Accordingly, a new indicator of functional literacy had to be derived to allow for a time- and cost-efficient assessment. Also, because no brief test of self-efficacy was available in German for 9- and 10-year-old children, we used a compilation of three indicator items. However, it would be preferable to use validated measures.

Moreover, we determined the reliability of the questionnaire with only a one-time assessment. However, it is also important to investigate test stability (retest reliability) by conducting at least one follow-up survey. We were unable to do this due to financial and time constraints. Particularly with respect to the development of HL over the life course, it would seem worthwhile to conduct several repeated assessments. Finally, we would like to point out that all reported findings are based on a German questionnaire tested on German-speaking children. English translations of items are presented here for illustrative purposes but have undergone neither a professional back-translation process nor an evaluation of psychometric properties, and both of these would be necessary before using the questionnaire in English.

## CONCLUSION

This is the first study using an age-adapted version of the HLS-EU-Q for children. Based on a statistical analysis of 26 items tested in a survey of 907 fourth-grade students, a well-performing 15-item scale, the HLS-Child-Q15, was developed. This scale has a high internal consistency and takes only a short time to screen self-reported generic HL in German-speaking children age 9 and 10 years. However, further studies need to explore the factor structure of the questionnaire and its convergent validity, and it also needs to be validated in different languages and settings. Finally, this study contributes significantly to the comparative assessment of HL across the life course by providing a promising measurement tool for children age 9 and 10 years.

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Gleich siehst du Sätze, in denen Wörter fehlen. Wo eine Lücke im Satz ist, siehst du auch immer vier Wörter. Wähle für jede Lücke das Wort aus, das am besten passt! Hierzu machst du einfach einen **Kreis um den Buchstaben vor dem richtigen Wort**.

Hier ist ein Beispiel:

In jede _____ kommt ein _____

| | |
|---|---|
| a. Karte | a. Mensch |
| b. Sonne | (b.) Wort |
| (c.) Lücke | c. Tier |
| d. Kurve | d. Schiff |

Alles klar? Los geht's!

Was ist eine Impfung?

Gegen viele _____ kann man sich impfen _____.

| | |
|---|---|
| a. Unfälle | a. haben |
| b. Krankheiten | b. müssen |
| c. Wartezimmer | c. können |
| d. Katzen | d. lassen |

Die Impfung _____ eine ganz _____ Erkrankung in deinem Körper.

| | |
|---|---|
| a. riecht | a. leckere |
| b. isst | b. dunkle |
| c. verursacht | c. laute |
| d. stört | d. leichte |

Meistens _____ du gar _____ davon, ...

| | |
|---|---|
| a. tust | a. nichts |
| b. merkst | b. viel |
| c. fliegst | c. keines |
| d. schmeckst | d. alles |

... weil der _____ mit diesen wenigen Keimen leicht fertig _____.

| | |
|---|---|
| a. Lehrer | a. geht |
| b. Körper | b. kann |
| c. Zeh | c. wird |
| d. Finger | d. macht |

Von nun an bist du eine bestimmte _____ vor dieser Krankheit _____.

| | |
|---|---|
| a. Person | a. gegangen |
| b. Namen | b. geschützt |
| c. Zeit | c. fertig |
| d. Summe | d. gewaschen |

_____ lange, _____ ist bei jeder Krankheit unterschiedlich.

| | |
|---|---|
| a. Wo | a. das |
| b. Was | b. der |
| c. Wer | c. die |
| d. Wie | d. er |

Figure A. Cloze procedure test that was used to assess functional health literacy. This test was developed based on the Test of Functional Health Literacy in Adults (Parker, Baker, Williams, & Nurss, 1995). A text on vaccination was used as the blueprint of this test that had been specifically developed for children age 8 to13 years (Zentrum für Kinder- und Jugendmedizin Heidelberg, 2011).

## Do adolescents understand the items of the European Health Literacy Survey Questionnaire (HLS-EU-Q47)-German version? Findings from cognitive interviews of the project "Measurement of Health Literacy Among Adolescents" (MOHLAA) in Germany

**Publikation 3**

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# Do adolescents understand the items of the European Health Literacy Survey Questionnaire (HLS-EU-Q47) – German version? Findings from cognitive interviews of the project "Measurement of Health Literacy Among Adolescents" (MOHLAA) in Germany

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## Abstract

**Background:** In Germany, there are no measurement tools to assess the general health literacy of adolescents. The aim of the study "Measurement of Health Literacy Among Adolescents" (MOHLAA) is to develop such a tool for use among adolescents aged 14–17. The German version of the European Health Literacy Survey Questionnaire (HLS-EU-Q47-GER) served as a blueprint for the development of the tool. The present study examined the extent to which the HLS-EU-Q47-GER can be applied to the measurement of general health literacy in adolescents.

**Methods:** The applicability of the HLS-EU-Q47-GER for adolescents was tested qualitatively using cognitive interviewing (CI). Purposive sampling was used to achieve an equal distribution of participants regarding age groups, educational backgrounds and gender. CI was standardized on the basis of an interview guide. Verbal probing and the retrospective think-aloud technique were applied. The interviews were audio-recorded, transcribed and analyzed using the criteria of theory-based analysis, which were derived from the model of cognitive processes. The analysis focused on identifying terms and questions that were difficult to understand and on scrutinizing the extent to which the content of the items is appropriate for assessing adolescents' health literacy.

**Results:** Adolescent respondents were unfamiliar with some terms of the HLS-EU-Q47-GER or provided heterogeneous interpretations of the terms. They had limited or no experience regarding some health-related tasks in health care and disease prevention that are addressed by HLS-EU-Q-items. A few items seemed to be too "difficult" to answer due to a high abstraction level or because they lacked any reference to the everyday lives of youth. Despite comprehension problems with some of the HLS-EU items, the respondents assessed the covered health-related tasks as "very easy" or "fairly easy". CI stressed the importance of interpersonal agents, especially parents, in helping adolescents understand and judge the reliability of health information.

(Continued on next page)

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(Continued from previous page)
**Conclusions:** The results of CI indicated that the applicability of the HLS-EU-Q47-GER to the measurement of general health literacy among adolescents aged 14–17 is limited. In order to prevent biased data, some items of the questionnaire should be adjusted to adolescents' state of development and experiences with health care and disease prevention.

**Keywords:** Health literacy, Measurement, HLS-EU-Q, Qualitative, Cognitive interviewing, Adolescents, Germany

## Background

The health literacy of children and adolescents is receiving increasing attention from scholars and practitioners. This growing interest is based on the assumption that better health literacy skills at a young age will improve health outcomes in adult life [1, 2]. The development of such skills among children and adolescents is even regarded as an opportunity to empower this vulnerable group to be more "engaged" and "productive" citizens [3]. Health literacy is commonly described as the set of health-related knowledge and abilities that enable a person to use resources and to make healthy choices in everyday life [4–6]. In this broad and comprehensive definition of health literacy, there is no restriction to specific aspects of health literacy, such as the use of health information with respect to specific health-related topics (e.g., diabetes literacy, mental health literacy) or contexts or domains (e.g., health literacy in healthcare, functional health literacy) [7, 8]. Health literacy is depicted as a skill that changes and develops through the life course [5]. Hence, acquiring health literacy at a young age may be a base for health-related quality of life as well as a promising approach to disease prevention and health promotion [1, 9].

Adolescence is regarded as a "transitional" stage that involves physical, emotional, and cognitive changes [10, 11]. Young people have to manage different developmental tasks, such as developing their own values and norms or establishing their gender identity [12]. At the same time, this period of life is characterized by an increase in risky behavior (e.g., unprotected sexual activity, dangerous driving, illegal substance use) and perception of vulnerability [13, 14]. In this regard, many studies show that adolescents' health behaviors are linked to health behaviors and health outcomes in later life [15–18]. In addition, in the age of digital technology and easy access to information, young people are constantly using online services, social media, and mobile applications, and they increasingly turn to digital media to answer their health-related questions [19, 20].

The results of the review by Fleary et al. regarding adolescent health literacy and health behaviors suggest that there is a meaningful relationship between health literacy and adolescents' health behaviors. However, this relationship was found in cross-sectional studies in which specific domains of health literacy such as functional and media health literacy were assessed [21]. Little is known about the distribution of general health literacy in adolescents and whether there is a link to their health behaviors. Thus far, no longitudinal studies have examined the predictive value of certain levels of health literacy in childhood and/or adolescence for health outcomes in later life. Accordingly, most statements about the relevance of the early promotion of health literacy are either theoretical or draw on evidence from related fields of research. Reviews of health literacy concepts and measurements in children and adolescents have noted that even though research in this field is increasing, clear definitions and measures – including comprehensive measurement tools – are still in development [9, 22, 23]. Furthermore, Okan et al. specify a need for health literacy measurements that are better suited to the specific health literacy needs of children and adolescents [22].

In Germany, we found only a few studies on adolescents' health literacy; these focused on the measurement of specific health literacy domains, such as health-related knowledge [24] or critical health literacy [25, 26], or they targeted certain age groups of adolescents: 9–13 year-olds [27], 15–29 year-olds [28] or a specific subgroup such as educationally alienated young people [29]. In the project "Measurement of Health Literacy Among Adolescents (MOHLAA)," we aim to develop a self-administered tool to measure the comprehensive concept of heath literacy (general health literacy) among adolescents aged 14 to 17. Because developmental stages differ throughout adolescence from 12 to 19 years of age, the development of a single instrument adequate for all age groups might not be feasible [30]. Hence, we focused here on young people in mid-adolescence, as they become more independent in making their own decisions and their risky behavior patterns increase [31, 32].

We chose the German version of the European Health Literacy Survey Questionnaire (HLS-EU-Q47-GER) as a blueprint for our tool. The HLS-EU-Q47 was developed and validated by the HLS-EU consortium for the comparative assessment of heath literacy among eight European countries [33]. More details about the conceptual model of the HLS-EU-Q47, the development of the

questionnaire, its translation, and its validation are provided by Sørensen et al. [5, 34, 35] and the European Health Literacy Project Consortium [36]. We took the HLS-EU-Q47-GER as a starting point for two reasons. Firstly, this questionnaire is based on a comprehensive conceptual model of health literacy. It focuses not only on health-related tasks in the health care setting but also on such tasks as they relate to health promotion and disease prevention, which are essential target domains for interventions in this age group. Secondly, the HLS-EU-Q47 was already applied in a large international sample – the European Health Literacy Survey, which had 8000 participants, including 1000 from the federal state of North Rhine-Westphalia, Germany. By the time the MOHLAA project started in 2015, the HLS-EU-Q47-GER and its short form (HLS-EU-Q16) had been applied in other studies in Germany [28, 37–39].

An in-depth examination of the applicability of the HLS-EU-Q47-GER among adolescents was deemed necessary for several reasons. The HLS-EU questionnaire was designed according to the Eurobarometer standards for surveys (face-to-face) in adult populations, defined as aged 15 years and above. Although some adolescents (aged 15+) participated in the field pretesting of the HLS-EU-Q47 in Ireland and the Netherlands, no published information is available on the acceptance and applicability of the questionnaire in this age group [35]. We wanted to examine whether the instrument could be applied as a self-administered paper-and-pencil questionnaire if respondents do not have a chance to ask an interviewer for help or explanations. Findings from the Heath Literacy Youth-Study in Austria (15 year-olds) [40] and from a pretest of the "German Health Interview and Examination Survey for Children and Adolescents" (14–17 year-olds) [41] indicate, based on the analysis of missing values and the distribution of responses, that some items of the HLS-EU-Questionnaire may be too difficult to understand for adolescents. The researcher of the Austrian Youth-Study suspected that for adolescents, the difficulty of some items may be due to unknown and incomprehensible terms, or to insufficient experience and knowledge with regard to health care [40]. However, the authors do not report in detail the specific terms that people in this age group find difficult to understand, which may be a reason for the observed numbers of missing responses. Accordingly, no in-depth information is currently available on the specific problems that can arise when using the HLS-EU questionnaire among adolescents. Thus, there is a lack of evidence with regard to whether and how the questionnaire can be revised so that it is appropriate for younger participants. Finally, a measurement tool applicable to adolescents should respond to their unique health-related needs and characteristics by distinguishing children and adolescents from the general adult population (cf. Rothmann et al. [42]) and by taking into account adolescents' conceptualization of health and their health-related knowledge, as explored in other studies of youth [43, 44].

The present study aims to investigate the applicability of the HLS-EU-Q47-GER for measuring the general health literacy of adolescents aged 14–17. The following research questions were examined: (1) To what extent do adolescents comprehend the items of the HLS-EU-Q47-GER? (2) Does the questionnaire consider the specific characteristics of adolescents, e.g., their cognitive abilities and their experience with health-related information?

## Methods

### Sampling and study population

We recruited respondents using a snowball approach according to a purposive sampling strategy [45]. Sampling criteria included age (14–17-year-olds in 4 age groups), educational background (in high school vs. not in high school), and gender (girls and boys). The category "not in high school" included all types of lower- and middle-secondary level schools existing in Berlin's education system at the time.

The sample size ($n = 20$) was chosen based on recommendations for cognitive interviews [46–48]. To recruit the purposive sample, we approached a variety of different venues to reach respondents with a variety of schooling backgrounds. For example, we sought adolescents from youth clubs, girls' clubs and sports clubs in socially disadvantaged city districts and from our research institute's employees.

### Cognitive interviewing

Cognitive interviewing (CI) is an approach that is used to evaluate sources of response error in survey questionnaires [49]. This approach is recommended for use in the early phase of questionnaire development in order to gain insights into the cognitive processes of responding [46, 48–51]. The aims of our CI were (1) to assess the comprehensibility of questions and terms; (2) to explore which personal experiences the given answers were based upon and what type of knowledge adolescents applied while answering the HLS-EU-Q47-GER items.

Mostly, verbal probes (specific and general probes) and retrospective think-aloud techniques [51, 52] were used. General probes after each of the three HLS-EU-Q47-GER subscales asked for non-specific information, e.g., "*How easy to answer were the questions in this section for you*?" or "*Which of the questions was the most difficult?*". The general probe "*Could you answer the questions based on your experiences*?" aimed to examine the extent to which adolescents answered

hypothetically. In turn, specific probes aimed to investigate adolescents' understanding of certain terms, the content of items, or whether adolescents' specific experiences were applicable, e.g.: "*What does the term 'health risks' mean to you?", or "What health risks come to your mind when you think about your friends?"*. When it became apparent during the interview that there was a problem with the questionnaire, e.g., when adolescents spontaneously asked for clarification or they took noticeably longer to give an answer, the interviewers applied ad hoc probes, e.g., "*Is there something that you didn't understand in this question?"*

### Data collection and procedure

The 20 interviews were carried out from December 2015 to March 2016 at the Robert Koch Institute, Berlin, Germany. The interviews lasted between 55 and 110 min. (70 min. on average). Cognitive interviews were conducted in a standardized manner by two interviewers (one 24-year-old female and one 26-year-old male interviewer), who used an interview guide developed by the research team. The interview guide included the detailed interview procedure and the items with their corresponding probes. Sixteen items were tested closely; these items are shown in bold in Table 1, which contains the original HLS-EU-Q items in English. The HLS-EU-Q47-GER (Additional file 1: Table S1) is a translation of the English version that has been verified within the scope of the European Health Literacy Survey [35]. Both versions of the HLS-EU-Q47 were provided by the developers of the instrument. We selected the items based on the findings of the Austrian Youth Study [27] and on theoretical assumptions about the cognitive abilities of adolescents in relation to the item difficulty and complexity [11]. Accordingly, we tested items with a proportion of missing values higher than the 5% observed in the Austrian study (e.g., items 1, 11, 18) and items that included sophisticated, abstract terms as "health risks", "political changes", "effort to promote your health", etc., or inquired about complex, cognitively demanding issues (e.g., item 42 "…judge how housing conditions help you to stay healthy"). Due to time constraints for cognitive interviews, we tested a sample of items that refer to specific domains of the HLS-EU questionnaire; therefore, we report the findings referring only to those domains.

First, the respondents filled out one subscale of the HLS-EU-Q47-GER. Then, they were queried on the whole subscale with general probes, followed by specific probes referring to selected items. This procedure was performed three times, as the HLS-EU-Q47-GER consists of three subscales (Additional file 1: Table S1).

### Data analysis

The interviews were audio-recorded, transcribed and entered into a standardized data analysis sheet by the interviewers. Interviewers' notes were also examined in order to add details to the transcripts. The data were structured according to the recommendation of Prüfer and Rexroth [48]: for each HLS-EU item, a case-specific list of all respondents' statements with the probes was compiled. Then, the data were analyzed by one coder (OD) based on seven analysis criteria. These criteria, which are presented in Table 2, were derived from the general cognitive model of response processes formulated by Tourangeau [53].

Depending on the occurrence of comprehension problems and on the applied probes, the extent to which these criteria were satisfied for each HLS-EU item was examined. The number of unanswered items (missing values) with reported justifications by respondents was considered an additional possible indication of comprehension problems or lack of relevance of the item. Based on the Framework Method described by Collins [54] and Gale et al. [55], we categorized the results of single-item analysis into key themes illustrating the main limitations of the HLS-EU-Q47-GER when used among adolescent respondents.

In order to ensure the "objectivity" [56] of the CI (with respect to application, analysis, and interpretation) different procedures were implemented. The interviewers attended a 2-day training and received feedback on their performance during the training and the field phase from two project researchers (OD/CF). The completeness and accuracy of the transcripts were verified by one member of the research team (CF), who independently coded parts of the transcripts. The entire research team (CF/SJ/OD) discussed the results of the analysis and the implications for the HLS-EU-Q47-GER.

## Results

The sample characteristics are presented in Additional file 2: Table S2. Participants from different age groups and genders were represented. We interviewed a total of $n = 20$ adolescents attending various school types. School types were categorized as (1) upper secondary education level (high school; $n = 6$) and (2) lower and middle secondary education levels ($n = 14$).

### Single-item findings

Detailed results for each item are summarized in Additional file 3: Table S3. 19 HLS-EU-Q47-GER items seemed to work as intended, and participants did not make any relevant remarks. However, due to the time constraints and the research questions, only two of those items were tested in-depth with specific probes. Problems related to **comprehensibility** were

**Table 1** The English version of European Health Literacy Survey Questionnaire (HLS-EU-Q47)

| Introduction text | | On a scale from very easy to very difficult, how easy would you say it is to: |
|---|---|---|
| Response categories | | 1 Very difficult; 2 Fairly Difficult; 3 Fairly Easy; 4 Very Easy |
| No. | HLS-EU-Q dimension | **Subscale: HEALTH CARE** |
| **1**[a] | Access | **…find information about symptoms of illnesses that concern you?** |
| 2 | | …find information on treatments of illnesses that concern you? |
| **3**[a] | | **…find out what to do in case of a medical emergency?** |
| 4 | | …find out where to get professional help when you are ill?<br>*(Instructions: such as doctor, pharmacist, psychologist)* |
| 5 | Understand | …understand what your doctor says to you? |
| **6**[a] | | **…understand the leaflets that come with your medicine?** |
| **7**[a] | | **…understand what to do in a medical emergency?** |
| 8 | | …understand your doctor's or pharmacist's instructions on how to take a prescribed medicine? |
| 9 | Appraise | …judge how information from your doctor applies to you? |
| 10 | | …judge the advantages and disadvantages of different treatment options? |
| **11**[a] | | **…judge when you may need to get a second opinion from another doctor?** |
| **12**[a] | | **…judge if the information about illness in the media is reliable?**<br>*(Instructions: TV, Internet or other media)* |
| 13 | Apply | …use information the doctor gives you to make decisions about your illness? |
| 14 | | …follow the instructions on medication? |
| 15 | | …call an ambulance in an emergency? |
| 16 | | …follow instructions from your doctor or pharmacist? |
| | | **Subscale: DISEASE PREVENTION** |
| 17 | Access | …find information about how to manage unhealthy behaviour such as smoking, low physical activity and drinking too much? |
| **18**[a] | | **…find information on how to manage mental health problems like stress or depression?** |
| 19 | | …find information about vaccinations and health screenings that you should have?<br>*(Instructions: breast exam, blood sugar test, blood pressure)* |
| 20 | | …find information on how to prevent or manage conditions like being overweight, high blood pressure or high cholesterol? |
| 21 | Understand | …understand health warnings about behaviour such as smoking, low physical activity and drinking too much? |
| 22 | | …understand why you need vaccinations? |
| **23**[a] | | **…understand why you need health screenings?**<br>*(Instructions: breast exam, blood sugar test, blood pressure)* |
| 24 | Appraise | …judge how reliable health warnings are, such as smoking, low physical activity and drinking too much? |
| 25 | | …judge when you need to go to a doctor for a check-up? |
| 26 | | …judge which vaccinations you may need? |
| 27 | | …judge which health screenings you should have?<br>*(Instructions: breast exam, blood sugar test, blood pressure)* |
| **28**[a] | | **…judge if the information on health risks in the media is reliable?**<br>*(Instructions: TV, Internet or other media)* |
| 29 | Apply | …decide if you should have a flu vaccination? |
| 30 | | …decide how you can protect yourself from illness based on advice from family and friends? |
| 31 | | …decide how you can protect yourself from illness based on information in the media?<br>*(Instructions: Newspapers, leaflets, Internet or other media?)* |
| | | **Subscale: HEALTH PROMOTION** |
| 32 | Access | …find information on healthy activities such as exercise, healthy food and nutrition? |
| **33**[a] | | **…find out about activities that are good for your mental well-being?**<br>*(Instructions: meditation, exercise, walking, pilates* etc.*)* |

**Table 1** The English version of European Health Literacy Survey Questionnaire (HLS-EU-Q47) *(Continued)*

| Introduction text | | On a scale from very easy to very difficult, how easy would you say it is to: |
|---|---|---|
| **34**[a] | | **…find information on how your neighborhood could be more health-friendly?** *(Instructions: Reducing noise and pollution, creating green spaces, leisure facilities)* |
| **35**[a] | | **…find out about political changes that may affect health?** *(Instructions: legislation, new health screening programmes, changing of government, restructuring of health services* etc.*)* |
| **36**[a] | | **…find out about efforts to promote your health at work?** |
| 37 | Understand | …understand advice on health from family members or friends? |
| 38 | | …understand information on food packaging? |
| 39 | | …understand information in the media on how to get healthier? *(Instructions: Internet, newspapers, magazines)* |
| 40 | | …understand information on how to keep your mind healthy |
| 41 | Appraise | …judge where your life affects your health and well-being? *(Instructions: Your community, your neighbourhood)* |
| **42**[a] | | **…judge how your housing conditions help you to stay healthy?** |
| 43 | | …judge which everyday behavior is related to your health? *(Instructions: Drinking and eating habits, exercise* etc.*)* |
| 44 | Apply | …make decisions to improve your health? |
| 45 | | …join a sports club or exercise class if you want to? |
| **46**[a] | | **…influence your living conditions that affect your health and wellbeing?** *(Instructions: Drinking and eating habits, exercise* etc.*)* |
| **47**[a] | | **…take part in activities that improve health and well-being in your community?** |

[a]Items tested with specific probes are shown in bold. HLS-EU-Q dimensions are not shown to the respondents

identified for 21 items. More specifically, we found items that included an unknown/ambiguous term (items 1, 11, 17, 18, 19, 20, 23, 33–36, and 47), had unclear wording or meaning (items 7, 9, 10, 13 and 46), or had a challenging level of abstraction (items 35, 41–43). Moreover, problems were identified concerning the **relevance of items** for the age group: respondents either lacked the required experience to give a reasoned answer (items 6, 10–13, 18 and 40), or items were not applicable to the age group (items 22, 23, 26, 27 and 29). Items with the largest proportion of missing values (3–4 of 20), potentially indicating both of these problems, were identified in the health promotion subscale (items 34, 41, 43 and 47). Issues relating to the comprehensibility and relevance of items were also observed in combination. For

**Table 2** Standardized analysis criteria applied to the cognitive interviews of the MOHLAA study in Germany (12/2015–03/2016)

| Cognitive processes by Tourangeau | Criterion | Corresponding research questions |
|---|---|---|
| Comprehension of the item wording | **C1** Sentence structure/grammar | Is the sentence syntax of the item clear?<br>Is the wording of the item immediately/easily understood? |
| Comprehension of the intention of the question | **C2** Comprehensibility of item content | Is the item understood as intended?<br>Was the item interpreted similarly by different respondents? |
| Comprehension of the meaning of the terms | **C3** Understanding of terms/hints | Could a proper definition of the term be given?<br>Was a given definition unambiguous?<br>Were hints in the item comprehensible and familiar? |
| Retrieval of relevant information from memory | **C4** Difficulty | Was the item assessed as "easy" or as "difficult" to answer?<br>Why was it assessed as "difficult"? |
| | **C5** Experience/knowledge | What type of knowledge and experience were recalled?<br>Is the given answer based on any experience or related to an abstract idea/concept? |
| Decision process, Motivation, sensitivity, social desirability | **C6** Reliability of the response | Does the reported justification of the given response suggest that the item evokes a tendency of social desirability?<br>Which motivation might underlie the given answer? |
| Response process | **C7** Accordance of the formal response category with an internal ascertained response category. | Can respondent find his/her answer option on the response category scale? |

example, participants did not understand the term "*Unterstützungsmöglichkeiten"* (possibilities for support) in the context of mental health, and they could not relate to the item, as the majority of respondents reported that they had never had to address mental health problems.

Additional file 3: Table S3 includes conclusions we derived from the results that may be useful for researchers interested in the adaption of the HLS-EU-Q for adolescents. These conclusions go beyond of the scope of the primary research question and are therefore not discussed in detail.

### General findings concerning comprehensibility and relevance for adolescents

Data analysis revealed five dominant themes: (1) Unfamiliar terms or ambiguous interpretations of terms (comprehensibility); (2) Challenging level of abstraction (comprehensibility); (3) Lack of experience and knowledge (relevance); (4) Mapping the response options, and (5) Importance of parents (relevance). These findings are presented in detail in the following.

### Unfamiliar terms or ambiguous interpretations of terms (comprehensibility)

Adolescent respondents were unfamiliar with certain terms in the HLS-EU-Q47-GER. This became evident when participants were asked to explain, in their own words, the meaning of a term or to provide an example for this term. For instance, four respondents reported not knowing the term "*Krankheitssymptome"* (symptoms of illnesses; item 1), although most respondents (15/20) were able to define it and give appropriate examples. One person was not able to describe the term correctly. However, only two of the four respondents who did not know the term left the question unanswered. A further example for a difficult term was "*Gesundheitsrisiken"* (health risks; items 20 and 28). One respondent interpreted the term incorrectly as the risk of having any symptoms or disorders whilst being ill (ID_11)[1]: "risk of losing blood because of having a certain disease", or "breathing difficulties using the stairs when having asthma". Another description of this term was the probability of becoming ill if one did not visit a doctor regularly (ID_14).

Regarding the health-related tasks addressed in some items (e.g., items 23, 27, and 36), respondents had difficulties giving examples of their own experience. When they were asked to give an example for *"Angebote zur Gesundheitsförderung"* (efforts to promote health; item 36), they mostly thought of hygienic preventive measures at school/in the workplace, such as "washing one's hands", "brushing teeth," or an ergonomically equipped workplace/school. The statements of two respondents expressed noted a lack of personal experience: they were not yet working, and a school, in their opinion, was "a healthy place", which is why they saw no need for health promotion. Other incorrect examples given were "First Aid Course", "drug prevention classes".

The specific probes showed that the terms "*Wohnumgebung* (neighborhood; item 34)", *"Wohnverhältnisse"* (housing conditions; item 42), and "*Lebensverhältnisse"* (living conditions; item 46) were fairly broad and understood in different ways by the respondents. For example, the term "housing conditions" (item 42) was defined as conditions connected to the flat/house respondents lived in ("light conditions", "flat size", "equipment", "cleanliness"). Other respondents understood the term as a condition of the spatial environment, related to where one lives ("living place", "part of the town") or as a social dimension of living together ("neighbors", "persons with whom one lives").

### Challenging level of abstraction (comprehensibility)

In several items of the health promotion subscale, respondents had to establish a link between their idea of health and the following complex concepts: their living environment (item 34 and 41), political changes (item 35), housing conditions (item 42), everyday behaviors (item 43), and living conditions (item 46). In order to give a valid response, the respondent needed to know the meaning of the specific terms, to connect this meaning to their personal life and to abstract how it affects their health.

The complexity and difficulty of these tasks are well illustrated by the example of item 35. Firstly, the term "*politische Veränderungen* (political changes)" was not clear to the respondents, nor were the examples given in the German version of the item ("legislation, new preventive programs, a change of government, health care reform"). Secondly, most respondents, when asked to name "a political change" that impacted someone they had known, were not able to give an example (12 out of 20). Thirdly, several respondents (5/20) expressed difficulties understanding the connection between health and political changes:

ID_10: "To what extent does a change of government affect my well-being? (...) I mean, if now they do not change any laws (…) I don't understand that."

Other adolescents reported not having any interest in political issues:

ID_08: "I do not really know much about the legislation on health or any health reforms, or anything, so I never really get involved with it, but I think, it would be not so difficult to find out about it, if you just sit down and do a search somewhere".

ID_12: "When we talk about politics at school, I really do not care about it".

Comparable results were found concerning the connection between housing conditions and their impacts on respondents' health (item 42). The term "*Wohnverhältnisse* (housing conditions)" was defined heterogeneously, as described above. Though some of the respondents were able to comprehend the connection between "housing conditions" and "health", this specific topic barely seemed related to their lives:

ID_04: "I just do not think about it."

Similarly, some of the respondents found it "difficult" for young people their age to make a statement on the matter.

### Lack of experience and knowledge (relevance)

The respondents had limited or no experience in managing some of the health-related tasks addressed by the items. For example, this was the case for items 11, 23, and 27. Though most respondents had an idea of what "*zweite Meinung von einem anderen Arzt*" (a second opinion from another doctor, item 11) meant, only a few respondents had experienced such a situation themselves. Instead, the participants answered the question with respect to what they would do in such a case, or in what type of situation they would need to contact another doctor. However, twelve out of twenty respondents found it "fairly easy" or "very easy" to judge when they needed to get a second opinion from another doctor. Further, two respondents mistook the action of getting a "second opinion" for getting a referral.

ID_10: "When I go to the physician and he is telling me to go to a surgeon or to a dermatologist, or physiotherapist - I have experienced it all."

Approximately half of the respondents (9/20) did not believe (7/9) or did not know (2/9) whether their friends of the same age had ever gotten a "second opinion from another doctor".

Probes on items 23 and 27 revealed little experience or specific knowledge about "*Vorsorgeuntersuchungen* (health screenings)" among the respondents. Most adolescents were able to explain this term. However, four respondents did not distinguish this type of medical examination from other common examinations that are conducted because of initial symptoms of illness, because of health problems, or in order to clarify the self-diagnosis. Not all respondents had a clear idea of which disease could be detected with the health screenings given as hints ("cancer screening, blood glucose test, blood pressure"). Cancer screenings were the best-known health screenings, followed by the blood glucose test. However, the adolescents had difficulties giving an example for a disease linked to blood pressure. Only two respondents gave an example of the recommended screenings or preventative measures related to their age, e.g., "vaccination against cervical cancer".

Another item related to experiences in health care is item 10 (… to judge the advantages and disadvantages of different treatments). Although this item was not tested using specific probes, the interviewers noticed that more time was needed to answer the item compared with other items. Two respondents made spontaneous remarks about not having the experience or appropriate skills to perform this task.

### Mapping the response options

Even though respondents admitted to knowing only little about certain health-related topics, or to having little experience related to these topics, they estimated their ability to access, understand, judge, and apply health-related information as sufficient ("fairly easy" or "very easy") (Table 3). In particular, searching for health information (e.g., items 1, 3 and 33) was perceived by adolescents as easy because of easy access to the Internet:

ID_07: "I was thinking about Google, you can just google many things".

ID_08: "Before I went to the doctor, I looked on the Internet first; because (…) I think it will be the easiest way. There (…) you put in a symptom and then it spits something out to you".

When respondents reported not knowing a term, or when they misunderstood a question, they usually gave a response instead of skipping the question. In such cases, other respondents chose the response option "fairly difficult," as shown by the first two examples in Table 3.

A further issue discovered through the cognitive interviews was the poor ability of participants to evaluate the "trustworthiness" of health information in the media. Our respondents almost exclusively provided proxy, secondary indicators, such as "reliability of the information source" or "reputation of the media source" based on preconceived opinions or generalizations. They also mentioned particular information sources such as "television", "websites without advertisement" or "science press" as sources they usually trusted, or as information sources they would not trust.

ID_01: "I would not at all look for this on the internet, maybe in case of something harmless…".

ID_08: "…also something like the yellow press, I would not trust (…), but I trust just the public news service or something more serious, or any medical or scientific websites, or magazines… I would trust it rather than any gossip-press."

However, it was not possible to verify to what extent they were really capable of appraising sources of health information in terms of their cognitive age-related developmental stage. These demanding competencies were even questioned by the adolescents themselves: "Not at all, it is too difficult."(ID_11).

**Table 3** Case examples of mismatches between selected response and revealed abilities in the cognitive interviews conducted in Germany (12/2015–03/2016)

| Ability addressed in the item | | Revealed ability using specific probes | Selected response category[a] | "Problematic" issues |
|---|---|---|---|---|
| Access | **Item 1** …to find information about "symptoms of illnesses" | ID_14 reported not knowing the meaning of "symptoms of illnesses". | "fairly difficult" | Respondent answered the item without knowing the meaning of a term. |
| | | ID_17 asked what "symptoms of illnesses" means. | "fairly difficult" | |
| Understand | **Item 6** …to understand leaflets | ID_07: "I don't read leaflets but if I did, I would understand them". | "fairly easy" | Discrepancy between reported knowledge/experience and self-estimated ability |
| | | ID_12 reported that he had never read a leaflet completely. He had rather listened to what the doctor said. | "fairly easy" | |
| Judge | **Item 11**…to judge when you may need to get a second opinion from another doctor | ID_09 confirmed difficulties in judging whether a doctor counseled someone wrong when a person is not familiar with the topic. He visited another doctor only once or twice. | "fairly easy" | Discrepancy between reported knowledge/experience and self-estimated ability |
| | | ID_17 reported getting a second opinion "not often". | "fairly easy" | |
| | **Item 28** …to judge if the information on health risks in the media is reliable | ID_02 doubted being able to easily judge information in the media. | "fairly easy" | |
| Apply | **Item 47**… to take part in activities that improve health and well-being in your community | ID_06 gave "charitable donation" as only one example of "activities improving health". His unique experience referred to a "charity run" that he took part in. | "very easy" | Term/item misunderstood, discrepancy between reported knowledge/experience and self-estimated ability |
| | | ID_16 did not understand the item, described the "activities improving health" as a type of experience. The respondent was not able to understand how this type of experience is connected to health. | "fairly easy" | |
| | | ID_17 interpreted the term "activities" as an action relating to a person, for example giving advice to a friend about exercising if he were "too fat". | "very easy" | |

[a]self-estimated ability
Results: cognitive interviews with adolescents living in Berlin (Germany) conducted in the MOHLAA study

The responses "very difficult" or "fairly difficult" were ticked when respondents did not know how to appraise the reliability of information (4/20), as well as in the opposite case, when they seemed to have critical thinking skills and recognized the difficulty of the task (2/20).

### Importance of parents

Moreover, adolescents often reported that their parents judged the reliability of information, explained the content of information (e.g., leaflets), and made health-related decisions about vaccinations and nutrition for them. They also reported turning to their parents when they felt sick or stressed.

Interviewer: "…if something was reported in the media, for example about vaccination or something similar, would you do it?"

ID_06: "Yes, if my mother would say that it is okay, I would do that".

Interviewer: "But, I mean…you don't look for any information on the Internet then, do you? …if you're not well…?"

ID_06: "No, I trust my Mum".

The adolescents relied on their parents' knowledge and abilities and did not question their competencies.

## Discussion

The study showed that adolescent respondents had difficulties in completing the HLS-EU-Q47-GER when they were unfamiliar or inexperienced with the topics addressed. We identified unknown terms and heterogeneous interpretations of the same terms. The HLS-EU-Q47 was originally designed based on a relational concept of health literacy and focuses highly on interaction and application; however this may be problematic due to lack of experience within this particular age group. As adolescents have limited or no experience related to items on the health care and disease prevention, it is very difficult for them to

realistically evaluate the required health literacy skills. The items assessing participants' own abilities to judge and apply information about the effects of different settings on health proved to be too demanding for adolescents, or they were perceived as not interesting or as irrelevant for their daily lives.

Despite not knowing a specific term or misunderstanding the content of an item, adolescents still ticked a response rather than not responding, or they ticked the response "very/fairly difficult". As a result, ticking such response options may reflect difficulties in understanding the item wording in some cases, rather than just respondents' perceived difficulty in managing a health-related task. Therefore, the extent to which the self-estimated difficulty of the addressed health-related tasks reflects the knowledge of the terms used in the questionnaire remains unclear. However, the critical issue we observed was that these responses did not clearly indicate lower health skills. Even when respondents ticked the option "difficult", further clarification would be required to determine whether the respondents would give a different answer if the items' wordings were replaced with familiar and simpler terms.

All mentioned issues may lead to biased responses and jeopardize the validity and reliability of the questionnaire when applied among adolescents. Hence, we conclude that the questionnaire in its current form is only partly appropriate for adolescents aged 14 to 17. Several terms are subject to misinterpretation or problems of comprehension and thus fail to provide valid data. Lastly, our interviews verified the importance of interpersonal agents, especially parents, for making health-related decisions and interpreting health information. Parents were also mentioned to be the most reliable source of information.

### Impact of respondents' experiences on the reliability and validity of responses

Our findings regarding adolescents' prior experience and their assessments of the difficulty of certain tasks are consistent with the findings of a study by Röthlin et al. [40]. In that study, conducted with 15 year-old adolescents, a weaker correlation was found between functional health literacy, as assessed by the Newest Vital Sign [2, 57], and their subjective health literacy score measured by the HLS-EU-Q47, as compared to a similar study in adults. This finding was explained by adolescents' limited experience with decision-making: On the one hand, adolescents are less frequently exposed to health decision-making due to their better overall health status; on the other hand, most of the important decisions at this age are made by parents or legal guardians. In comparison with older age groups, adolescents may judge the complexity and difficulty of such situations more based on expectations and much less on experience [40].

A methodological study ($n = 188$) with younger (aged 11–13) and older adolescents (aged 16–18) by Diersch and Walther suggested that younger respondents hardly seemed to have strong attitudes and concrete experience, especially towards some abstract topics they could not relate to, such as environmental protection. This may lead to a stronger orientation within the context of the questionnaire whilst answering [58]. The study indicated that particularly in the younger age group (11–13), the absence of strong attitudes towards a certain topic was expressed in the tendency toward socially desirable answers.

An association between lack of experience and biased responses was also observed in a study with adults (aged 18 years and older) by Gerich et al. [59]. The Austrian study aimed to investigate individual experiences and factors that are associated with high and low values of self-assessed health literacy, as measured by the short version (HLS-EU-Q16). Gerich et al. claimed that potential difficulties in performing health-related tasks are sometimes not recognized because respondents are not aware of the challenges related to a task. Thus, such hypothetical tasks tend to be judged as easy. In contrast, greater reflection upon health issues or more health-related experience may lead to lower scores on the HLS-EU-Q, much like a lack of general knowledge of how to address a certain situation can lead to low scores [59].

### Biased answers towards overestimation

We have interpreted the inconsistencies between difficulties expressed during probes and responses given in the questionnaire ("fairly easy" and "very easy") as instances of overestimation. The "positive" self-estimation of health literacy by our respondents can be explained by the nature of self-report instruments. The problem of discrepancy between self-reported perceived health literacy and the objective estimation of health literacy with performance-based instruments was already discussed by Frisch et al. [60]. Screening questions, such as those of the HLS-EU-Q47, are based on self-reports, reducing the likelihood of people feeling ashamed and embarrassed when their health literacy abilities are tested directly by a performance test. The major weakness of self-estimation questions is that they are likely to assess self-efficacy or behavior instead of health literacy [60]. The question that arises from our study–what assessment approach (self-estimation versus performance-based instruments) is more appropriate for our target group?–requires further methodological studies. The current state of research on health literacy in childhood and adolescent indicates that both methods are useful and should be used complementarily in a mixed-mode approach [22].

Biased answers could also be caused by the design of the current study, particularly the interview situation [58] or the social context of the interview [61]. Those factors could explain the finding that the majority of the respondents reported not having experience with mental problems, which is a rather socially desirable answer to this sensitive topic. It is possible that participants would give more "honest" answers if they answered the questionnaire anonymously and did not need to discuss the topics with the interviewers. However, we instructed our respondents in the introduction of each interview that the interview was not concerned with the answers to the questions on the tested questionnaire but rather about how they understand these questions and how they arrived at their answers. We explained that if they did not want to answer, they did not have to do so and that if they had difficulties in answering a few questions, then we need to improve the questionnaire. Eventually, it is also probable that they gave biased answers to avoid the negative feeling caused by conceding their "incompetence" in understanding or in judging health-related information. Similar observations were made by Joffer et al. in terms of answering a question about self-reported health [62].

#### Key role of interpersonal agents

Another important issue emerging from our cognitive interviews is the role of interpersonal agents. Parents were often named as the main source of health information or as those who verify the reliability of such information. Parents strongly support or make important health decisions; for example, they decide for their children what vaccinations or medical examinations will be necessary. This finding is in line with the results of recent studies indicating that parents remain the most frequently turned-to source of health information [19, 63, 64]. As an information source, the Internet was mentioned by adolescents in second or third place after, e.g., "doctors and nurses". This may indicate that the Internet is not replacing interpersonal sources but rather supplementing them [19]. Consequently, a self-reported assessment of the health literacy competencies of adolescents should take into account their perception of the possibilities of their social context, depicted as "interpersonal factors" by Higgins et al. [65].

Our cognitive interviews verified the findings of previous studies [19, 66–68] that adolescents start their searches for health information with the search engine Google and often select the first search result instead of considering additional search results. These findings are consistent with a qualitative study by Cusack et al. [64], which showed that adolescents (aged 12–15) tended to rely only on substitute indicators, such as endorsements, when evaluating the credibility of claims. This could be explained by the finding that cognitive abilities such as information processing, logical thinking, judgment, and decision-making processes are still developing in adolescence [11]. We also supposed that adolescents are not sufficiently informed about the importance of evaluating the credibility of information and how they should do so.

These findings indicate, on the one hand, a particular need for the accurate evaluation of critical health literacy skills among adolescents, and, on the other hand, the responsibility of all health information providers and the key role of parents in providing reliable and comprehensible health information or making sound decisions for their children. Therefore, health literacy interventions should also target parents, and other significant adults in adolescents' lives to support their critical health literacy skills.

#### Methodological considerations

Referring to the method of CI by applying, e.g., the think-aloud technique, "reactive thinking" may affect the cognitive process that determines what people report on [69]. Cognitive interviews may flag "problems" that would not turn out to be "real" in surveys (errors of commission). Furthermore, cognitive interviews can fail to identify problems that exist in an actual survey (errors of omission), and findings may be inconsistent when conducted by independent groups of researchers [50]. In our cognitive interviews, we focused on the items that, based to our inclusion criteria, were identified as difficult to understand. We mostly used retrospective verbal probing instead of a think-aloud technique, which may be a more suggestive approach by flagging problems that individuals have with a questionnaire. However, this approach is recommended in the literature for our target group [61], and it ensures greater objectivity in conducting cognitive interviews through standardized probes. To minimize interpretation bias in the analyzed data, we used double coding of randomly selected parts of the data. However, because this procedure is time- and labor-intensive, we double coded approximately 20% of the transcripts (3 of 15 extensively tested items).

Another limitation relates to the characteristics of our sample. We considered only age, gender and educational level when selecting participants. No data were collected regarding the proficiency level of German language skills or on participants' migrant backgrounds, which may be additional important factors influencing the comprehension of questionnaires measuring health literacy [29, 70, 71].

Due to the limited sample size, we could not examine whether there were any different response patterns within participating age groups and educational levels. Further, not all items could be tested with specific

probes because of the time constraints generally suggested for cognitive interviews [46, 47] and for qualitative interviews with children and adolescents [72, 73]. For the same reason, it was not possible to examine how respondents justified their decisions for a certain response category for each item. Such probes could provide deeper insights into the reliability of answers and could reveal possible reasons for overestimation of health literacy skills in adolescents. Nevertheless, we are confident that we have identified major challenges that adolescents face when answering the HLS-EU-Q47-GER. In line with other studies among young respondents [51, 52], our study confirmed that adolescents are able to handle the demands of the cognitive interview and do provide valuable information that is necessary for improving a questionnaire.

Lastly, when considering change of the questionnaire scales towards more easy application among youth, it should still considered how to secure the scales' ability to discriminate the levels of health literacy with respect to the primary aim of the questionnaire.

## Conclusions

The results of our research indicate that the applicability of the HLS-EU-Q47-GER as measurement of general health literacy among adolescents aged 14–17 is limited. Based on our findings, we assume that the data on general health literacy collected with this questionnaire are partly biased in this age group, with a tendency toward overestimation. Therefore, when using this questionnaire across all age groups, the data gathered from adolescents should be interpreted with caution.

Some of these items could be altered by adding examples and situations to which youth can easily relate or by simplifying the wording. We suggest either concretizing items with a high level of abstractions using age-related examples or omitting these items. Some of the HLS-EU-Q47 items worked as intended and can be applied among adolescents.

Our study highlights the need for age-adjusted assessment tools for health literacy that are better tailored to adolescents' developmental stage, interests, experience, rights and responsibilities in dealing with health-related information. The required health literacy skills change depending on the phase of life, context, or individual needs; some of these skills only become relevant in adult life.

## Endnotes

[1]IDs refer to individual participants

## Additional files

**Additional file 1: Table S1.** German version of the European Health Literacy Survey Questionnaire tested in the MOHLAA study in Germany (12/2015–03/2016). (DOCX 53 kb)

**Additional file 2: Table S2**. Characteristics of the participants of cognitive interviews in the MOHLAA study in Germany (12/2015–03/2016). (DOCX 45 kb)

**Additional file 3: Table S3.** Results of cognitive interviews in the MOHLAA study in Germany (12/2015–03/2016) and derived implications per individual item. (DOCX 29 kb)

### Abbreviations

CI: Cognitive interviewing; HLS-EU-Q47: The European Health Literacy Survey Questionnaire; HLS-EU-Q47-GER: The European Health Literacy Survey Questionnaire – German Version; MOHLAA: Measurement of Health Literacy Among Adolescents

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### Availability of data and materials

The interview guide and the analyzed data sheet with transcripts are available in the German language from the corresponding author upon reasonable request.

### Authors' contributions

OD made substantial contributions to the conception of the study, performed qualitative analysis and drafted the manuscript. CF made substantial contributions in the conception of the study, performed the analysis and critically reviewed the manuscript. SJ conceptualized the present study, contributed substantially to the interpretation of findings and critically reviewed the manuscript. CH was consulted regarding the methodology of the present study, made contribution to data analysis and critically reviewed the manuscript. TMB and KS contributed substantially to the interpretation of the data, critically reviewed and edited the manuscript. All authors approved the final manuscript.

### Ethics approval and consent to participate

The study was approved by the Federal Commissioner for Data Protection and Freedom of Information, Germany. Participants, as well as their parents or legal guardians, were informed about the study objectives, the interview process, and the applicable data protection guidelines (anonymous data processing and record keeping). Written informed consent was obtained from each participant and her/his parents or legal guardians.

### Consent for publication

Not applicable.

### Competing interests

The authors declare that they have no competing interests.

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## Development and Psychometric Properties of a Questionnaire Assessing Self-Reported Generic Health Literacy in Adolescence

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# Development and Psychometric Properties of a Questionnaire Assessing Self-Reported Generic Health Literacy in Adolescence

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**Abstract:** Health literacy is a promising approach to promoting health and preventing disease among children and adolescents. Promoting health literacy in early stages of life could contribute to reducing health inequalities. However, it is difficult to identify concrete needs for action as there are few age-adjusted measures to assess generic health literacy in young people. Our aim was to develop a multidimensional measure of health literacy in German to assess generic health literacy among 14- to 17-year-old adolescents, namely, the "Measurement of Health Literacy Among Adolescents Questionnaire" (MOHLAA-Q). The development process included two stages. Stage 1 comprised the development and validation using a literature review, two rounds of cognitive interviews, two focus groups and two rounds of expert assessments by health literacy experts. Stage 2 included a standard pretest ($n$ = 625) of the questionnaire draft to examine the psychometric properties, reliability and different validity aspects. The MOHLAA-Q consists of 29 items in four scales: (A) "Dealing with health-related information (HLS-EU-Q12-adolescents-DE)"; (B) "Communication and interaction skills", (C) "Attitudes toward one's own health and health information", and (D) "Health-related knowledge". The confirmatory factor analysis indicated a multidimensional structure of the MOHLAA-Q. The internal consistency coefficients (Cronbach's α) of the scales varied from 0.54 to 0.77. The development of the MOHLAA-Q constitutes a significant step towards the comprehensive measurement of adolescents' health literacy. However, further research is necessary to re-examine its structural validity and to improve the internal consistency of two scales.

**Keywords:** adolescents; health literacy; questionnaire; self-assessment; subjective measurement; validation; MOHLAA-Questionnaire

## 1. Introduction

Health literacy has been explored in numerous studies in adult populations. These studies have found that health literacy is associated with different health outcomes (e.g., health status, use of health services, mortality) [1] but is also an independent predictor of health status in addition to common sociodemographic factors such as age, income or education [2–4]. According to its broad, widespread definition, health literacy comprises the competencies, knowledge, and motivation to

access, understand, appraise, and apply health-related information in order to make judgments and health decisions in everyday life [5]. The World Health Organization regards health literacy as "a critical determinant of health" as well as a resource that "must be an integral part of the skills and competencies developed over a lifetime, first and foremost through the school curriculum" [6].

In recent times, the promotion of health literacy as a strategy to reduce health disparities has been discussed, as limited health literacy is supposed to be an important predicator of health disparities [7]. Accordingly, promoting those skills in early stages of life should contribute to reducing health inequalities caused, among others, by a low health literacy level in the population. However, the evidence on the exact nature of the relationship between health literacy and health disparities remains still scarce [7]. This is because there is a lack of studies that examine the dynamic, contextual nature of health literacy and specify its level and change in the life span: in childhood, in adolescence and different phases of adult life.

Adolescence is an important life phase in terms of emotional, social, and cognitive developmental processes [8,9]. This phase of life is characterized by improvements in cognitive skills, information processing and cognitive self-regulation [10], which are basic skills for decision-making. Adolescents must manage different developmental tasks, such as developing their autonomy, their own norms, and values [8] as well as assuming responsibility for their lives and health. At the same time, adolescents assess their vulnerability differently than adults do [11,12] by underestimating risk factors and consequences of their health-related actions. Thus, adolescents are prone to risky behavior (e.g., unprotected sexual activity, dangerous driving, and substance use). In addition, adolescents are growing up in the modern information and digital society with easy and ubiquitous access to health information, health apps and devices, and they often become the target group for health-related services [13]. Health literacy may therefore be particularly important in adolescence, as it involves the development of skills that go beyond theoretical and practical knowledge and involve the critical thinking, self-awareness and the skills required to be active citizens who take responsible actions to promote their own and others' health [14].

Compared to the knowledge on adult populations, there is little knowledge about the level of health literacy and its distribution in children and adolescents and the importance of health literacy for health care, disease prevention, and health promotion in these population groups. Most previous studies and surveys in this population have been conducted in clinical or medical contexts or have focused on functional literacy or media literacy [15,16]. The lack of health literacy data for children and adolescents can be attributed to different causes, one of which is that a clear and commonly accepted definition and conceptual framework of health literacy in these age groups is lacking [17]. In addition, there is a lack of high-quality, valid, and age-adjusted measurements [18–20], followed by a lack of studies with children and adolescents [21].

In Germany, a few studies on adolescents' health literacy have focused on the measurement of specific health literacy domains, such as health-related knowledge [22] or critical health literacy [23,24], or have targeted certain age groups of adolescents, e.g., 9- to 13-year-olds [25], 15- to 29-year-olds [26], or specific subgroups, such as educationally alienated young people [27] or adolescent and young adult cancer patients [28]. On the one hand, these studies provided insightful findings relating to those age groups and initiated the health literacy research among children and adolescents in this country. On the other hand, a research gap opened up in Germany regarding a measurement tool assessing generic health literacy of young people in mid-adolescence. To close this gap, the "Measurement of Health Literacy Among Adolescents (MOHLAA)" project aimed to develop and validate an age-adjusted instrument in the German language to assess self-reported generic health literacy. The project was conducted as part of the German Health Literacy in Childhood and Adolescence (HLCA) Consortium [29].

We focused on young people in mid-adolescence (adolescents aged 14–17 years) as they start to make their own health-related decisions, while patterns of increased risky behavior can also be observed [30,31]. Our aim was to develop a self-administered, paper-and-pencil measurement tool applicable for the monitoring and evaluation of health literacy in population-based studies. This paper

describes the development process of the MOHLAA-Q, with a focus on evaluating the instrument's applicability for the target group and its psychometric properties.

## 2. Materials and Methods

The development process of the MOHLAA-Q, as shown Figure 1, consisted of two stages: the development and qualitative testing of the 1st and 2nd drafts of the MOHLAA-Q (stage 1) and quantitative testing of the 2nd draft with a standard pretest and finalization of the MOHLAA-Q (stage 2).

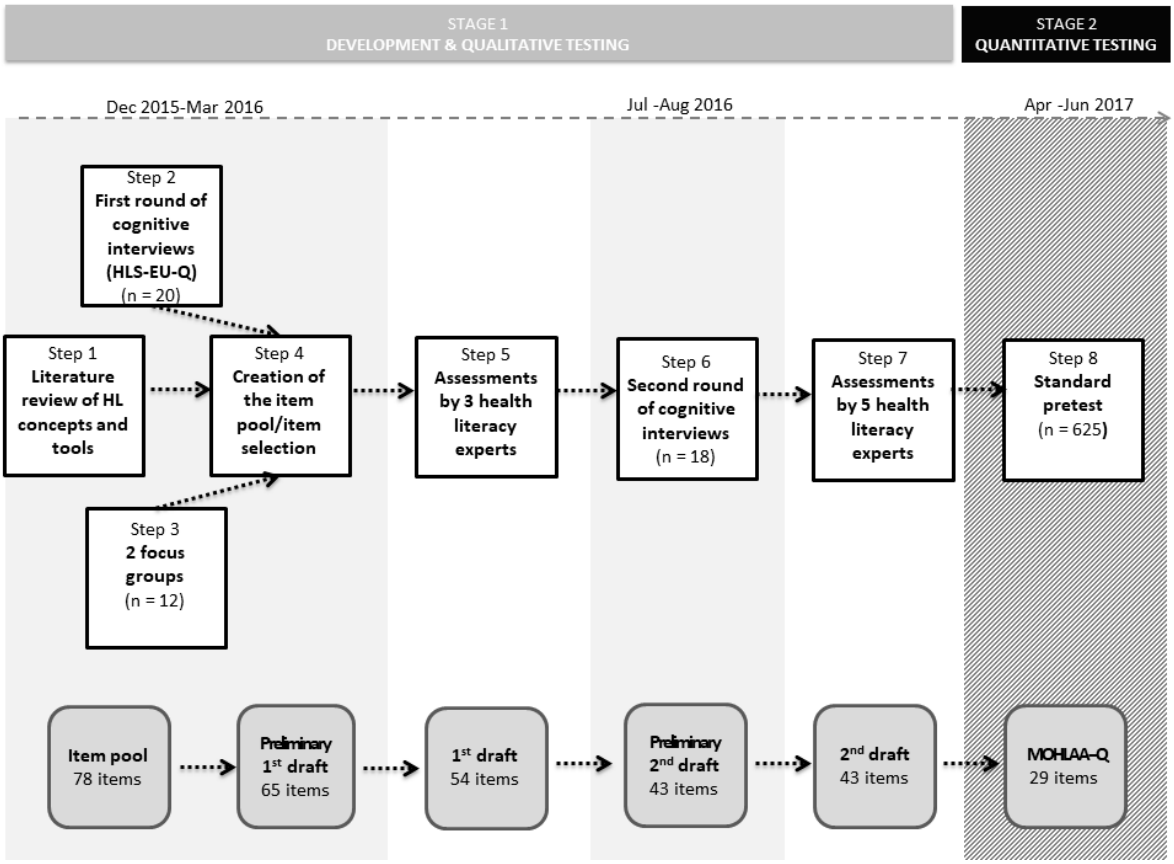


**Figure 1.** Phases of the development process of the MOHLAA-Q applied in the MOHLAA study (2015–2018) in Germany.

### 2.1. Stage 1: Development and Qualitative Testing

Stage 1 comprised a literature review (LR) (step 1), two rounds of cognitive interviews (CIs) (step 2 and 6) and focus groups (FGs) (step 3), both with adolescents aged 14–17, the creation of the item pool (step 4) and two rounds of expert assessments (EAs) by health literacy experts (step 5 and 7). Here, we only describe the most important steps, a detailed description of the methods and results of the first-round CIs and the FGs can be found elsewhere [32,33].

At step 1, we conducted an LR on definitions, models and concepts of health literacy in relation to adolescents to determine a conceptual framework for our questionnaire. The framework underlying the MOHLAA-Q is grounded on findings of a systematic review on definitions and models by Bröder et al. [17], in which health literacy of children and adolescents is regarded as "comprising variable sets of key dimensions, each appearing as a cluster of related abilities, skills, commitments, and knowledge that enable a person to approach health information competently and effectively and to derive at health-promoting decisions and actions" [17]. This multidimensional construct interrelates with "social and contextual determinants". The key health literacy dimensions can to be clustered

according to three core categories of individual attributes: (1) cognitive, (2) behavioral or operational, and (3) affective and conative. For example, all mental abilities and actions that enable a person to think, learn and process information are attributed to the cognitive category. In our final framework that we specified according to the findings of CIs and FGs (c.f. Section 3.1), we determined four theoretical dimensions (denoted as factors) of individual health literacy: cognitive (f1), behavioral (f2), behavioral/communicative (f3) and affective/conative competencies (f4). Furthermore, Bröder et al. highlight that families, peers and schools are major socialization agents in young people's lives that influence their opportunities for being or becoming health literate. This was considered in the preliminary framework as a contextual factor (f5) of individual health literacy.

At this study phase, we also examined the literature on instruments to measure self-reported generic health literacy that had been developed exclusively for adolescents (13 to 18 years of age), or had been applied in these age groups. We determined the 47-item version of the European Health Literacy Survey Questionnaire (HLS-EU-Q47-GER [34]) as a blueprint. Its validity and reliability have been confirmed in many studies with adults [35–38]. Based on this instrument, we added scales and topics that more specifically considered adolescents' health-related needs and characteristics [39]. To test the applicability of the HLS-EU-GER for measuring the generic health literacy of adolescents, CIs were applied (step 2). Simultaneously, we conducted two FGs (step 3) to explore in depth adolescents' experiences of managing diseases, navigating health care services and promoting their own health. In step 4, the item pool and the 1st draft of the MOHLAA-Q was created. In the item pool, we included the age-group-relevant HLS-EU-Q47-GER items. We adapted items when feasible and added items from other instruments available in English or German that operationalized affective/conative and behavioral/communicative (i.e., communication and interaction skills) health literacy components, and health-related knowledge. Then, two project team members selected items from the item pool based on two criteria: appropriateness of the item language (plain and concise wording) and relevance of item content for the age group. To ensure the content validity of our tool, the preliminary version of the questionnaire was assessed by three researchers (experts) from the HLCA consortium (step 5) with different educational and professional backgrounds, including one teacher. They provided a qualitative assessment of the item language and relevance for operationalizing adolescents' health literacy. The expert assessments resulted in the final 1st MOHLAA-Q draft. The main results of the development process were also discussed with the HLCA Scientific Advisory Board, which includes international health literacy experts. To test the 1st draft of the MOHLAA-Q, we once again conducted CIs (step 6) following the same procedure as in the 1st round of CIs [32] apart from the sampling and recruitment procedure. Subsequently, in step 7, five experts from the HLCA consortium scored the clarity of the wording of each item of the preliminary 2nd draft and the item relevance regarding the generic health literacy construct. The adaptation process resulted in the 2nd draft of the MOHLAA-Q. Methodological details of the mentioned developmental processes of stage 1 are described in Supplementary Materials Table S1.

### *2.2. Stage 2: Quantitative Testing*

To test the feasibility and selected aspects of the criterion validity, construct validity and reliability (internal consistency) of the 2nd draft of the MOHLAA-Q, we conducted a standard pretest as step 8 [40].

#### 2.2.1. Pretest Design and Data Collection

In step 8, the pretest was conducted as a cross-sectional postal survey in the city of Berlin (Germany). A stratified random sample of addresses from four selected districts (Marzahn-Hellersdorf, Mitte, Neukölln und Friedrichshain-Kreuzberg) from the Berlin city resident register was used. These districts are characterized by a high proportion of people with immigration background and a heterogeneous social-economic structure of inhabitants. In our sample, we aimed to balance the distribution among four age groups (14- to 17-year-olds) and among girls and boys. The study participants received an incentive (voucher) with a value of 10 euros. The paper-and-pencil survey included 43 items from the

2nd draft of the MOHLAA-Q; other health literacy measures; a self-efficacy scale; questions regarding health behavior, subjective health status and use of health services; and some sociodemographic questions (details described below).

The study was approved by the Federal Commissioner for Data Protection and Freedom of Information, Germany. Participants, as well as their parents or legal guardians, were informed about the study objectives and the applicable data protection guidelines (anonymous data processing and record keeping). Written informed consent was obtained from each participant and her/his parents or legal guardians.

#### 2.2.2. Measures

##### 2nd Draft of the MOHLAA-Q

The 2nd draft of the MOHLAA-Q contained five scales. Table 1 shows topics of the scales (col. 1), a corresponding theoretical dimension (col. 2) and specified health literacy attributes (col. 3) which are operationalized in the respective scale. For example, scale A operationalizes two health literacy dimensions: a *cognitive* dimension that corresponds to understanding and appraising skills and a *behavioral* dimension that corresponds to information seeking and applying health-related information. The items of scales A-C were intended to measure subjective generic health literacy at the individual level. Scale D was intended to measure selected aspects of health-related knowledge. Scale E aimed at assessing respondents' perceptions of the competencies of social agents (doctors, parents, friends, and persons in school settings) for communication and interaction about health-related issues. In our conceptual framework, scale E was assumed to represent a factor that substantially affected individual-related health literacy in adolescents. Response options in the scales A, B and E were designed as 4-point Likert-scales, in scale C as a 5-point Likert-scale and, in scale D as single choice with 5 response options (dichotomy coded). The higher values scored on the respective scales implied better individual-related subjective health literacy.

**Table 1.** 2nd draft of the MOHLAA-Q: Assessed topics and related skills.

| Topic of the Scale (No. of Items) | Theoretical Key Dimension | Specified, Evaluated Health Literacy Attributes |
|---|---|---|
| A Dealing with health-related information (16 items) | *cognitive*<br>*behavioral* | understanding, appraising, critical thinking, and functional literacy skills<br>information seeking, application of health information |
| B Communication and interaction skills (5 items) | *behavioral /communicative* | skills to communicate and interact about health information |
| C Attitudes toward one's own health and health information (7 items) | *affective/conative* | self-awareness, self-control, self-efficacy, motivation, interest |
| D Health-related knowledge (10 items) | *cognitive* | knowledge about physical activity; the health risks of alcohol use, cannabis use and smoking; the emergency number; first aid measures in case of skin burns; medication leaflets; nutrition labels; patient rights; ways of transmitting HIV/AIDS |
| E Support for health-related issues by social agents (5 items) | *contextual factor affecting individual health literacy* | competencies of social agents, including doctors, parents, and friends, for communication and provision of support related to health topics |
| 43 items | | |

##### Further Scales for Validation

To examine the criterion (concurrent) and construct (convergent) validity of our instrument, we included in the survey established scales that measure subjective generic health literacy, functional health literacy, self-efficacy, social support, and one question about self-reported health status (scored

as 1—very good, 2—good, 3—moderate, 4—bad, and 5—very bad). The first scale was the German version of the Health Literacy Assessment Tool (HLAT-8) [41], which assesses subjective generic health literacy in three health literacy domains (functional, interactive and critical) in the context of family and friends. In a Swiss study, the tool showed moderate internal consistency (Cronbach's $\alpha = 0.64$) and expected known-group validity (positive associations with one's own and parental education). The tool consists of 8 items with 4- or 5-point Likert response scales and a differently formulated "does not apply" option (scored as 0). The valid responses are summed for a total HLAT-8 score with a range of 0–37 points.

The second scale was the Newest Vital Sign (NVS) test [42], which assesses basic reading and numeracy skills (functional heath literacy). The NVS showed high internal consistency (Cronbach's $\alpha > 0.74$), and its criterion validity was confirmed in many studies [43]. This frequently used tool has also been validated for adolescents [44,45]. The NVS was originally designed to be administered verbally; however, for the purpose of our study, the instrument was adapted as a self-administered, paper-and-pencil questionnaire. We used the German version of the NVS applied in the European Health Literacy Survey [34].

The third scale was a self-efficacy scale that measures the general construct of self-efficacy which was validated in many countries and for adolescents [46]. In the validation study with adolescents, Cronbach's $\alpha > 0.78$ was found and confirmatory factor analysis confirmed the one-factor structure of the scale [46]. The scale consists of 10 items that measure one's confidence in the ability to master difficult situations, whereby success is attributed to one's own competence.

The last scale was the Multidimensional Scale of Perceived Social Support (MSPSS) [47] as an indicator of social support. We applied two subscales, namely "Family" (4 items) and "Friends" (4 items) which showed good internal consistency in the validation study with adolescents (Cronbach's $\alpha$ of 0.81 and 0.92, respectively [47]).

Sociodemographic Questions

The participants were categorized into four age groups (14-, 15-, 16-, and 17-year-olds). To assess their educational backgrounds according to the Berlin school system, we asked each participant whether he/she was attending school and which type of secondary school leaving certificate he/she planned to achieve (1—"I do not know yet"; 2—"Vocational Training Maturity (BBR)"; 3—"Advanced Vocational Training Maturity (eBBB)"; 4—"Intermediate Secondary School Leaving Certificate (MSA)"; 5—"Matriculation for a university of applied sciences"; 6—"High School Certificate (Abitur)"; 7—"Other school certificate, namely, (open ended)"). If the participant was not currently attending school, we asked which type of certificate she/he has already achieved (1—"Left school without a degree"; 2—"Certificate of secondary education (Hauptschulabschluss), Vocational Training Maturity (BBR)"; 3—"Advanced Vocational Training maturity (eBBR), Intermediate Secondary School Leaving Certificate (MSA), Secondary School Certificate (Realschulabschluss)"; 4—"Matriculation for a university of applied sciences, High School Certificate"; 5—"Other school certificate, e.g., acquired abroad"). We aggregated those data into one variable with three categories: (1) no high school certificate, (2) high school certificate, and (3) I do not know yet which degree I would like to achieve. Migration background (yes/no) was assessed with questions about the country of origin of both the participants and their parents. A participant who had at least one parent who was not born in Germany was regarded as a person with a migration background. To determine adolescents' socioeconomic status, we used the six-item version of the Family Affluence Scale III (FAS) [48]. The responses to the items were given as specific values and calculated as an aggregated FAS index ranging from 0 to 13. The FAS index was divided into quintiles and categorized as follows: (1) low (1st quintile, <20% of the sample), (2) medium (2nd–4th quintiles, 20–80% of the sample) and (3) high (5th quintile, >80% of the sample) [49]. As a proxy indicator of parents' education, we asked about the number of books in the adolescent's home [50].

#### 2.2.3. Psychometric Analyses

First, we conducted item and reliability analyses. The aim of the item analysis was to identify the items and scales in the 2nd draft of the MOHLAA-Q that had poor psychometric properties, which would be excluded from the further analysis. For each item, we examined the missing values, distribution (mean, variance, skewness, and kurtosis) and item discrimination based on the corrected item-total (ITC) correlation [51]. No firm cutoffs for item variance have been suggested; however, one recommendation is to select items with higher variance [52]. We considered floor or ceiling effects to be present if >15% of the participants scored the lowest or highest possible score on the scales, respectively [53]. We also computed a difficulty index (DI) for each of the knowledge questions, which was calculated for each item as the percentage of correct answers divided by the number of responses. A high DI indicates an easy item, and a low percentage indicates a difficult item. In general, items should have DIs of no less than 20% and no greater than 80% [52].

In summary, in the first step of the analysis, we determined the following criteria for poorly performing items: a proportion of missing values over 5%, distribution characterized by substantial departure from normality (e.g., skewness = 2 and kurtosis = 7) [54], item discrimination values < 0.26 or DIs over 80% for the knowledge items.

To estimate the reliability of the scales, we examined internal consistency with Cronbach's $\alpha$ coefficient for the multipoint scales (A, B, C and E) and the Kuder-Richardson (KR20) coefficient of reliability for dichotomous items (0-false, 1-true) in scale D. However, for scale D, we used a formative measurement model [55]. In this model, so-called cause indicators (items) can be independent from each other, as only the (latent) construct causally depends on each indicator. Therefore, reliability in the sense of internal consistency is not meaningful when indices are formed as a linear sum of measurements [56]. Accordingly, we assumed a low KR20 for scale D.

Second, we conducted confirmatory factor analysis (CFA) with the remaining items to examine the construct validity, more specifically, the structural validity of the single scales and the overall instrument consisting of scales A, B, and C. Scale D was specified in our conceptual framework as a single health literacy component operationalized as a formative measurement model [57]. In line with the finding of Schmidt et al. [25] and theoretical considerations about disentangling health knowledge from health literacy [58], we hypothesized a weak association of scale D with the other health literacy components. With the CFA, we examined the extent to which the empirical data fit the factor structure of the conceptual framework underlying the MOHLAA-Q. Additionally, we conducted CFA of scale A with the adapted HLS-EU-Q47-GER items with the same factor structures as those used in the HLS-EU-Q47-GER: a three-factor structure (perceived difficulty of dealing with health information in the contexts of (1) health care, (2) health promotion, and (3) disease prevention) and a four-factor structure (perceived difficulty of: (a) accessing, (b) understanding, (c) appraising, and (d) applying health information).

We used the robust weighted least squares mean-adjusted (WLSM) estimator for categorical data. The 1- or 2-factor model for each scale (cf. Table 1) was identified by fixing the variance of the latent variables. Finally, we examined the model fit for the three scales in relation to the four factors (cognitive, behavioral, behavioral/communicative, and affective/conative components) and for the overall model, where we assumed multidimensionality of the construct. The single scales were minorly revised to improve the goodness of fit and interpretability of the CFA model based on substantive justifications related to our specified model or poorly performing items (factor loading < 0.30). Modification indices were used to identify pairs of items within the scale that, if the error estimates were allowed to correlate, would improve the model fit and for which there appeared to be theoretically justifiable shared "method effects" [59]. We considered factor loadings and substantial changes related to the modification indices. To evaluate the model fit of the scales and the overall instrument, we considered the results of the chi-square test of model fit, $\chi^2$(df), with the $p$-value and the following fit indices, including the strict cutoffs for an good fit in parentheses [60]: Comparative Fit Index (CFI $\geq$ 0.96), Tucker-Lewis Index (TLI $\geq$ 0.95) [59,60], Root Mean Square Error of Approximation (RMSEA < 0.06) [61] and Weighted

Root Mean square Residual (WRMR < 1.00) [62]. It has to be noted, however, that the goodness-of-fit indices are often affected by various aspects such as model complexity, estimation method, normality of data, and most notably, sample size (e.g., $\chi^2$ is inflated by sample size, and large N solutions are routinely rejected on the basis of $\chi 2$) and that they are only one aspect of model evaluation [59,62,63].

Finally, to assess the convergent validity, we examined the relationship of the final versions of scales A-C of the MOHLAA-Q with the other measures of health literacy (the HLAT-8 and NVS) and the self-efficacy scale. We expected a positive moderate correlation of scales A-C with the HLAT-8. As the NVS captures only certain basic attributes of generic health literacy (reading and numeracy skills), we expected a weak correlation of scale A with the NVS as shown in other studies [64,65], and no correlation with scale B and C. The self-efficacy scale was used specifically for the validation of scale C, which is intended to measure, among other factors, affective/conative health literacy components, such as health-related self-efficacy and motivation. There, we expected a weak to moderate positive association between the self-efficacy scale and scale C. To verify the concurrent validity, we examined the extent to which scales A-C were correlated with subjective health status. We expected a negative statistical association, as shown in studies with adults [66]. To validate scale D, we examined its relationship with the NVS and the question about the number of books at home. We expected a positive association with both the NVS and the question about books, as has been previously found, e.g., between functional health literacy and the number of books by Driessnack et al. [67]. For validation of scale E, we planned to use the MSPSS. To explore the differences between groups, we conducted the chi-square or Mann-Whitney U test (rank test) for independent groups. We used the Spearman rank-order correlation (denoted as rho) to explore the associations between variables that were not normally distributed and categorical. The GESIS Leibniz Institute for the Social Sciences was consulted twice regarding the procedure of psychometric evaluation of the 2nd draft and its results. For all descriptive and association analyses, we used STATA 15, (StataCorp LLC, Texas, TX, USA) and to perform CFA with the categorical variables, we used Mplus 8 (Muthén & Muthén, Los Angeles, CA, USA) [68].

## 3. Results

### 3.1. Stage 1 Development and Qualitative Testing

Development of the underlying conceptual framework, which was briefly described in the Methods section, started with an LR; its specification and operationalization was performed during the entire stage 1. As a second result of the LR, we identified six tools that have been applied in studies with adolescents [64,68–72]. Hence, we decided to use the HLS-EU-Q47-GER as a blueprint for the following reasons: the tool was available in the German language; its short version had already been tested in a quantitative study with 15-year-olds in Austria [64]; and the instrument considers health literacy not only relating to health care but also to disease prevention and health promotion [32].

We conducted CIs with nine girls and 11 boys aged 14–17 who attended various types of schools. The first round of CIs revealed limited appropriateness of the HLS-EU-Q47-GER items for adolescents. The limitations related to aspects such as unfamiliarity with some concrete and abstract terms in particular, and limited experiences regarding health care or disease prevention. Surprisingly, the respondents evaluated the health-related tasks as being "very easy" or "fairly easy". Additionally, the findings stressed the importance of interpersonal agents, especially parents, in helping adolescents understand and judge the reliability of health information [32]. For the 1st draft of the MOHLAA tool, we adapted 16 items based on the HLS-EU-Q47-GER.

One FG was conducted with adolescents aged 14–15 ($n$ = 5), and another FG was conducted with adolescents aged 16–17 ($n$ = 7). Adolescents reported that the first source of health information was (in most cases) their parents and named other sources of information and support, including friends, teachers and healthcare professionals, depending on the health topic [33]. Accordingly, we added two additional scales: scale B to more accurately operationalize skills related to communication

and interaction about health topics and scale E that aimed to evaluate adolescents' perceptions of the communication skills of doctors, parents, friends and staff at school, regarding health issues. Moreover, adolescents reported that they could easily find reliable information on the internet, and they stated frequently using the internet for that purpose. However, it became evident that they did not use suitable criteria to evaluate information on the internet. This finding suggested that adolescents in our sample tend to overestimate their competencies. As this constitutes a potential source of bias when using a self-report measurement of health literacy, we also included a health knowledge scale to obtain a more robust assessment of different aspects of health literacy. While knowledge and subjective health literacy are somewhat different constructs, knowledge is regarded a constituent part of a broader understanding of health literacy, as stated by Sørensen et al. [5] and by Bröder et al. [17]. Accordingly, the questionnaire was extended with a scale including 10 knowledge questions (scale D).

Subsequently, based on the results of the LR, CIs, and FGs, we created an initial item pool that related best to our conceptual framework. The initial item pool consisted of 78 items that were derived, adapted or translated from different scales, including items from the HLS-EU-Q47-GER [34], Health Literacy Measure for Adolescents (HELMA) [70], Health Literacy Assessment Tool (HLAT-8) [41], Multidimensional Measure of Adolescents Health Literacy [71], HLS-NRW-Q [73,74], and Health Consciousness Scale [75] and one item operationalizing self-efficacy from the measure described by Schmidt et al. [25]. Health-related knowledge questions were taken or adapted among others from the health knowledge quiz described by Wallmann et al. [22], the drugcom.de quiz [76] and the food labeling quiz [77].

For the preliminary 1st draft of the MOHLAA-Q, we selected 65 items that were regarded relevant and appropriate for the age group. Based on the results of experts' assessments and the second round of CIs, we adjusted appropriate and deleted inadequate items. For further details, see Supplementary Materials Table S1. Stage 1 was finalized with the 2nd draft including 43 items (see Table 3).

### 3.2. Stage 2: Quantitative Testing

We received data from 625 adolescents, for whom the provision of informed consent was ensured (both the participant's and parents' consent). The response rate for our postal survey was approximately 23% among the 2722 contacted persons. The average age of the respondents was 15.5 years (Std. = 1.12), and the distribution among the four age groups was fairly equal, as shown in Table 2.

The proportion of girls was 58.7 %. Approximately 94% of the respondents were still attending school, and 74.7% desired or had already achieved a high school certificate. The percentage of respondents with a migration background was 43.4%, which was higher than the average level for Germany (30.2–34.6% for 10–20-year-olds) [78]. All demographics characteristics were distributed statistically independently from sex (data not shown).

#### 3.2.1. Item and Reliability Analysis

The descriptive statistics of each item and the scale-level reliability coefficients as well as information on whether the items were removed from their respective scales are presented in Table 3.

##### Missing Values and Item Distribution

The frequency of missing responses ranged from 0.16% to 5.81% in scale A, from 0.48% to 0.96% in scale B, from 0.32% to 1.12% in scale C, and from 0.48% to 0.80% in scale E. Only five items had proportions of missing responses greater than 1% (items 3, 6, 15, 16 and 26); only one item had a proportion over 5%, and this item posed a somewhat a sensitive question (*How easy or difficult is it for you to understand how to use condoms*?).

The mean item scores varied depending on the scale and its response range. A mean of over 2 indicated that participants responded mostly with "easy"/"agree" or "very easy"/"strongly agree". The mean scores on scale A varied from 1.95 to 3.53; on scale B, they varied from 2.24 to 3.04; and on scale E, they varied from 3.08 to 3.80, with a response range of 1-4. The mean scores were higher

on scale C (3.38 to 4.35) due to the response range of 1–5. Most of the items had a distribution with an elongated left-hand tail (negative skew), apart from items 4, 8, 14 and 21. The gender-specific items had different difficulty levels as indicated by the mean values ($mean_{item15}$ = 3.07 for girls vs. $mean_{item16}$ = 3.50 for boys) and different distributions. Therefore, we excluded them from further analysis. Furthermore, the item variance varied depending on the scale, with values ranging from 0.35 (Item 5) to 1.18 (Item 25). The lowest variance was observed for items on scale A. Overall, the items were not normally distributed, and we observed ceiling effects on the item level in all four Likert-scales (see Supplementary Materials Figure S1). The response options least frequently (<10%) used by adolescents in the majority of the items were "very difficult" (scale A) and "strongly disagree" (scale B–E).

Discrimination and Difficulty Index

The lowest discrimination (ITC values) was observed for items on scale E (0.09 and 0.23). Some items with ITCs below 0.30 (item 24–25 and 27) were also on scale C, which indicates that these items had low correlations with the remaining items on the same scale. The items with the highest discrimination on average were on scale A.

We computed DIs for scale D based on the mean item scores (proportion of correct answers). The average DI was 62%, and the DIs varied from 32% to 95%. Item 33, which asked about knowledge of the emergency number, and item 35, which asked about knowledge regarding the content of medicine leaflets, were answered correctly by over 95% of the respondents; therefore, we removed them from the final scale D.

**Table 2.** Sample characteristics in stage 2 of the MOHLAA study ($n$ = 625).

| | Total | Percentage | Missing Values |
|---|---|---|---|
| | ($n$) | % | ($n$)% |
| **Demographic characteristics** | | | |
| **Sex** | | | (0) 0.00 |
| Girl | (367) | 58.72 | |
| Boy | (258) | 41.28 | |
| **Age** | | | (0) 0.00 |
| 14 years | (159) | 25.44 | |
| 15 years | (165) | 26.40 | |
| 16 years | (145) | 23.20 | |
| 17 years | (156) | 24.96 | |
| **Socioeconomic characteristics** | | | |
| **Are you going to school?** | | | (4) 0.64 |
| Yes | (586) | 93.76 | |
| No | (35) | 5.60 | |
| **Educational level** | | | (9) 1.44 |
| No high school certificate | (120) | 19.20 | |
| High school certificate | (467) | 74.72 | |
| I do not know yet | (29) | 4.64 | |
| **Family affluence** | | | (5) 0.80 |
| Low | (136) | 21.76 | |
| Medium | (379) | 60.64 | |
| High | (105) | 16.80 | |
| **Migration background** | | | (7) 1.12 |
| None/German | (347) | 55.52 | |
| One-sided | (109) | 17.44 | |
| Two-sided | (162) | 25.92 | |

**Table 3.** Results of the item and internal consistency analysis analyses of the 2nd MOHLAA-Q draft ($n$ = 625).

| Var. Name | Scale A Dealing with Health-Related Information * *How Easy or Difficult Is It for You to?* | Source of Item | N | Missing [%] (n) | Mean | Skewness | Kurtosis | Variance | Cronbach's α | ITC | Excluded in Step |
|---|---|---|---|---|---|---|---|---|---|---|---|
| info1 | … find information about what to do when you feel ill to make yourself get better? | HLS-EU-Q47 [34] (Q1) | 622 | 0.48 (3) | 3.37 | −0.50 | 3.11 | 0.36 | 0.775 | 0.46 | |
| info2 | … find information about what you can do in case of a medical emergency? *e.g., an accident, severe skin burn, alcohol poisoning* | HLS-EU-Q47 [34] (Q3) | 623 | 0.32 (2) | 3.15 | −0.30 | 2.74 | 0.44 | 0.780 | 0.40 | 2 |
| info3 | … understand a medication leaflet | HLS-EU-Q47 [34] (Q6) | 616 | 1.44 (9) | 3.03 | −0.38 | 2.58 | 0.60 | 0.783 | 0.36 | |
| info4 | … judge which information about an illness in the media you can trust and which you cannot? *media: internet, TV, radio, press* | HLS-EU-Q47 [34] (Q12) | 622 | 0.48 (3) | 2.58 | 0.09 | 2.59 | 0.58 | 0.776 | 0.44 | |
| info5 | ...follow the instructions of your doctor or pharmacist? | HLS-EU-Q47 [34] (Q16) | 622 | 0.48 (3) | 3.48 | −0.80 | 3.39 | 0.35 | 0.781 | 0.39 | |
| info6 | ...find information about how you can deal with mental problems? *e.g., permanent stress, depression, being bullied, eating disorder* | HLS-EU-Q47 [34] (Q18) | 618 | 1.12 (7) | 2.84 | −0.19 | 2.39 | 0.66 | 0.773 | 0.48 | |
| info7 | ...understand how you can protect yourself against sexually transmitted diseases? *By sexually transmitted diseases we mean diseases such as HIV/AIDS, chlamydia infection, or herpes.* | HLS-EU-Q47 [34] (Q19) | 620 | 0.80 (5) | 3.53 | −1.17 | 4.17 | 0.39 | 0.778 | 0.43 | |
| info8 | ...judge whether you can trust the media when they warn you of health risks? | HLS-EU-Q47 [34] (Q28) | 619 | 0.96 (6) | 2.69 | 0.10 | 2.51 | 0.53 | 0.779 | 0.42 | |
| info9 | … implement advice from your family so you do not get sick? | HLS-EU-Q47 [34] (Q30) | 620 | 0.80 (5) | 3.12 | −0.47 | 2.79 | 0.54 | 0.789 | 0.29 | |
| info10 | … ask your friends for health tips? | HLS-EU-Q47 [34] (Q30) | 619 | 0.96 (6) | 2.94 | −0.38 | 2.79 | 0.60 | 0.783 | 0.37 | 2 |
| info11 | ...find information about healthy behavior such as exercise and nutrition? | HLS-EU-Q47 [34] (Q32) | 623 | 0.32 (2) | 3.41 | −0.63 | 2.40 | 0.42 | 0.774 | 0.47 | |
| info12 | ...understand information on food packaging? | HLS-EU-Q47 [34] (Q38) | 624 | 0.16 (1) | 3.13 | −0.53 | 2.33 | 0.69 | 0.775 | 0.46 | |
| info13 | ...judge how what you do daily affects your health? *e.g., eating, drinking, exercise, relaxation, body care* | HLS-EU-Q47 [34] (Q43) | 622 | 0.48 (3) | 3.02 | −0.28 | 2.21 | 0.64 | 0.770 | 0.52 | |
| info14 | ...get involved in promoting a healthier life in your neighborhood? *e.g., more parks and sports grounds, less noise and traffic, better air quality* | HLS-EU-Q47 [34] (Q47) | 620 | 0.80 (5) | 1.95 | 0.59 | 2.90 | 0.66 | 0.794 | 0.23 | 1 |
| | Test scale A (without item 15 and 16) | | | | | | | | 0.792 [a] | | |
| info15 girls | ...understand information about the vaccination against cervical cancer (HPV)? | HLS-EU-Q47 [34] (Q23) | 367 | 1.09 (4) | 3.07 | −0.54 | 2.90 | 0.61 | NC | NC | 1 |
| info16 boys | ...understand how to use condoms? | HLS-EU-Q47 [34] (Q23) | 258 | 5.81 (15) | 3.50 | −1.57 | 5.89 | 0.47 | NC | NC | 1 |

**Table 3.** *cont.*

| | **B Interactions and communication skills** *To what extent do you agree with the following sentences?* | **Source of item** | **N** | **Missing [%] (n)** | **Mean** | **Skewness** | **Kurtosis** | **Variance** | **Cronbach's α** | **ITC** | **Excluded in step** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| com1 | When you think about your last visit to the doctor, did you ask all the questions that interested you? | HELMA [70] (Q37) | 621 | 0.64 (4) | 3.01 | −0.41 | 2.43 | 0.69 | 0.514 | 0.39 | |
| com2 | I chat with my friends about how one can avoid unhealthy behavior, *e.g., smoking, drinking over the limit.* | HELMA [70] (Q41) | 621 | 0.64 (4) | 2.75 | −0.17 | 2.18 | 0.82 | 0.546 | 0.33 | |
| com3 | If my friends or siblings have questions about health, I can help them. | HLAT-8 [41] (Q5) | 620 | 0.80 (5) | 3.04 | −0.35 | 3.05 | 0.47 | 0.495 | 0.42 | |
| com4 | It is easy for me to talk with my parents about topics about health. | Peak et al. 2011 [79] | 622 | 0.48 (3) | 3.31 | −0.93 | 3.27 | 0.60 | 0.515 | 0.39 | |
| com5 | I talk to people at school or at the workplace if I have stress or problems, *e.g., with a school social worker/school teacher.* | Peak et al. 2011 [79] | 619 | 0.96 (6) | 2.24 | 0.33 | 2.00 | 1.03 | 0.604 | 0.22 | 1 |
| | Test scale B | | | | | | | | 0.591 [a] | | |
| | **C Attitudes toward one's own health and health information** *To what extent do you agree with the following sentences?* | **Source of item** | **N** | **Missing [%] (n)** | **Mean** | **Skewness** | **Kurtosis** | **Variance** | **Cronbach's α** | **ITC** | **Excluded in step** |
| att1 | How much in general do you pay attention to your health? | Health Consciousness Scale [75] | 621 | 0.64 (4) | 3.38 | −0.03 | 3.28 | 0.60 | 0.548 | 0.34 | |
| att2 | I am aware of my physical condition throughout the day. | Health Consciousness Scale [75] | 623 | 0.32 (2) | 4.31 | −0.88 | 4.54 | 0.44 | 0.541 | 0.36 | 1 |
| att3 | I feel very quickly when my mood is changing. | FPSI-K [80] | 623 | 0.32 (2) | 4.35 | −1.37 | 5.11 | 0.64 | 0.582 | 0.24 | 1 |
| att4 | I seek advice from others when I am ill. | Locus of Control about illness and health [81] | 623 | 0.32 (2) | 3.62 | −0.56 | 2.47 | 1.18 | 0.575 | 0.26 | |
| att5 | It is up to me to protect myself from diseases. | Locus of Control about illness and health [81] | 618 | 1.12 (7) | 4.14 | −1.05 | 4.52 | 0.67 | 0.549 | 0.34 | |
| att6 | I can influence whether or not I feel well. | Locus of Control about illness and health [81] | 621 | 0.64 (4) | 3.77 | −0.64 | 2.84 | 1.06 | 0.575 | 0.26 | |
| att7 | It is important to me to know about health issues. | Health Motivation [82] | 623 | 0.32 (2) | 3.64 | −0.44 | 2.45 | 1.04 | 0.530 | 0.39 | |
| 7 | Test scale C | | | | | | | | 0.595 [a] | | |

**Table 3.** *cont.*

| | D Health-related knowledge | Source of item | N | Missing [%] (n) | Mean/item difficulty | Skewness | Kurtosis | Variance[a] | KR-20 | ITC[a] | Excluded in step |
|---|---|---|---|---|---|---|---|---|---|---|---|
| know1 | How often should a young person at your age to be physically active? | Health quiz [22] | 624 | 0.16 (1) | 0.32 | n.a. | n.a. | 0.22 | n.a. | 0.05 | |
| know2 | How does it affect the body if you regularly drink a lot of alcohol? | Quiz drug com [76] | 625 | 0.00 (0) | 0.43 | n.a. | n.a. | 0.25 | n.a. | 0.09 | |
| know3 | What are the health effects for young people of consuming cannabis (marijuana, hashish) often? | Quiz drug com [76] | 625 | 0.00 (0) | 0.45 | n.a. | n.a | 0.25 | n.a. | 0.08 | |
| know4 | What is not one of the possible effects of smoking? | Quiz drug com [76] | 622 | 0.48 (3) | 0.56 | n.a. | n.a. | 0.25 | n.a. | 0.10 | |
| know5 | What phone number do you need to dial if you need an ambulance? | HLS-NRW-Q [74] | 620 | 0.80 (5) | 0.97 | n.a. | n.a. | 0.03 | n.a. | −0.04 | 1 |
| know6 | How can small burns be treated? | Quiz aponet [83] | 624 | 0.16 (1) | 0.66 | n.a. | n.a. | 0.23 | n.a. | 0.13 | |
| know7 | Under which keyword does a medication package leaflet describe the undesirable effect of the medicine? | Educational material about medication leaflet [84] | 624 | 0.16 (1) | 0.95 | n.a. | n.a. | 0.05 | n.a. | 0.27 | 1 |
| know8 | Which ingredient is contained in the highest amount in a cocoa drink powder with the ingredients listed on the package as follows: sugar, dextrose, low-fat cocoa drink powder, emulsifying agent (lecithin), salt? | Food label quiz [77] | 623 | 0.16 (2) | 0.80 | n.a. | n.a. | 0.16 | n.a. | 0.17 | |
| know8 | We want to know if you know what your rights are. Which of the above statements is incorrect? | Massey et al. [71] (Q14) | 622 | 0.16 (3) | 0.39 | n.a. | n.a. | 0.24 | n.a. | 0.07 | |
| know 10 | How can HIV/AIDS be transmitted? | self-developed | 622 | 0.16 (3) | 0.70 | n.a. | n.a. | 0.21 | n.a. | 0.06 | |
| | Test scale D | | | | 0.63 | | | | 0.263 [b] | | |
| | **E Support for health-related issues by social agents** | | **N** | **Missing [%] (n)** | **Mean** | **Skewness** | **Kurtosis** | **Variance** | **Cronbach's α** | **ITC** | **Excluded in step** |
| cont1 | Thinking about your last visit to the doctor, did your doctor explain everything to you so that you understood it? | Massey [71] (Q2) | 621 | 0.64 (4) | 3.52 | −1.21 | 4.24 | 0.41 | 0.332 | 0.13 | 1 |
| cont2 | At school/work, there are people who help me if I have stress or problems. | self-developed | 622 | 0.48 (3) | 3.08 | −0.55 | 2.50 | 0.73 | 0.247 | 0.23 | 1 |
| cont4 | My family helps me when I have questions about health. | HLAT-8 [41](Q6) | 621 | 0.64 (4) | 3.59 | −1.55 | 5.40 | 0.39 | 0.245 | 0.23 | 1 |
| cont4 | If you do something that harms your health, would your friends try to dissuade you of that? | Jessor et al. [85] | 621 | 0.64 (4) | 3.31 | −0.85 | 3.15 | 0.57 | 0.286 | 0.18 | 1 |
| cont5 | I usually can use the internet alone and undisturbed. | Peak et al. 2011 [84] | 620 | 0.80 (5) | 3.80 | −2.61 | 9.82 | 0.25 | 0.362 | 0.09 | 1 |
| | Test scale E | | | | | | | | 0.345 [a] | | |

Legend: Source of item = from what source (instrument, quiz, educational material, survey) the item was taken with original wording or adapted or derived, and in parentheses the number of the respective item in the original instrument is shown, [a] = Cronbach's α for the scale including listed items, [b] = KR-20 was computed for complete cases in the scale D (n = 609), ITC = item-total correlation; exclusion step 1: item and reliability analysis, exclusion step 2: confirmatory factor analyses. * The English translations of the items were done by the authors and are only illustrative.

Reliability Analysis before the CFA

The Cronbach's α values for scales B and C were relatively low, with values barely below 0.600. Scale E had a Cronbach's α of 0.345, which we considered too low, so we discarded the scale. Furthermore, the reliability estimate of scale D was low, as expected (KR20 = 0.263), because of the intended heterogeneity of the tested knowledge.

Due to our criteria for poorly performing items and scales, we excluded the following: items 14-16 (scale A), item 21 (scale B), items 23 and 24 (scale C), and scale E.

3.2.2. Structural Validity

After confirming the assumption about a weak relationship between the items of scale D and other scales, we excluded scale D from the CFA. With the remaining 20 items, we conducted a CFA first for scales A–C and then for the overall model with the slightly revised scales. After analysis of the modification indices and factor loadings, we slightly revised scales A and C, i.e., we allowed the correlation of the residuals of items 4 and 8. Such a correlation may be an indicator of a further latent factor or a close similarity of the item wording, which was the case here. For the other scales, the residuals were not allowed to correlate.

Table 4 shows the fit indices of the slightly revised final scales and the overall model with the internal consistency coefficients of each scale. According to the conservative cut-off values for all considered fit indices, we found a good fit to the data for the scale B. In case of the scales A and C the values of CFI, TLI and RMSEA are very close to the prespecified cutoffs or above what may be indicative of an acceptable model fit. However, the found value of the WRMR for scale A does not indicate a good model fit.

**Table 4.** Results of the confirmatory factor analysis ($n$ = 577) for scales A–C and the overall model.

| MOHLAA-Q Scale | Specified Measurement Model/Factor | *No.* | $x^2_{WLSMV}$(df) *p*-value | RMSEA | CFI | TLI | WRMR | Cronbach's α |
|---|---|---|---|---|---|---|---|---|
| A Dealing with health-related information | Two-factor<br>*f1 behavioral*<br>*f2 cognitive* | <br>7<br>4 | 153.80 (42)<br>$p < 0.0001$ | 0.068 | 0.947 | 0.931 | 1.134 | 0.772 |
| B Communication and interaction skills | Single-factor<br>*f3 behavioral/communicative* | 4 | 2.79 (2)<br>$p = 0.247$ | 0.026 | 0.997 | 0.992 | 0.333 | 0.589 |
| C Attitudes toward one's own health and health information | Single-factor<br>*f4 affective/conative* | 5 | 15.69 (5)<br>$p = 0.008$ | 0.061 | 0.964 | 0.928 | 0.626 | 0.539 |
| Overall model Scales A+B+C | Single-factor | 20 | 868.86 (170)<br>$p < 0.0001$ | 0.084 | 0.821 | 0.800 | 1.783 | 0.824 |
| Overall model Scales A+B+C | Four-factor<br>*f1, f2, f3, f4* | 20 | 522.83 (163)<br>$p < 0.0001$ | 0.062 | 0.908 | 0.893 | 1.336 | 0.824 |

Legend: df = degrees of freedom; No. = Number of items per factor; CFI = Comparative Fit Index; RMSEA = Root Mean Square Error Approximation, TLI = Tucker-Levis Index; WRMR = Weighted Root Mean Square Residual.

The single-factor solution for the overall model had a poor fit. In the four-factor solution, the goodness-of-fit indices showed substantial improvement. The indices were close to the values considered to indicate sufficient model fit, e.g., CFI > 0.90 and RMSEA less than or close to 0.06 [59]. Figure 2 shows the final model with a four-factor solution. The range of the standardized factor loadings (cf. Figure 2) was 0.43–0.74 for scale A, 0.45–0.72 for scale B and 0.39–0.58 for scale C. We found a high correlation coefficient for factor 3, *behavioral/communicative*, and factor 4, *affective/conative* (0.91), which indicated no clear discrimination between them.

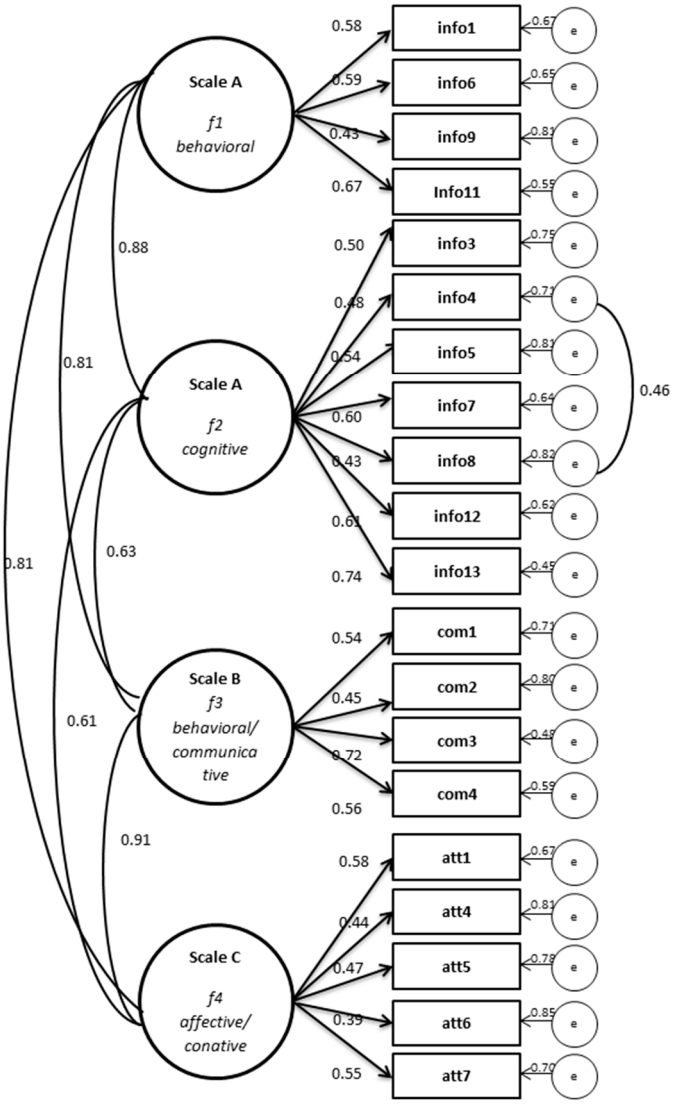


**Figure 2.** Standardized results of the CFA for the four-factor solution of the model underlying the MOHLAA-Q. Legend: Completely standardized estimates: Factor correlations, factor loadings, residual variance.

The additional analysis for scale A with the three-factor and four-factor models proposed by Sørensen et al. [5] showed a poor fit (see Supplementary Materials Table S2), indicating that the sample data showed a better fit to our two-factor specified model (*f1 behavioral* and *f2 cognitive*) for this scale with the reduced number of items after removing poorly performing items.

### 3.2.3. Convergent and Concurrent Validity

In Table 5, the results of the convergent validity analysis for the final scales A–C with complete cases are shown. A moderate correlation (rho = 0.459–0.528) between the MOHLAA-Q scales and the HLAT-8 indicated that our tool measures a similarly defined construct of generic health literacy. Our scales were moderately correlated (0.383–0.464) with the self-efficacy scale; the strongest effect size was found for scale A, not for scale C as we expected. A moderate association between the items measuring self-efficacy and the adapted HLS-EU-Q scale (for 4th grade pupils) was also previously found by Bollweg et al. [86]. When testing the concurrent validity, we confirmed the hypothesis regarding a negative statistical association of scales A–C with self-reported health status.

**Table 5.** Results of the validity (correlation) analysis for scales A–C ($n$ = 577).

| Scale | HLAT-8 | NVS | Self-Efficacy | Subjective Heath Status |
|---|---|---|---|---|
| n | (565) | (555) | (573) | (576) |
| Cronbach's α coefficient/KR-20 | 0.673 | 0.756 [a] | 0.856 | n.a. |
| A Dealing with health-related information | 0.528 *** | 0.144 *** | 0.464 *** | −0.253 *** |
| B Communication and interaction skills | 0.484 *** | 0.028 (n.s.) | 0.383 *** | −0.209 *** |
| C Attitudes toward one's own health and health information | 0.459 *** | 0.077 (n.s.) | 0.383 *** | −0.207 *** |

Legend: *** $p < 0.001$, n.s. = not significant, Cronbach's α coefficient/KR-20 = were computed for the respective validation scales, [a] = KR-20 was computed, rho = Spearman correlation coefficient, n.a. = not available.

Scale D was significantly associated with the functional literacy scale NVS (rho = 0.352, $p < 0.001$), as expected, as well as with the number of books at home (rho = 0.320, $p < 0.001$). We found weak correlations between scale D and scales A–C, with values ranging from 0.099 to 0.155.

Finally, due to the results of the item and reliability analyses and the CFA, we adjusted the wording of four items that showed poor psychometric properties. We decided to revise and reinclude item 14, which we had previously excluded as a result of the item and reliability analysis. In doing so, we intended to ensure the methodological and theoretical comparability and integrity of the adapted HLS-EU-Q47-GER items with those of the original instrument for adults. The current version of the MOHLAA-Q (cf. Supplementary Materials Figure S2) consists of 29 items in four scales: scale A, "Dealing with health-related information (HLS-EU-Q12-DE-adolescents)" (12 items); scale B, "Communication and interaction skills" (4 items); scale C, "Attitudes toward one's own health and health information" (5 items); and scale D, "Health-related knowledge" (8 items). For scales A–C, the mean raw item scores can be generated, whereby higher mean scores indicate higher self-reported skills in the corresponding dimension of generic health literacy. For scale D, assessing health-related knowledge, a sum score of the correct answers is considered. The coding of the responses can be found in Supplementary Materials Figure S2.

## 4. Discussion

We developed the first German multidimensional instrument for the assessment of self-reported generic health literacy among 14- to 17-year-olds. The MOHLAA-Q consists of four scales and 29 items, including eight questions related to health-related knowledge. For the development and validation of the MOHLAA-Q, we used a multistep study design applying several qualitative and quantitative methods. Thus, we sought to ensure a theoretical and empirical foundation of the instrument. By conducting cognitive testing of the MOHLAA-Q drafts with adolescents, we adjusted item wording for the target age group and improved the comprehensibility and acceptability of our instrument. The content validity was confirmed through the evaluation of the questionnaire drafts by the health literacy experts. Finally, the pretest results indicated the convergent validity of the individual scales. Scale A was moderately correlated with the HLAT-8 and it was found that lower health literacy mean scores are associated with poorer subjective health status; scale D was correlated, as expected, with the NVS. However, the results of the CFA (structural validity) and internal consistency analysis also identified certain limitations of the instrument and pointed to some borders in operationalization and measurement of generic health literacy. Moreover, the study revealed challenges in testing health-related knowledge and evaluating the role of social agents in processing (seeking, understanding, critical appraisal, etc.) health information.

### *4.1. Structural Validity*

The MOHLAA-Q is based on a four-dimensional health literacy construct that reflects the main components of generic health literacy [17]. The goodness-of-fit indices of the overall model (scales A–C) showed better values for the four-factor solution than for the single-factor model, which may be indicative of the multidimensionality of the underlying construct. However, a closer examination

of the TLI (just below the cut-off of 0.90) and high residual variance values for each item indicates that our specified age-adjusted measurement model did not show a sufficient fit to the sample data. The high correlation (0.91) between factor 3 (*behavioral/communicative*) and factor 4 (*affective/conative*) indicated no clear discrimination between the factors, suggesting that a higher-order factor may be present. From a theoretical point of view, we would not expect any common factor of those two factors (scales B and C). The localized areas of the poor fit of the specified four-factor model to the sample data must be examined in a further sample, and if necessary, the underlying conceptual framework of the MOHLAA-Q and its operationalization may require adjustment.

When comparing the MOHLAA-Q with the self-reported instruments developed for adolescents (aged 12–19) in other languages, we found instruments with similar complex structures (at least three-dimensional), e.g., the Health Literacy Measure for Adolescents (HELMA; 44 items), which is divided into eight factors (access, reading, understanding, appraisal, use, communication, self-efficacy, and numeracy) [70]; the Multidimensional Measure of Adolescents Health Literacy (22 items), which has five dimensions (interaction with the health care system, rights and responsibilities, preventive care, information seeking, and patient-provider encounter [71]; and the Health Literacy Assessment Scale for Adolescents (HAS-A; 15 items), which has three dimensions (communication about health information, confusion about health information and understanding health information) [87]. Interestingly, only one instrument, namely, the Health Literacy for School-Aged Children (HLSAC; 10 items), showed acceptable fit of a single-factor model, although the HLSAC was constructed based on five theoretical components (theoretical knowledge, practical knowledge, critical thinking, self-awareness, and citizenship) [71]. Similar to the majority of the considered instruments, the MOHLAA-Q takes into account the dimension of skills for communication and interaction with interpersonal sources, which are of great importance in this phase of life [57,79].

The intended multidimensional structure of the MOHLAA-Q has several consequences, e.g., for the length of the instrument and the interpretation of findings. Due to the multidimensionality and complexity of the generic health literacy construct, operationalization of the construct requires the consideration of multiple scales that cover single dimensions of health literacy. As a result, the instrument, i.e., the MOHLAA-Q, becomes long, which does not adhere to the pragmatic recommendations for the measurement of health literacy in this age group [57]. The multidimensionality of the MOHLAA-Q also raises the question of whether an overall index that is a sum score or a mean score for the health literacy dimensions would be an accurate indicator of generic health literacy if no single common factor is found (no unidimensionality). This fundamental point was already debated in reference to the HLS-EU-Q47-in a Norwegian validation study by Finbraten et al. [88]. Therefore, in our analysis, we considered the single scales separately by computing mean scores for scales A–C and a sum score for scale D.

Another point related to multidimensionality is that no single instrument, including the MOHLAA-Q, is capable of fully assessing all aspects of the multidimensional generic health literacy construct. However, the MOHLAA-Q addresses many health-related topics (e.g., medication adherence, nutrition, risk health behavior, physical activity) and covers many diverse health literacy aspects. The tool is intended to measure more than the perceived difficulties related to the core health literacy competencies (understanding, finding, appraising and applying health information), as in the case of the HLS-EU-Q47-GER. Rather, the MOHLAA-Q operationalizes additional core health literacy components such as health-related communication, motivation and health-related knowledge across the three health domains, as stated in the health literacy definitions proposed by Sørensen et al. [5] and Bröder et al. [17].

### 4.2. Internal Consistency

The internal consistency index (Cronbach's $\alpha > 0.7$) [89] for scale A turned out to be sufficient. However, the values for the other scales were poor, particularly for scale C that assessed affective/conative components (Cronbach's $\alpha = 0.54$). Interestingly, similar low reliability values were

reported for the HELMA for a comparable scale in terms of content [70] (the self-efficacy scale with 4 items, Cronbach's $\alpha = 0.61$) and for an instrument developed by Schmidt [25] (the health-related attitudes scale, $\alpha = 0.57$). This finding may be a result of the complexity of the single components (self-awareness, self-efficacy, motivation, etc.), which were represented with only five individual items. The low internal consistency could be caused by ceiling effects (meaning lower variance) on the item level which also we found for other scales. A further cause of the low value may be linked to our sample. In a very homogeneous sample in which there are hardly any differences between individuals, the reliability may be lower than in a heterogeneous sample with significant differences between persons [90]. In addition, the index of internal consistency is sensitive to the number of items (higher values with a higher number of items in a scale) and can be biased if the scale components are not essentially tau-equivalent (i.e., do not have equal factor loadings) or there is not a single common factor measured [91]. Therefore, further research is needed to examine how this scale performs in other samples and whether modified scale with additional items would result in improved measurement reliability.

### *4.3. Testing of Health-Related Knowledge (Scale D)*

According to our conceptual framework, health-related knowledge is a core cognitive component of health literacy. Through the qualitative methods [32,33], we observed that adolescents tended to overestimate their skills. Thus, we integrated a few health-related knowledge questions into the instrument as a performance-based, objective measurement approach. We followed a mixed-method approach combining subjective and objective measurements, as recommended in the literature [19,92]. However, in the quantitative pretest, we found a moderate relationship of scale D with the scale measuring functional health literacy (the NVS) and only a weak relationship between scale D and A. No correlation was found with scales B and C. This finding is in line with the study by Schmidt et al. that found no statistical relationship of knowledge with the self-reported health literacy scales (measuring health-related self-efficacy, communication and attitudes) [25]. Our result may indicate that although health-related knowledge is connected to other core components of the broad concept of health literacy on the theoretical level [14,17,58], it is not necessarily closely linked to these components on the empirical level.

Testing health-related knowledge in this target group or in self-administered questionnaires in general entails some challenges and inherent limitations that also affected our study. Health-related knowledge is dynamic because of new evidence gained from health sciences, which requires ongoing updates to relevant items. A further difficulty is related to determining which health-related knowledge is essential and is practically relevant in adolescents' lives. Hence, testing knowledge usually involves testing only some aspects of knowledge, as in the MOHLAA-Q. Another difficulty is composing questions that represent the age-relevant aspects of health-related knowledge in cognitively different age groups and that take into account gender-specific aspects of health literacy. Furthermore, with self-administered instruments that are used at home, it cannot be ensured that respondents answer the questions without any support of other persons or technical devices (which may cause measurement error and jeopardize the reliability of measurement). These constraints to testing health-related knowledge should be considered when interpreting results relating to scale D of the MOHLAA-Q. Regardless of whether health-related knowledge could be measured more comprehensively, accurately, and specifically (related to different health topics) in educational settings, a measurement of this health literacy component in a population-based survey should focus on questions relating to practical knowledge.

### *4.4. Consideration of the Role of Social Agents (Scale E)*

Our results confirmed, as shown in other studies, a key role of social agents, particularly parents, in adolescents' seeking and critical assessing health information and the complementary role of internet searches [13,79,93]. Therefore, Scale E ("Support for health-related issues by social agents") was

included in our instrument to assess this topic. However, due to the low internal consistency of this scale, the scale was discarded from the current version of the MOHLAA-Q. The low correlation of items within the scale may be a result of the variation in personal sources (doctor, parents, friends, and persons in school or work setting). Adolescents are likely to view and treat these personal sources differently based on the health subject matter [71]. Not only can adolescents' perceptions of the health literacy of social agents vary greatly but also do these agents' own levels of health literacy, causing indirectly low item correlation. Our findings suggest that future research should examine the nuances of accessing health information from personal sources and to what extent these sources influence adolescents' health literacy. This suggestion is supported by other international studies that have found positive associations between parents' educational level, literacy, and health literacy on the one hand and adolescents' health literacy on the other hand [94,95].

### 4.5. Strengths and Limitations

In summary, our study highlights different challenges of operationalizing and measuring the broad concept of health literacy in adolescents. Referring to the latest established recommendations for the development and validation of pragmatic health literacy measures [19,57], we successfully drew on the current research in this age group and assessed the content validity of the instrument with health literacy experts. The items aim to capture characteristics of this period of life by asking about health risks and consequences of risky behavior (cf. Supplementary Materials Figure S2, item 6, 8, knowledge questions). We conducted qualitative and quantitative testing with the target group to ensure that our tool is relevant, understandable and measures what is intended to be measured (face validity). Those findings support the validity of the instrument. Further, we extensively evaluated the psychometric properties of the tool (multiple forms of validity, including structural, convergent and concurrent validity) in a large random sample. However, to ensure that our tool meets other criteria (e.g., that it is "actionable", "broadly applicable", "useful across settings", etc.) [57], an ongoing development process is required. The current version of the MOHLAA-Q was applied in an additional online survey in 2019 in a representative Germany-wide sample ($n \approx 1200$). Renewed examination of the structural validity, of internal consistency and a determination of the cut-off points and a classification scheme for the categories of self-reported health literacy assessed by the tool are planned with data on a representative sample.

The strength of measuring health literacy by self-reports is the consideration of respondents' personal perspectives, especially, their interest and attitudes regarding seeking health-related information. However, one of the developmental characteristics of adolescents is a high drive for social recognition. Adolescents may answer questions in a socially desirable way with a tendency to overestimate their skills, which has been discussed elsewhere [32]. This possible interpretation can also be supported by ceilings effects we found for all scales in the pretest. It should be noted that ceiling effects could also be observed for similar instruments applied in adult populations [35,37,64]. Nevertheless, we believe the positive self-estimation and social desirability can partly be counteracted by ensuring that adolescents can fill out the questionnaire absolutely anonymously, outside of a context where social desirability plays a major role, e.g., in the class room. Further, the inclusion of a performance-based task (scale D) allows a performance-based estimation which is not prone to social desirability.

In our study design, we included the perspective of adolescents through qualitative testing of the drafts with $n = 38$ adolescents. Thus, we were able to adjust the item content and wording based on adolescents' cognitive development states and needs. However, adolescents did not take part in the item selection. With only two FGs that were composed exclusively based on age-ranges, achievement of data saturation cannot be claimed. Participant inclusion in the earlier questionnaire development steps might have improved the resulting questionnaire's acceptability and relevance for the target group [19,96]. Additionally, involvement of more experts who work with adolescents on a regular

basis (e.g., teachers, nursery school teachers, school nurses) or also involvement of parents could have resulted in items that are as relevant to everyday life of adolescents as possible.

The further limitations relate to the methodology of the standardized pretest: to examine the convergent validity, we used the HLAT-8 and the NVS. The first instrument has not been validated for our target group (14 to 17-year-olds) in the German language, only in Chinese [97]. However, according to the systematic review on the quality of health literacy instruments used in children and adolescents, the HLAT-8 shows the best construct validity among the 29 considered instruments [18]. In the case of the NVS, we adapted the tool as a paper-and-pencil questionnaire. In this way, we modified the original mode of data collection, which may have altered the validity of the NVS. Only one study, from the USA, has applied the NVS as a self-administered written questionnaire among adolescents [44], and one study, from Iran, used the NVS with exclusively female adolescent students [98]. In those studies, the NVS performed well. Apart from the validation instruments, the results of the convergent validity for scale B and C should be interpreted with more caution, as only scale A met the required threshold for internal consistency. However, the values of correlation coefficients with the HLAT-8, the self-efficacy scale and the self-reported health status are similar over the scales and thus support the assumption of the convergent validity also for those scales.

Due to financial and time constraints, it was not possible to evaluate the test-retest reliability of the tool and thus measure the test consistency over time. This property is seen as an indicator of replicable and stable results [51], which will be important if the MOHLAA-Q is be applied in longitudinal studies.

Our stratified random sample included a high proportion of participants who desired or had achieved a high school certificate (approximately 75% vs. the expected 47%) [99] and a higher proportion of females than males (approximately 59% vs. the expected 50%). Such a homogeneous composition of our validation sample may have positively impacted the item difficulty indices and negatively impacted reliability values because of the smaller sample variance. Moreover, we did not collect data on non-responders, which would have provided additional insights into the validity of the results and helped to quantify sample bias.

## 5. Conclusions

Our study highlights key challenges and borders when trying to operationalize such an extensively multidimensional and broad construct as manifested by health literacy. Among those challenges was the requirement of achieving satisfactory internal consistency in all of the various scales, which was not achieved fully in this study. The most criteria of construct validity were achieved in scale A derived from the HLS-EU-items. Thus, further revision and testing in other samples is necessary to re-examine structural validity of the MOHLAA-Q and to improve the internal consistency of two scales.

The strength of our tool is that it is tailored as much as possible to the traits of health literacy in adolescence and goes beyond the assessment of perceived difficulties in dealing with health information, namely, by operationalizing health-related communication and the affective and conative components of health literacy. By complementing the tool with health-related knowledge questions, we used the recommended mixed-method measurement approach. The MOHLAA-Q reflects the multidimensionality of the health literacy construct, which is evident in the conceptualization of generic health literacy in adolescence.

**Supplementary Materials:** The following are available online at http://www.mdpi.com/1660-4601/17/8/2860/s1, Figure S1: Response distribution of the 2nd draft of the MOHLAA-Q items (ceiling effects), Figure S2: Final version of the Measurement Health Literacy Among Adolescents - Questionnaire (MOHLAA-Q), Table S1: Development of the MOHLAA-Q: Overview of steps, results of stage 1 (development and qualitative testing) and implications for the MOHLAA-Q drafts, Table S2: Three- and four-factor solutions for scale A according to the HLS-EU-Q model ($n$ = 592).

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## Abbreviations

| | |
|---|---|
| CFA | Confirmatory Factor Analysis |
| CFI | Comparative Fit Index |
| CI | Cognitive Interview |
| df | Degrees of Freedom |
| EAs | Expert Assessments |
| FAS | Family Affluence Scale |
| FGs | Focus Groups |
| HLCA | Health Literacy in Childhood and Adolescence |
| HLS-EU-Q47-GER | German version of the European Health Literacy Survey Questionnaire, 47-item version |
| ITC | Corrected Item-Total Correlation |
| LR | Literature Review |
| MOHLAA-Q | Measurement of Health Literacy Among Adolescents Questionnaire |
| MSPSS | Multidimensional Scale of Perceived Social Support |
| NVS | Newest Vital Sign |
| HLAT-8 | Health Literacy Assessment |
| RMSEA | Root Mean Square Error of Approximation |
| TLI | Tucker-Lewis Index |
| WHO | World Health Organization |
| WLSM | Robust Weighted Least Square Mean-Adjusted |
| WRMR | Weighted Root Mean Square Residual |

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## Lebenslauf

Mein Lebenslauf wird aus datenschutzrechtlichen Gründen in der elektronischen Version meiner Arbeit nicht veröffentlicht.

Mein Lebenslauf wird aus datenschutzrechtlichen Gründen in der elektronischen Version meiner Arbeit nicht veröffentlicht.

## Publikationsliste

*Fachartikel mit Peer-Review*

| Beitrag | JIF |
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| Bollweg, T.M., Okan, O., Pinheiro, P., Broder, J., Bruland, D., Fretian, A.M., **Domanska, O.M**., Jordan, S. und Bauer, U., *Adapting the European Health Literacy Survey for Fourth-Grade Students in Germany: Questionnaire Development and Qualitative Pretest.* Health Lit Res Pract, 2020. 4(2): S. e119-e128. | N/A |
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