BMJ Open

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Journal:	*BMJ Open*
Manuscript ID	bmjopen-2019-034943
Article Type:	Original research
Date Submitted by the Author:	15-Oct-2019
Complete List of Authors:	Sarhan, Mohammed; The University of Tokyo, Graduate School of Medicine, Department of Community and Global Health Shannon, Harry ; McMaster University Fujiya, Rika; Keio University, Faculty of Nursing and Medical Care Jimba, Masamine; The University of Tokyo, Graduate School of Medicine, Department of Community and Global Health Giacaman, Rita; Birzeit University, Institute of Community and Public Health
Keywords:	PUBLIC HEALTH, Community child health < PAEDIATRICS, STATISTICS & RESEARCH METHODS

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Psychometric properties of an Arabic-language health literacy assessment scale for adolescents (HAS-A-AR) in Palestine

Mohammed B A Sarhan BDS, MPH [1], Harry S Shannon PhD [2], Rika Fujiya PhD [3], Masamine Jimba * MD, MPH, PhD [4], Rita Giacaman PharmD, MPhil [5].

[1] Department of Community and Global Health, Graduate School of Medicine, The University of Tokyo, Japan, PhD student, mohammed.ba.sarhan@gmail.com.

[2] McMaster University, Canada, Professor Emeritus, shannonh@mcmaster.ca.

[3] Faculty of Nursing and Medical Care, Keio University, Kanagawa, Japan, Assistant Professor, rfujiya@sfc.keio.ac.jp.

[4] Department of Community and Global Health, Graduate School of Medicine, The University of Tokyo, Japan, Professor, mjimba@m.u-tokyo.ac.jp.

[5] Institute of Community and Public Health, Birzeit University, Birzeit, Palestine, Professor, rita@birzeit.edu.

* Corresponding author: Masamine Jimba, Department of Community and Global Health, Graduate School of Medicine, The University of Tokyo TEL: +81-3-5841-3698 E-mail: mjimba@m.u-tokyo.ac.jp

Word count (3,867)

Number of tables (4)

Number of figures (1)

Number of supplements (1)

Abstract

Objectives: Health literacy research in Palestine is limited, and a locally validated tool for use among adolescents has been unavailable until now. Therefore, this study aimed to adapt health literacy assessment scale for adolescents (HAS-A) into Arabic language (HAS-A-AR) and Palestinian context and to investigate its psychometric properties.

Design: A cross-sectional household survey design.

Setting and participants: We conducted 1200 household face-to-face interviews with 12-15 years old adolescents in the Ramallah and al-Bireh district of the West Bank, Palestine.

Methods: We translated and adapted HAS-A to be sensitive to the Palestinian context and tested the psychometric properties of (HAS-A-AR). We evaluated face and content validity during the back-translation process. Then, we checked for construct validity through exploratory factor analysis (EFA). We tested for internal consistency using Cronbach's alpha (α), MacDonald's omega test (ω) and the greatest lower bound (GLB). Furthermore, we calculated the scale's average inter-item correlation.

Results: EFA revealed that HAS-A-AR has a similar structure to the original HAS-A. It extracted three factors (communication, confusion and functional health literacy) whose eigenvalues were >1. Together they explained 57% of the total variance. The proportions of adolescents with high levels of communication, confusion and functional health literacy were 45%, 68%, and 80%, respectively. Cronbach's alpha (α), MacDonald's omega (ω) and the greatest lower bound (GLB) values for HAS-A-AR three subscales were > 0.7. The average-inter-item correlation for the subscales ranged between 0.36 and 0.59.

Conclusion: HAS-A-AR is a valid and reliable health literacy measuring instrument with appropriate psychometric properties. HAS-A-AR is now available for use in Palestine and the surrounding Arab countries with similar characteristics as Palestine, including language, culture, and political instability.

Word count: 272

Keywords: Public health, community child health, statistics and research methods

Strengths and limitations of this study

- In this study, we developed the Arabic version of health literacy assessment scale (HAS-A-AR), which is the only valid and reliable scale in the Arabic language. HAS-A-AR was developed to assess adolescent health literacy and it is sensitive to the Palestinian context.
- In this study, we used a representative sample of Palestinian adolescents from Ramallah district. We included adolescents from all social groups; those who live in urban, rural and refugee camps.
- We can assume that the HAS-A-AR is an appropriate instrument to use among all adolescent age groups since it has a similar structure to the original HAS-A.
- We used various tests to measure HAS-A-AR psychometric properties. However, we could not perform a criterion validity test due to the lack of a gold standard tool.

Introduction

Health literacy is gaining attention globally and becoming a priority to governments, health sectors [1] and researchers [2]. It can help individuals engage in health-promoting activities, participate in screening programs and use preventive services [3]. Even though health literacy needs to be approached from a public health perspective [4], its primary focus has been on health care services [3], given the influence it has on health status, health outcomes [5], medical expenditure, proper use of health services [6], and adherence to health care and medications [7]. Attention has also been directed towards the need for patients to take a central role in the management of their health [8]. In general, patients have low levels of health and medical information, where it is estimated that 40-80% of received medical information is lost almost immediately [9]. While the method of information delivery is critical, persons with low levels of health literacy also find difficulties in remembering both spoken and written medical information [9 10].

The complex health care services requires persons to use a wide range of health literacy skills [11]. The required skills should be more than basic reading and numeracy skills, as emphasized by some of the available health literacy measures [12]. Health literacy has to be more comprehensive by including communication, understanding, problem-solving, and decision-making skills [12]. It also has to include skills which persons need to navigate the health care system and critique health information to receive better health care [11]. Sørensen et al. stated that health literacy "entails people's knowledge, motivation and competencies to access, understand, appraise, and apply health information in order to make judgments and take decisions in everyday life concerning healthcare, disease prevention and health promotion to maintain or improve quality of life during the life course" [13]. In this definition, they captured all the essential aspects of the health literacy concept by focusing on public health and medical approaches and emphasizing on health literacy's vital competencies that are necessary to navigate complex health care systems [3].

Health literacy research related to adolescents is limited in the literature [14-16], likely as the proper tools to measure it is not available for this age group. This is a significant research gap as adolescents gain more autonomy at this stage of their lives [16], and thereby become more aware of their rights, ready to take decisions on their own and have a more active role in dealing with their health care [16 17].

In the Middle East, health literacy research has increased recently. However, a few studies have focused on testing the psychometric properties of health literacy instruments, and have measured health literacy levels among adolescents [18-20]. For example, the Health Literacy Measure for Adolescents (HELMA) [18], and the Health Literacy for School-Aged Children (HLSAC-T) scale [20] were developed and tested for their psychometric properties in Iran and Turkey

respectively. However, the quantity of health literacy scales production, and testing the psychometric properties of health literacy scales in the Arabic language continues to be low [1]. In Lebanon, a study validated the Arabic versions of the Rapid Estimate of Adult Literacy in Medicine revised (REALM-R) and the Short Test of Functional Health Literacy for Adults (S-TOFHLA) [1]. In Saudi Arabia, a study validated the Arabic Rapid Estimate of Adult Literacy in Dentistry (AREALD-30) [21], while an Iraqi survey validated the Newest Vital signs (NVS) and S-TOFHLA in Iraq [22]. Moreover, in Egypt, a study used the Arabic versions of the Swedish Functional Health Literacy Scale (S-FHL scale) and the European Health Literacy Survey Questionnaire (HLS-EU-Q16) among patients older than 15 years attending a tertiary health care facility [23]. Finally, the health literacy of Palestinian adult patients with type 2 diabetes mellitus was studied recently in Palestine [24 25]. In the Arab World, the adapted health literacy scales are mainly targeting adults, not adolescents.

The Health Assessment Scale for Adolescents (HAS-A) is a self-reported scale for assessing the health literacy of adolescents. HAS-A mainly evaluates adolescent ability to navigate the health care system, including the communication process with their doctors about health issues or knowledge regarding medicines or illnesses. The original English-language HAS-A is a valid tool generated by including children from both clinical and community settings and was validated in New York. According to Manganello et al., using the HAS-A to assess adolescents' health literacy in medical and/or school settings could help providing adequate health promotion and health care activities [16]. Given the paucity of work on health literacy in adolescents and the scarcity of the Arabic-language health literacy scales for adolescents, this study was conducted to (i) translate the HAS-A into Arabic; (ii) adapt the scale to be sensitive to the Palestinian socio-economic context; and (iii) measure the psychometric properties of the new scale among Palestinian adolescents.

Methods

Health literacy assessment scale for adolescents (HAS-A)

HAS-A includes 15 questions divided into three subscales; communication, confusion and functional health literacy. Communication subscale focuses on oral communication and comfort when asking questions to health care professionals (HCPs), confusion subscale which focuses on the degree of confusion about received health information and functional health literacy, which evaluates reading ability and numeracy. For each subscale, adolescents had to choose among one of the following options (always=4, usually=3, sometimes=2, rarely=1, and never=0) for each item of the HAS-A. However, to adapt the HAS-A to the Palestinian context (see table 4), we added a sixth option to each item to reflect the fact that HCPs tend to talk about the adolescent health with parents rather than directly with the adolescent. For example,

we added the option “Doctor does not ask me” to the question “How often your doctor seems to understand you when you answer a question he or she asks?”. These added responses were given the same value as “Never” for calculating scores. We calculated scores by summing responses of the items. We considered those who scored 15 or more in the communication scale, less than 8 in the confusion scale and less than 12 in the functional health literacy scale as having a high health literacy level on the scale [16].

Translation and adaptation of HAS-A.

We based our translation methods and cultural adaptation of scales on the model created by Wild et al. [26]. In our study, the research team held several discussions to obtain an in-depth understanding of the HAS-A and to translate and culturally adapt it. Following the preparation stage, a native Arabic speaker who is fluent in English translated the scale into Arabic, and then two main researchers from Palestine reviewed the Arabic translation separately, followed by several discussions until they reached agreement and reconciliation of the two revisions, which produced the final forward translated version of the HAS-A.

We followed the same approach in the back translation process, as a native English speaker who is fluent in Arabic, back-translated the reconciled Arabic version into English. Again two main researchers reviewed the back translation separately, reaching an agreement as to its appropriateness. The two researchers met to compare the back-translated version with the original HAS-A version, agreeing that the final translated version was conceptually equivalent to the original one. Next, we piloted the Arabic version among a sample of adolescents representing the age, gender and locality distribution of our study’s target group. We measured the duration of interviews and checked questions for clarity and comprehensibility. This was done by taking into consideration reading the interviewer’s report on the interviews and by asking the adolescents if they found any difficulty in understanding or answering any questions. Based on the pilot results and expert opinions, we made final adjustments to the questionnaire.

Design and Sampling

This survey targeted 1200 Palestinian households with 12-15 years old children who live in the Ramallah and al-Bireh district of the West Bank. We followed a cross-sectional household survey design. To have a representative sample, we divided the Ramallah and al-Bireh district into three strata according to locality type: urban, rural, and refugee camps. We obtained a list of all locations within each locality type from the Palestinian Central Bureau of Statistics (PCBS). We chose a random sample of urban, rural, and Palestinian refugee camp locations to include in the study. Each location was divided into geographic cells to facilitate the process of data collection; each cell contained almost 150 households. We then chose a random sample of cells from each selected location. We included 60 cells in the study, 23 urban, 22 rural and 15 refugee camps, randomly choosing 20 households from each cell. Whenever we found more

than one child between the ages of 12-15 in the household, we used the Kish grid method to choose one child randomly. As the number of Palestinian refugee camp residents was low compared to urban and rural areas, we oversampled respondents from refugee camps. The final sample consisted of 460 urban, 440 rural, and 300 camp households. Given the unequal probabilities of selecting respondents, we calculated sample weights. The overall probability of choosing any adolescent was the product of the probabilities of choosing a cell within the locality (P_c), choosing a household within the cell (P_h), choosing a household including at least one age-eligible child (P_e), and choosing the child within the household (P_a). The sample weight was the inverse of this overall probability.

$$\textbf{Probability of choosing an adolescent } (P_{tot}) = P_c * P_h * P_e * P_a$$

Evaluation of the psychometric properties of HAS-A-AR

To evaluate the psychometric properties of HAS-A-AR, we used different validity methods. First, we evaluated face and content validity during the translation process. A group of experts revised the HAS-A several times during the back-translation process [27]. Those experts were members of the research team and an official from the Ministry of Education. To check the construct validity, we performed an exploratory factor analysis (EFA) [28 29]. We used the entire data set for EFA. We did not do a formal sample size calculation in advance, but a sample of 1000 or more is considered to be excellent for EFA [30]. For sampling adequacy of the EFA, we used the Kaiser-Meyer-Olkin (KMO) test (KMO>0.50), and Bartlett's test of sphericity (*p* value<0.05) [31]. To check for the absence of multicollinearity, we checked if the determinant value was higher than 0.00001 [32]. Moreover, we used anti-image correlations to determine if reliable factors could be generated (cut-off>0.5) [32]. To determine the number of factors, we used a scree plot and Kaiser's criterion (eigenvalues>1), which states that items with eigenvalues greater than one should be retained [32]. However, we also performed a confirmatory factor analysis (CFA) on the same sample to check the overall goodness fit of model [33]. To determine the reliability we used various measures: we tested for internal consistency using Cronbach's alpha (α) [34], MacDonald's omega test (ω) [35], and greatest lower bound (GLB) [36]. Furthermore, we calculated inter-item correlations [37 38], average inter-item correlation [39 40] and item-rest correlations [37 41] (Table 1).

Table 1. Reliability criteria for this study

Reliability statistics	Criteria
Cronbach's alpha (α)	Greater than 0.7
MacDonald's omega (ω)	
Greatest lower bound (GLB)	
Inter-item correlations	Greater than 0.3
Average inter-item correlation	Between 0.15-.50
Item-rest or item-to-total correlations	Greater than 0.4

Statistical analysis

We used the JASP 0.9.2.0 software to calculate MacDonald's omega and greatest lower bounds (GLB); while we used IBM SPSS V24 software to perform all other statistical analytic procedures including the descriptive analysis of the sample characteristics, HAS-A-AR scores and health literacy levels, taking in consideration the sampling weights.

Ethical approvals

We obtained ethical approvals from the Research Ethics Committee of the Graduate School of Medicine, the University of Tokyo, and The Research Ethics Committee (REC) of Birzeit University. We informed adolescents of what the study was about, why we were conducting this study; that they were not obliged to participate in the study if they did not wish to; that they were able to refuse to answer any question they did not want to answer; and that they could withdraw from the study at any time they wished. We obtained adolescent's oral consent following disclosure and explanation, with field workers signing the disclosure form confirming they have read the disclosure form and that they have obtained oral consent from participants. Oral consent (in non-invasive procedures) is what the REC at Birzeit University guidelines stipulate, given that local experience indicates that people become suspicious and ill at ease if you ask them to sign their names on paper.

Patient and Public Involvement

It was not appropriate or possible to involve patients or the public in the design, or conduct, or reporting, or dissemination of our research.

Results

Sample characteristics

Almost 99% of approached households agreed to participate in this study. Fifty-one per cent of the adolescents in this study were females, with an average age of 13.5 (1.1) years. The majority had completed at least the 6th grade (primary school) at the time of interviews. More than half of them (61%) reported having "very good" or "excellent" school averages. Almost 30% and 26% of their mothers and fathers had higher than high school education, respectively. The majority (92%) reported that their fathers were currently employed, compared to 72% of mothers who were working outside the home (employed). Internet was available to almost 87% of households (table 2).

Table 2 Sociodemographic characteristics of adolescents		N	% $^{+}$
Gender	Male	590	49
	Female	610	51
Age group	< 12 years	21	1.8
	12 - <13	399	33.2

	13 - < 14	272	22.7
	14 - <15	292	24.3
	≥ 15	216	18.0
The class graduated from last year N=1197	6th grade	374	31.3
	7th grade	277	23.2
	8th grade	285	23.8
	9th grade	254	21.2
	Left school	7	0.6
School average N=1197	Excellent	292	24.4
	Very good	444	37.1
	Good	315	26.3
	Fair	110	9.2
	Poor	35	2.9
Mother's educational level N=1136	Not educated	37	3.2
	Educated till high school	756	66.5
	Higher than high school	343	30.2
Father's educational level N=1199	Not educated	41	3.8
	Educated till high school	775	70.4
	Higher than high school	285	25.9
Mother has job	Yes	359	29.9
	No	839	69.9
	Do not know	2	.2
Father has job N=1199	Yes	1103	92.0
	No	90	7.5
	Do not know	6	0.5
Internet access	Yes	1038	86.5
	No	162	13.5
+ Weighted percentages			

Arabic health literacy assessment scale for adolescents (HAS-A-AR)

We summarized the results of HAS-A-AR in tables 3 and 4. The HAS-A scales results showed that only 45% of adolescents had a high level of health literacy in terms of interpersonal communication. However, almost 68% of them showed high levels of health literacy according to HAS-A-AR confusion subscale, while 80% showed high health literacy in their ability to read and understand health information (table 3). The context-related categories that we added to HAS-A scale items showed a wide range of frequencies. Some items had relatively low rates such as "How often does your doctor seem to understand you when you answer a question he or she asks?", with around 7% responding that their doctor does not ask them any questions. Others showed high frequencies as "How often do you think the forms you complete at your doctor's office are confusing?" where 54% of the adolescents reported that they do not complete forms at the doctor's office (table 4).

Table 3 Results of three scales of HAS-A-AR ††			
	Communication	Confusion +	Functional health literacy ++
Mean	13 (5.3) †	5.4 (3.8) †	7 (4.9) †
Median	14	5	6
Minimum possible	0	0	0
Maximum possible	20	16	24
High health literacy ‡	539 (44.9%) †	826 (68.8%) †	960 (80.3%) †
Low health literacy	661 (55.1%) †	374 (31.2%) †	236 (19.7%) †
Cronbach's α	0.87	0.78	0.77
McDonald's ω	0.88	0.77	0.77
Greatest lower bound (GLB)	0.90	0.79	0.80
Average Inter-item correlation	0.59	0.45	0.36

+ N=1199, ++ N=1196

‡ High health literacy subscales: communication (15-20), confusion (0-7), and functional health literacy (0-11)

† weighted means and percentages

†† HAS-A-AR: An Arabic translated version of HAS-A

Psychometric properties of HAS-A-AR

Validity

Face and content validity testing revealed that all items were understandable with minor modifications made. Based on the Scree plot and eigenvalues, we decided to retain three factors (figure 1). We performed EFA using the principal axis factoring method of extraction. The overall KMO statistic was 0.89, while Bartlett's test of sphericity was significant ($\chi 2$ (1200) = 6505.6, $p<0.001$). Anti-image correlation matrix diagonal values were all > 0.8. We found that our sample did not have the issue of multicollinearity. Factor 1 (Communication) included five items that explained 33% of the variance with factor loadings range from 0.62 to 0.82. Factor 2 (functional health literacy) included six items that explained 17% of the total variance with loadings range between 0.40 and 0.76, while factor 3 (confusion) included four items that explained 7% of the total variance with loadings between 0.47 and 0.83. Even though the chi-square statistic was statistically significant ($P < 0.001$), other goodness of fit measures showed that the model had a good fit. Root mean square error of approximation (RMSEA) was 0.57. Tucker-Lewis index (TLI) and comparative fit index (CFI) values were 0.95 and 0.94, respectively, while standardized root means square residual (SRMR) was 0.038.

Figure 1

Reliability analysis

Reliability analysis showed that HAS-A-AR, which consists of 15 items, is a reliable scale (α = 0.85, ω=0.88, GLB=0.90) (table 4). Inter-item correlations for all items of factors 1 and 3 were more than 0.3, while in factor 2, inter-item correlations between item 3.5 and both items 3.1 and 3.2 were slightly below 0.3 (Supplement 1). Average Inter-item correlation for all HAS-A-AR scales combined is 0.28. The average-inter-item correlation for the subscales range was between 0.36 and 0.59. Item-rest correlations were all above 0.4 (Table 4).

Table 4 HAS-A-AR items and their psychometric properties

	HAS-A items with the added responses			Factor loading			Reliability
	Items ++	Added response	Weighted % of added response	F1+	F2*	F3+	IRC†
1.1	How often is it easy for you to ask your doctor questions about your health?	There is no special doctor	18.6	0.62			0.61
1.2	How often does your doctor understand what you mean when you ask him or her, a question about your health?	I don't ask the doctor	9.6	0.81			0.75
1.3	How often can you easily describe a health problem you have to your doctor?	Not me who describes my health problem for the doctor	10.4	0.82			0.73
1.4	How often does your doctor seem to understand you when you answer a question he or she asks?	The doctor doesn't ask me	7.2	0.79			0.72
1.5	How often do you understand the answers your doctor gives to your questions?	I don't ask the doctor any questions	8.1‡	0.79			0.72

2.1	How often do you get confused because you find different information about the same health topic?	I don't search/find information	15.3			0.47	0.49
2.2	How often do you get confused when your doctor tells you about taking medicine?	The doctor doesn't talk with me about medicine	14.3			0.72	0.58
2.3	How often do you get confused when your doctor tells you about possible side effects from a medicine or treatment?	The doctor doesn't tell me about possible side effects from a medicine or treatment	22.9 ‡			0.83	0.66
2.4	How often do you get confused when your doctor tells you about test results, like results of an X-ray?	The doctor doesn't tell me about test results, like results of an X-ray	28.1 ‡			0.56	0.55
3.1	How often do you get confused when reading instructions for medicine?	I don't read instructions for medicine	29.1		0.40		0.5
3.2	How often do you have problems learning about an illness or health topic because of difficulty understanding the written information you get?	I don't get information about illness or health topic	22.7 ‡		0.47		0.49
3.3	How often do you think the forms you complete at your doctor's office are confusing?	I don't complete forms at my doctor office	54.1 ‡		0.55		0.54

3.4	How often are you confused by health information that has a lot of numbers and statistics?	I don't read such health information	37.8 ‡‡		0.62		0.55
3.5	When you talk to people other than your doctor about health issues, how often are you confused by what they tell you?	I don't talk to other people than my doctor	22.7		0.54		0.46
3.6	When reading brochures or hand-outs about health issues, how often do you need someone to help you read them?	I don't read brochures or hand-outs about health issues	30.3		0.76		0.53

† IRC: Item-rest correlation (item-total correlation)

++ HAS-A original English-language questions

Note. Of the observations, † 1199 were used, 1 was excluded listwise, * 1196 were used, 4 were excluded listwise, and 1200 were provided. ‡ 1 missing case, ‡‡ 2 missing cases

-Eigenvalue: factor 1= 4.937 (33% of variance), factor 2= 2.570 (17% of variance), factor 3= (7% of variance)

-Extraction Method: Principal Axis Factoring.

-Rotation Method: Promax with Kaiser Normalization.

-Determinant = 0.04

-Kaiser-Meyer-Olkin Measure of Sampling Adequacy= 0.886

-Bartlett's Test of Sphericity = 6505.6 (p<.0.001)

Discussion

In this study, we applied published methods for translation of the HAS-A to provide an Arabic version of this tool (HAS-A-AR). Adolescents clearly understood the translated version, and testing its psychometric properties showed that HAS-A-AR is a valid and reliable tool to be used for measuring health literacy among Palestinian adolescents living in the Ramallah District.

Psychometric properties

Adding the extra options in HAS-A-AR that we think are relevant for the Palestinian context did not change the factor structure. The initial step of validation of the Arabic version of HAS-A-AR was testing the factorial structure [42]. EFA revealed that HAS-A-AR has a similar structure to the original HAS-A, which supports the usage of similar scoring methods. Solid and stable factors need to have minimum factor loadings between 0.4 and 0.5 [12 28]. All of the factor loadings were >0.5 except two, which were ≥0.4. Therefore, we retained all the original HAS-A items. Around 57% of the variance is explained by the three retained factors, which is close to 60%, the value

that Hair et al. reported as acceptable to consider the construct to be valid [37]. This pattern of factor loadings and model fit suggests that the HAS-A-AR has adequate construct validity.

Cronbach's alpha values suggest that HAS-A-AR has good internal consistency. Compared to the reliability testing of the original HAS-A [16], the Arabic version showed a higher (α) for the communication and confusion scales and was similar for the functional health literacy scale. However, in the literature, there is some debate regarding the adequacy of Cronbach's alpha (α) to assess the reliability of scales, especially those with ordinal items, as this may bias the measured reliability of the tested scale [43]. Alternatives were suggested such as MacDonald's omega test (ω) [35], and greatest lower bound (GLB) [36] as preferable to α. Since authors are recommended to report reliability estimates other than (α) [44], we measured ω, GLB, and α (for comparability with other studies). Values of reliability measures, which are higher than 0.7, indicate that the scale is reliable [34 45 46]. Therefore, our results suggest that HAS-A-AR is a reliable instrument to be used in this population.

Furthermore, the average inter-item correlations also indicate good internal consistency. The recommended range of average inter-item correlation is between 0.15-0.5 [47]. The confusion and functional health literacy scales' average inter-item correlations were within the recommended range, while the communication scale's average inter-item correlation was slightly higher than 0.5. This indicates that items in the confusion and functional health literacy and to a lower extent, the communication scale, are homogenous, enough to describe the same construct but still have their unique variance that distinguishes one from the other. In general, these results provide additional support for the reliability of the measure.

Health literacy

In this study, the percentage of adolescents choosing the added responses, which expressed a lack of active involvement with their health care, was relatively high in most questions. We expected such a pattern, as it emphasizes a gap in interaction and communication between the Palestinian adolescents and their health care providers (HCPs). The quality of communication with HCPs is also essential, especially to the subsequent empowerment of individuals, as the way of communicating can be a facilitator or a barrier for health information exchange [48]. Neuroscience research indicates that adolescents can possess adequate communication skills essential for their ability to make medical or health-related decisions [48]. Good communication between the Palestinian adolescents and their HCPs has to be created to enhance adolescents' health literacy competencies, which may impact on the received health care services quality.

Moreover, adolescents in this study showed a low level of health literacy. Compared to American adolescents [16], the adolescents of this study had similar levels of functional health literacy, but reported lower communication skills and were more likely to be confused regarding health information. This could be because Palestinian adolescents lack the autonomy

to participate actively in decision making regarding their health. Parents usually have the power to communicate directly with HCPs and make health-related decisions on behalf of their children. However, it is worth noting that being in control can enhance the feeling of confidence, which in turn will contribute to an active role and involvement in health [49]. The age of 12 might be when adolescents start to possess the competencies for that enable to have an active role in medical or health-related decision making [48]. In the Netherlands, 12-17 years old adolescents expressed their desire to be involved in health-related decision making with advice from their parents [50]. Encouraging shared decision making between Palestinian adolescents and their parents may help improve adolescent health literacy levels.

Strengths and limitations

Using a representative sample of Palestinian adolescents from Ramallah district, including all social groups who live in urban, rural and refugee camps is strength of this study. We were unable to include adolescents from other cities in the West Bank or Gaza Strip due to financial and political considerations. However, residents from all over the West Bank and to a lower extent from the Gaza strip tend to move to live and work in Ramallah since it is an economic center in Palestine. This can, to some extent, overcome the issue of only including the Ramallah district in our study. We included in the study adolescents aged 12-15 years, so we cannot generalize the results to all adolescents' age groups. However, the original HAS-A targeted a wider age group, and since our results were similar to the original HAS-A, it may be reasonable to assume that the HAS-A-AR is an appropriate instrument to use among all adolescent age groups.

The meticulous translation process that involved experts with multiple revisions, and the fact that adolescents faced no problems in understanding questions during interviews is another strength of this study. The addition of the extra options to the questionnaire to make it relevant to the Palestinian context and maybe to other countries in the Arab region is also strength of this study. Since concerns regarding the reliability of self-reported scales were noted [16], conducting face-to-face interviews could be one of the reasons for the high response rate in our study, especially that interviews were with adolescents who may not have completed a self-administered questionnaire as required. We used various tests which showed that HAS-A has good psychometric properties. However, we could not perform a criterion validity test due to the lack of a gold standard tool. Even though we performed CFA to confirm the results of EFA, we need to perform CFA using different samples in the future.

Conclusion

Health literacy research in Palestine is limited, and a locally validated tool for use among adolescents has been unavailable until now. This study demonstrates that HAS-A-AR has good construct validity and reliability. Thus, the HAS-A-AR is now available for use in Palestine and

the surrounding Arab countries that have similar characteristics as Palestine, including language, culture, and political instability. Further research is needed to check for the other psychometric properties of the tool or to use the scale to evaluate adolescent health literacy and its associated factors. Even though a public health-related health literacy approach is highly recommended, medical health literacy is also important, especially for adolescents [4], as using health literacy measures in medical settings may lead to better understanding of the needs of adolescents and therefore increase their involvement in their health, and may also lead to improving the quality of health services provided for adolescent.

Footnotes

Contributorship statement

Study design: MBAS, RF, MJ, RG. Direct supervision on data collection: MBAS, RG. Development and revision of methods and measures: MBAS, HSS, RF, MJ, RG. Data analysis: MBAS. Revision of statistical analysis: HSS. Interpretation: MBAS, HSS, RF, MJ, RG. Writing of the first and final version of the manuscript: MBAS. Revision for important intellectual content: MBAS, HSS, RF, MJ, RG. All authors approved the final version for publication.

Funding

This work was supported by JSPS KAKENHI Grant Number 16KT0039.

Competing interests

None declared.

Ethics approval

We obtained ethical approvals from the Research Ethics Committee of the Graduate School of Medicine, the University of Tokyo (Ethical approval nr: 11545-(1)), and The Research Ethics Committee (REC) of Birzeit University (Ethical approval nr: 161013).

Provenance and peer review

Not commissioned; externally peer-reviewed.

Data availability statement

Data are available upon reasonable request.

Patient and Public involvement

Not applicable.

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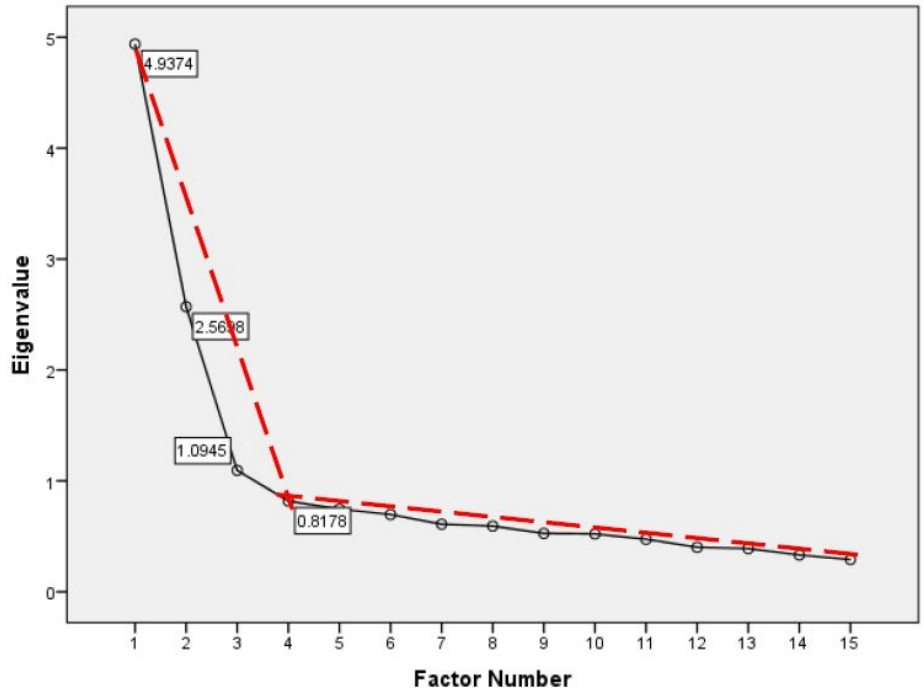

Figure 1: Scree Plot and the eigenvalues of the three retained factors and one non-retained factor

215x153mm (96 x 96 DPI)

Psychometric properties of an Arabic-language health literacy assessment scale for adolescents (HAS-A-AR) in Palestine

Supplement 1: Inter-item correlations of the factors retained

Factor 1 Spearman Correlations

		1.1	1.2	1.3	1.4	1.5
1.1	Spearman's rho	—				
	p-value	—				
	Upper 95% CI	—				
	Lower 95% CI	—				
1.2	Spearman's rho	0.569	—			
	p-value	< .001	—			
	Upper 95% CI	0.606	—			
	Lower 95% CI	0.530	—			
1.3	Spearman's rho	0.468	0.574	—		
	p-value	< .001	< .001	—		
	Upper 95% CI	0.511	0.611	—		
	Lower 95% CI	0.422	0.535	—		
1.4	Spearman's rho	0.421	0.524	0.570	—	
	p-value	< .001	< .001	< .001	—	
	Upper 95% CI	0.466	0.564	0.607	—	
	Lower 95% CI	0.373	0.481	0.530	—	
1.5	Spearman's rho	0.452	0.538	0.527	0.620	—
	p-value	< .001	< .001	< .001	< .001	—
	Upper 95% CI	0.496	0.577	0.567	0.654	—
	Lower 95% CI	0.406	0.496	0.485	0.584	—

Factor 2 Spearman Correlations

		3.1	3.2	3.3	3.4	3.5	3.6
3.1	Spearman's rho	—					
	p-value	—					
	Upper 95% CI	—					
	Lower 95% CI	—					
3.2	Spearman's rho	0.347	—				
	p-value	< .001	—				
	Upper 95% CI	0.395	—				
	Lower 95% CI	0.296	—				
3.3	Spearman's rho	0.381	0.354	—			
	p-value	< .001	< .001	—			
	Upper 95% CI	0.428	0.403	—			

	Lower 95% CI	0.331	0.304	—			
3.4	Spearman's rho	0.373	0.357	0.480	—		
	p-value	< .001	< .001	< .001	—		
	Upper 95% CI	0.420	0.405	0.522	—		
	Lower 95% CI	0.323	0.306	0.435	—		
3.5	Spearman's rho	0.284	0.267	0.303	0.332	—	
	p-value	< .001	< .001	< .001	< .001	—	
	Upper 95% CI	0.335	0.319	0.354	0.382	—	
	Lower 95% CI	0.231	0.213	0.251	0.281	—	
3.6	Spearman's rho	0.375	0.326	0.328	0.391	0.430	—
	p-value	< .001	< .001	< .001	< .001	< .001	—
	Upper 95% CI	0.423	0.375	0.378	0.438	0.475	—
	Lower 95% CI	0.325	0.274	0.277	0.342	0.383	—

Factor 3 Spearman Correlations

		2.1	**2.2**	**2.3**	**2.4**
2.1	Spearman's rho	—			
	p-value	—			
	Upper 95% CI	—			
	Lower 95% CI	—			
2.2	Spearman's rho	0.389	—		
	p-value	< .001	—		
	Upper 95% CI	0.436	—		
	Lower 95% CI	0.340	—		
2.3	Spearman's rho	0.413	0.545	—	
	p-value	< .001	< .001	—	
	Upper 95% CI	0.458	0.584	—	
	Lower 95% CI	0.364	0.504	—	
2.4	Spearman's rho	0.335	0.421	0.553	—
	p-value	< .001	< .001	< .001	—
	Upper 95% CI	0.384	0.466	0.591	—
	Lower 95% CI	0.283	0.373	0.513	—

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6,7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	
Bias	9	Describe any efforts to address potential sources of bias	N/A
Study size	10	Explain how the study size was arrived at	6,7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5,6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7,8
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	N/A
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	7
		(*e*) Describe any sensitivity analyses	N/A
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6 (only participants number)
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	8-10 (tables 2 and 3)
Outcome data	15*	Report numbers of outcome events or summary measures	9-12
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	N/A
		(*b*) Report category boundaries when continuous variables were categorized	10 (table 3)
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	13-15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15, 16
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Psychometric properties of an Arabic-language health literacy assessment scale for adolescents (HAS-A-AR) in Palestine

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2019-034943.R1
Article Type:	Original research
Date Submitted by the Author:	14-Feb-2020
Complete List of Authors:	Sarhan, Mohammed; The University of Tokyo, Graduate School of Medicine, Department of Community and Global Health Shannon, Harry ; McMaster University Fujiya, Rika; Keio University, Faculty of Nursing and Medical Care Jimba, Masamine; The University of Tokyo, Graduate School of Medicine, Department of Community and Global Health Giacaman, Rita; Birzeit University Institute of Community and Public Health
Primary Subject Heading:	Public health
Secondary Subject Heading:	Global health
Keywords:	PUBLIC HEALTH, Community child health < PAEDIATRICS, STATISTICS & RESEARCH METHODS

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Psychometric properties of an Arabic-language health literacy assessment scale for adolescents (HAS-A-AR) in Palestine

Mohammed B A Sarhan BDS, MPH [1], Harry S Shannon PhD [2], Rika Fujiya PhD [3], Masamine Jimba * MD, MPH, PhD [4], Rita Giacaman PharmD, MPhil [5].

[1] Department of Community and Global Health, Graduate School of Medicine, The University of Tokyo, Japan, PhD student, mohammed.ba.sarhan@gmail.com.

[2] McMaster University, Canada, Professor Emeritus, shannonh@mcmaster.ca.

[3] Faculty of Nursing and Medical Care, Keio University, Kanagawa, Japan, Assistant Professor, rfujiya@sfc.keio.ac.jp.

[4] Department of Community and Global Health, Graduate School of Medicine, The University of Tokyo, Japan, Professor, mjimba@m.u-tokyo.ac.jp.

[5] Institute of Community and Public Health, Birzeit University, Birzeit, Palestine, Professor, rita@birzeit.edu.

* Corresponding author: Masamine Jimba, Department of Community and Global Health, Graduate School of Medicine, The University of Tokyo TEL: +81-3-5841-3698 E-mail: mjimba@m.u-tokyo.ac.jp

Word count (4297)

Number of tables (4)

Number of figures (2)

Number of supplements (1)

Abstract

Objectives: Health literacy research in Palestine is limited, and a locally validated tool for use among adolescents has been unavailable until now. Therefore, this study aimed to adapt health literacy assessment scale for adolescents (HAS-A) into Arabic language (HAS-A-AR) and Palestinian context and to investigate its psychometric properties.

Design: We conducted a cross-sectional household survey using a stratified random sample and household face-to-face interviews.

Setting and participants: We conducted 1,200 interviews with 6th to 9th graders in the Ramallah and al-Bireh district of the West Bank, Palestine in 2017.

Methods: We translated and adapted HAS-A to be sensitive to the Palestinian context and tested its psychometric properties. We evaluated face and content validity during the back-translation process and checked for construct validity through exploratory factor analysis (EFA). We tested for internal consistency using Cronbach's alpha, MacDonald's omega test and the greatest lower bound (GLB). Furthermore, we calculated the scale's average inter-item correlation.

Results: EFA revealed that HAS-A-AR has a similar structure to the original HAS-A. It extracted three factors (communication, confusion and functional health literacy) whose eigenvalues were >1. Together they explained 57% of the total variance. The proportions of adolescents with high levels of communication, confusion and functional health literacy were 45%, 68%, and 80%, respectively. Cronbach's alpha, MacDonald's omega and the GLB values for communication were 0.87, 0.88 and 0.90, and they were 0.78, 0.77 and 0.79 for confusion, while for functional healthy literacy, they were 0.77, 0.77 and 0.80, respectively. The average-inter-item correlation for the subscales ranged between 0.36 and 0.59.

Conclusion: HAS-A-AR is a valid and reliable health literacy measuring instrument with appropriate psychometric properties. HAS-A-AR is now available for use among adolescents in Palestine and the surrounding Arab countries with similar characteristics as Palestine, including language, culture, and political instability.

Word count: 295

Keywords: Public health, health literacy, community child health, psychometric properties statistics and research methods

Strengths and limitations of this study

- This is the first study in Palestine which aimed to assess Palestinian adolescent health literacy.
- We validated an Arabic version of health literacy assessment scale for adolescents (HAS-A-AR) to be sensitive to the Palestinian context.
- HAS-A-AR is an appropriate instrument to use among 11-16 years old adolescents.
- We did not perform test-retest reliability analysis.
- We did not perform a criterion validity test due to the lack of a gold standard tool.

Introduction

Health literacy is gaining attention globally and becoming a priority to governments, health sectors [1] and researchers [2]. It can help individuals engage in health-promoting activities, participate in screening programs and use preventive services [3]. Sørensen et al. stated that "health literacy entails people's knowledge, motivation and competencies to access, understand, appraise, and apply health information in order to make judgments and take decisions in everyday life concerning healthcare, disease prevention and health promotion to maintain or improve quality of life during the life course" [4]. In this definition, they captured all the essential aspects of the health literacy concept by focusing on public health and medical approaches and emphasizing on health literacy's vital skills that are necessary to navigate through the complex demands of health in the current modern societies [3]. These required skills should be more than basic reading and numeracy skills, as emphasized by some of the available health literacy measures [5]. Health literacy has to be more comprehensive by including communication, understanding, problem solving and decision-making skills [5].

Health literacy needs to be approached from a public health perspective [6], an approach that has been recognized by the World Health Organization (WHO) in 2016, which considered health literacy as a public health goal to be achieved [7]. Consequently, health care and clinical facilities are less and less the recommended contexts for promoting health literacy. Rather, schools are increasingly becoming the place where health literacy of students is developed [8]. It is believed that health education within schools is necessary to equip students with knowledge, skills and competencies [8], which is designed to change their behaviors and attitudes [9]. In other words, including health literacy in school programs can ensure that students acquire what they need to take care of their own health [10].

Adolescents gain more autonomy at this stage of their lives [11], becoming more aware of their rights and more ready to take decisions on their own [11 12]. Combining these changes with improvements in adolescents' health literacy may not only influence their critical thinking and decision making abilities, health status and well-being, it may also bring benefits to the local community by helping students to be responsible and productive citizens and become more efficient users of services [10 13], especially medical services by learning the necessary skills to navigate the health care system, critically assess health information and receive better health care [14].

Despite its increase in the past decade, health literacy research related to adolescents is still limited in the literature [11 15 16,] likely because good quality tools to measure it are not available for this age group [15]. In the Middle East, health literacy research has increased recently as well. However, few studies have focused on testing the psychometric properties of health literacy instruments, and have measured health literacy levels among adolescents [17-19]. For example, the Health Literacy Measure for Adolescents (HELMA) [17], and the Health Literacy for School-Aged Children (HLSAC-T) scale [19] were developed and tested for their psychometric properties in Persian and Turkish languages respectively. However, health literacy research is under-researched in the Arab world, which reflects the unavailability of validated tools in Arabic language which measure and assess adolescent health literacy [1]. In Lebanon, a study validated the Arabic versions of the Rapid Estimate of Adult Literacy in Medicine revised (REALM-R) and the Short Test of Functional Health Literacy for Adults (S-TOFHLA) [1]. In Saudi Arabia, a study validated the Arabic Rapid Estimate of Adult Literacy in Dentistry (AREALD-30) [20], while an Iraqi survey validated the Newest Vital signs (NVS) and S-TOFHLA in Iraq [21]. Moreover, in Egypt, a study used the Arabic versions of the Swedish Functional Health Literacy Scale (S-FHL scale) and the European Health Literacy Survey Questionnaire (HLS-EU-Q16) among patients older than 15 years attending a tertiary health care facility [22]. Finally, the health literacy of Palestinian adult patients with type 2 diabetes mellitus was studied recently in Palestine [23 24]. In the Arab World, the adapted health literacy scales are mainly targeting adults, not adolescents.

The Health Assessment Scale for Adolescents (HAS-A) is a self-reported scale for assessing the health literacy of adolescents. HAS-A is a tool generated by including children from both clinical and community settings and was validated in New York. The main difference between HAS-A and other health scales such as HELMA or HLSAC-T is that HAS-A evaluates specifically adolescent ability to navigate the health care system, including the communication process with their doctors about health issues or knowledge regarding medicines or illnesses. Moreover, the original English-language HAS-A was validated among a group of adolescents with a wide range of ages (12-19 years old). According to Manganello et al., using the HAS-A to assess adolescents' health literacy in medical or school settings could help to provide adequate health promotion and health care activities [11].

In Palestine, adolescents suffer from the negative impacts of the chronic political conflict [6], such as chronic stress and mental health problems. They may also suffer from various health-related problems, including malnutrition, accidents, disabilities, and compromised accessibility to health care [25]. Health literacy may help Palestinian adolescents to reduce the negative health impact of chronic exposure to violence [6]. However, the paucity of work on health literacy in adolescents and the scarcity of the validated Arabic-language health literacy scales for adolescents in Palestine limit the possibilities to address health literacy and its determinants among the Palestinian adolescents. Therefore, this study was conducted to (i) translate the HAS-A into Arabic; (ii) adapt the scale to be sensitive to the Palestinian socio-economic context; and (iii) measure the psychometric properties of the new scale among Palestinian adolescents.

Methods

Measurement of demographic and socioeconomic characteristics

We measured demographic and socioeconomic characteristics by asking adolescents about their sex, age, grade finished last year academic year, school average description (student's self-report of performance), educational level of mother and father, occupation of mother and father, family financial status and access to internet.

Health literacy assessment scale for adolescents (HAS-A)

HAS-A includes 15 questions divided into three subscales; communication, confusion and functional health literacy. Communication subscale focuses on oral communication and comfort when asking questions to health care professionals (HCPs), confusion subscale which focuses on the degree of confusion about received health information and functional health literacy, which evaluates reading ability and numeracy. For each subscale, adolescents had to choose among one of the following options (always=4, usually=3, sometimes=2, rarely=1, and never=0) for each item of the HAS-A. However, to adapt the HAS-A to the Palestinian context (see table 4), we added a sixth option to each item to reflect the fact that HCPs tend to talk about the adolescent health with parents rather than directly with the adolescent. For example, we added the option "Doctor does not ask me" to the question "How often your doctor seems to understand you when you answer a question he or she asks?". These added responses were given the same value as "Never" for calculating scores. We calculated scores by summing responses of the items. The range of the possible scores for each subscale is "0 to 20" for communication subscale, "0-16" for confusion subscale and "0 to 24" for functional health literacy subscale. We considered those who scored "15 to 20" in the communication subscale as having a high health literacy level, the same for "0 to 8" in the confusion subscale and "0 to 12" the functional health literacy subscale [11].

Translation and adaptation of HAS-A.

We based our translation methods and cultural adaptation of scales on the model created by Wild et al. [26] (figure 1). In our study, the research team held several discussions to obtain an in-depth understanding of the HAS-A and to translate and culturally adapt it. Following the preparation stage, a native Arabic speaker who is fluent in English translated the scale into Arabic, and then two main researchers from Palestine reviewed the Arabic translation separately, followed by several discussions until they reached agreement and reconciliation of the two revisions, which produced the final forward translated version of the HAS-A.

We followed the same approach in the back translation process, as a native English speaker who is fluent in Arabic, back-translated the reconciled Arabic version into English. Again two main researchers reviewed the back translation separately, reaching an agreement as to its appropriateness. The two researchers met to compare the back-translated version with the

original HAS-A version, agreeing that the final translated version was conceptually equivalent to the original one. Next, we piloted the Arabic version among 30 adolescents (15 boys and 15 girls) who were in 6th to 9th grades in 2017. We ensured they came from all localities (urban, rural and refugee camps). We measured the duration of interviews and checked questions for clarity and comprehensibility. This was done by taking into consideration reading the interviewer's report on the interviews and by asking the adolescents if they found any difficulty in understanding or answering any questions. Based on the pilot results and expert opinions, we made final adjustments to the questionnaire.

Figure 1 Process for translating and adapting HAS-A-AR here

Design and Sampling

This survey targeted Palestinian households with adolescents who finished 6th to 9th grade in 2017 and who were living in the Ramallah and al-Bireh district of the West Bank. We followed a cross-sectional household survey design. To identify a representative sample, we divided the Ramallah and al-Bireh district into three strata according to locality type: urban, rural, and refugee camps. We obtained a list of all locations within each locality type from the Palestinian Central Bureau of Statistics (PCBS). We chose a random sample of urban, rural, and Palestinian refugee camp locations to include in the study. Each location was divided into geographic cells to facilitate the process of data collection; each cell contained almost 150 households. We then chose a random sample of cells from each selected location. We included 60 cells in the study, 23 urban, 22 rural and 15 refugee camps, randomly choosing 20 households from each cell. Whenever we found more than one child between the ages of 12-15 in the household, we used the Kish grid method to choose one child randomly. As the number of Palestinian refugee camp residents was low compared to urban and rural areas, we oversampled respondents from refugee camps. The final sample of 1,200 consisted of 460 urban, 440 rural, and 300 camp households. Given the unequal probabilities of selecting respondents, we calculated sample weights. The overall probability of choosing any adolescent was the product of the probabilities of choosing a cell within the locality (P_c), choosing a household within the cell (P_h), choosing a household including at least one age-eligible child (P_e), and choosing the child within the household (P_a). The sample weight was the inverse of this overall probability.

$$\textbf{Probability of choosing an adolescent } (P_{tot}) = P_c * P_h * P_e * P_a$$

Evaluation of the psychometric properties of HAS-A-AR

To evaluate the psychometric properties of HAS-A-AR, we used different validity methods. First, we evaluated face and content validity during the translation process. A group of experts revised the HAS-A several times during the back-translation process [27]. Those experts were members of the research team and an official from the Ministry of Education. To check the

construct validity, we performed an exploratory factor analysis (EFA) [28 29]. We used the entire data set for EFA. We did not do a formal sample size calculation in advance, but a sample of 1000 or more is considered to be excellent for EFA [30]. For sampling adequacy of the EFA, we used the Kaiser-Meyer-Olkin (KMO) test (KMO>0.50), and Bartlett's test of sphericity (*p* value<0.05) [31]. To check for the absence of multicollinearity, we checked if the determinant value was higher than 0.00001 [32]. Moreover, we used anti-image correlations to determine if reliable factors could be generated (cut-off>0.5) [32]. To determine the number of factors, we used a scree plot and Kaiser's criterion (eigenvalues>1), which states that items with eigenvalues greater than one should be retained [32]. However, we also performed a confirmatory factor analysis (CFA) on the same sample to check the overall goodness fit of model [33]. To evaluate the overall model fitness we calculated the chi-square statistic, which should has a *p* value> 0.05. We also measured root mean square error of approximation (RMSEA) which has to be lower than 0.6. Additionally, we looked at the values of the Tucker-Lewis index (TLI) and comparative fit index (CFI), both have to ≥0.9. Finally, we calculated the standardized root mean square residual (SRMR), which is preferable to be < 0.1 [28]. To determine the reliability we used various measures: we tested for internal consistency using Cronbach's alpha (α) [34], MacDonald's omega test (ω) [35], and greatest lower bound (GLB) [36]. Furthermore, we calculated inter-item correlations [37 38], average inter-item correlation [39 40] and item-rest correlations [37 41] (Table 1). We followed complete case analysis (exclude listwise) to deal with missing data during the analysis process [42].

Table 1. Reliability criteria for this study

Reliability statistics	Criteria
Cronbach's alpha (α)	Greater than 0.7 [32 43 44]
MacDonald's omega (ω)	
Greatest lower bound (GLB)	
Inter-item correlations	Greater than 0.3 [33]
Average inter-item correlation	Between 0.15-.50 [36]
Item-rest or item-to-total correlations	Greater than 0.4 [37]

Statistical analysis

We used the JASP 0.9.2.0 software to calculate MacDonald's omega and greatest lower bounds (GLB); while we used IBM SPSS V24 software to perform all other statistical analytic procedures including the descriptive analysis of the sample characteristics, HAS-A-AR scores and health literacy levels, taking in consideration the sampling weights.

Ethical approvals

We obtained ethical approvals from the Research Ethics Committee of the Graduate School of Medicine, the University of Tokyo, and The Research Ethics Committee (REC) of Birzeit

University. We informed adolescents of what the study was about, why we were conducting this study; that they were not obliged to participate in the study if they did not wish to; that they were able to refuse to answer any question they did not want to answer; and that they could withdraw from the study at any time they wished. We obtained adolescent's oral consent following disclosure and explanation, with field workers signing the disclosure form confirming they have read the disclosure form and that they have obtained oral consent from participants. Oral consent (in non-invasive procedures) is what the REC at Birzeit University guidelines stipulate, given that local experience indicates that people become suspicious and ill at ease if you ask them to sign their names on paper.

Patient and Public Involvement

It was not appropriate or possible to involve patients or the public in the design, or conduct, or reporting, or dissemination of our research.

Results

Sample characteristics

Almost 99% of approached households agreed to participate in this study. Fifty-one per cent of the adolescents in this study were females, with an average age of 13.5 (1.1) years. The majority had completed at least the 6th grade (primary school) at the time of interviews. More than half of them (61%) reported having "very good" or "excellent" school averages. Almost 30% and 26% of their mothers and fathers had higher than high school education, respectively. The majority (92%) reported that their fathers were currently employed, compared to 72% of mothers who were working outside the home (employed). Internet was available to almost 87% of households (table 2).

Table 2 Sociodemographic characteristics of adolescents		N	% $^{+}$
Gender	Male	590	49
	Female	610	51
Age group	11-12 years	21	1.8
	12 - <13	399	33.2
	13 - <14	272	22.7
	14 - <15	292	24.3
	15-16	216	18.0
The class graduated from last year N=1,197	6th grade	374	31.3
	7th grade	277	23.2
	8th grade	285	23.8
	9th grade	254	21.2
	Left school	7	0.6
School average description	Excellent	292	24.4

N=1,197	Very good	444	37.1
	Good	315	26.3
	Fair	110	9.2
	Poor	35	2.9
Mother's educational level N=1,136	Not educated	37	3.2
	Educated till high school	756	66.5
	Higher than high school	343	30.2
Father's educational level N=1,199	Not educated	41	3.8
	Educated till high school	775	70.4
	Higher than high school	285	25.9
Mother has job	Yes	359	29.9
	No	839	69.9
	Do not know	2	.2
Father has job N=1,199	Yes	1103	92.0
	No	90	7.5
	Do not know	6	0.5
Internet access	Yes	1038	86.5
	No	162	13.5
[+] Weighted percentages			

Arabic health literacy assessment scale for adolescents (HAS-A-AR)

We summarized the results of HAS-A-AR in tables 3 and 4. The HAS-A scales results showed that only 45% of adolescents had a high level of health literacy in terms of interpersonal communication. However, almost 68% of them showed high levels of health literacy according to HAS-A-AR confusion subscale, while 80% showed high health literacy in their ability to read and understand health information (table 3). The context-related categories that we added to HAS-A scale items showed a wide range of frequencies. Some items had relatively low rates such as "How often does your doctor seem to understand you when you answer a question he or she asks?", with around 7% responding that their doctor does not ask them any questions. Others showed high frequencies as "How often do you think the forms you complete at your doctor's office are confusing?" where 54% of the adolescents reported that they do not complete forms at the doctor's office (table 4).

Table 3 Descriptive results and reliability of three subscales of HAS-A-AR [++]

	Communication	Confusion [+]	Functional health literacy [++]
Mean	13 (5.3) [†]	5.4 (3.8) [†]	7 (4.9) [†]
Median	14	5	6
Minimum possible	0	0	0
Maximum possible	20	16	24

High health literacy ‡	539 (44.9%) †	826 (68.8%) †	960 (80.3%) †
Low health literacy	661 (55.1%) †	374 (31.2%) †	236 (19.7%) †
Cronbach's α	0.87	0.78	0.77
McDonald's ω	0.88	0.77	0.77
Greatest lower bound (GLB)	0.90	0.79	0.80
Average Inter-item correlation	0.59	0.45	0.36

+ N=1,199, ++ N=1,196

‡ High health literacy subscales' scores: communication (15-20), confusion (0-7), and functional health literacy (0-11)

† weighted means and percentages

†† HAS-A-AR: An Arabic translated version of HAS-A

Psychometric properties of HAS-A-AR

Validity

Face and content validity testing revealed that all items were understandable with minor modifications made. Based on the Scree plot and eigenvalues, we decided to retain three factors (figure 2). We performed EFA using the principal axis factoring method of extraction. The overall KMO statistic was 0.89, while Bartlett's test of sphericity was significant ($\chi 2$ (1200) = 6505.6, p<0.001). Anti-image correlation matrix diagonal values were all > 0.8. We found that our sample did not have the issue of multicollinearity. Factor 1 (Communication) included five items that explained 33% of the variance with factor loadings range from 0.62 to 0.82. Factor 2 (functional health literacy) included six items that explained 17% of the total variance with loadings range between 0.40 and 0.76, while factor 3 (confusion) included four items that explained 7% of the total variance with loadings between 0.47 and 0.83. Even though the p-value for the chi-square statistic was low ($X^2 = 426.42$, $p < 0.001$), other goodness of fit measures showed that the model had a good fit. Root mean square error of approximation (RMSEA) was 0.57. Tucker-Lewis index (TLI) and comparative fit index (CFI) values were 0.95 and 0.94, respectively, while standardized root means square residual (SRMR) was 0.038.

Figure 2 Scree Plot and the eigenvalues of the three retained factors and one non-retained factor here

Reliability analysis

Reliability analysis showed that HAS-A-AR, which consists of 15 items, is a reliable scale (α = 0.85, ω=0.88, GLB=0.90) (for details on α, ω and GLB of HAS-A-AR subscales, see table 3). Inter-item correlations for all items of factors 1 and 3 were more than 0.3, while in factor 2, inter-item correlations between item 3.5 and both items 3.1 and 3.2 were slightly below 0.3

(Supplement 1). Average Inter-item correlation for all HAS-A-AR scales combined is 0.28. The average-inter-item correlation for the subscales range was between 0.36 and 0.59. Item-rest correlations were all above 0.4 (Table 4).

Table 4 HAS-A-AR items and their psychometric properties

	HAS-A items with the added responses			Factor loading			Reliability
	Items ++	Added response	Weighted % of added response	F1+	F2*	F3+	IRC†
1.1	How often is it easy for you to ask your doctor questions about your health? N=1,200	There is no special doctor	18.6	0.62			0.61
1.2	How often does your doctor understand what you mean when you ask him or her, a question about your health? N=1,200	I don't ask the doctor	9.6	0.81			0.75
1.3	How often can you easily describe a health problem you have to your doctor? N=1,200	Not me who describes my health problem for the doctor	10.4	0.82			0.73
1.4	How often does your doctor seem to understand you when you answer a question he or she asks? N=1,200	The doctor doesn't ask me	7.2	0.79			0.72
1.5	How often do you understand the answers your doctor gives to your questions? N=1,199	I don't ask the doctor any questions	8.1‡	0.79			0.72

2.1	How often do you get confused because you find different information about the same health topic? N=1,200	I don't search/find information	15.3			0.47	0.49
2.2	How often do you get confused when your doctor tells you about taking medicine? N=1,200	The doctor doesn't talk with me about medicine	14.3			0.72	0.58
2.3	How often do you get confused when your doctor tells you about possible side effects from a medicine or treatment? N=1,199	The doctor doesn't tell me about possible side effects from a medicine or treatment	22.9 ‡			0.83	0.66
2.4	How often do you get confused when your doctor tells you about test results, like results of an X-ray? N=1,199	The doctor doesn't tell me about test results, like results of an X-ray	28.1 ‡			0.56	0.55
3.1	How often do you get confused when reading instructions for medicine? N=1,200	I don't read instructions for medicine	29.1		0.40		0.5
3.2	How often do you have problems learning about an illness or health topic because of difficulty understanding the written information you get? N=1,199	I don't get information about illness or health topic	22.7 ‡		0.47		0.49
3.3	How often do you think the forms you complete at your doctor's office are confusing? N=1,199	I don't complete forms at my doctor office	54.1 ‡		0.55		0.54

3.4	How often are you confused by health information that has a lot of numbers and statistics? N=1,198	I don't read such health information	37.8 ‡‡		0.62		0.55
3.5	When you talk to people other than your doctor about health issues, how often are you confused by what they tell you? N=1,200	I don't talk to other people than my doctor	22.7		0.54		0.46
3.6	When reading brochures or hand-outs about health issues, how often do you need someone to help you read them? N=1,200	I don't read brochures or hand-outs about health issues	30.3		0.76		0.53

† IRC: Item-rest correlation (item-total correlation)

++ HAS-A original English-language questions

Note. Of the observations, † 1,199 were used, 1 was excluded listwise, * 1,196 were used, 4 were excluded listwise, and 1,200 were provided.

‡ 1 missing case, ‡‡ 2 missing cases

-Eigenvalue: factor 1= 4.937 (33% of variance), factor 2= 2.570 (17% of variance), factor 3= (7% of variance)

-Extraction Method: Principal Axis Factoring.

-Rotation Method: Promax with Kaiser Normalization.

-Determinant = 0.04

-Kaiser-Meyer-Olkin Measure of Sampling Adequacy= 0.886

-Bartlett's Test of Sphericity = 6505.6 (p<.0.001)

Discussion

In this study, we applied published methods for translation of the HAS-A to provide an Arabic version of this tool (HAS-A-AR). Adolescents clearly understood the translated version, and testing its psychometric properties showed that HAS-A-AR is a valid and reliable tool to be used for measuring health literacy among Palestinian adolescents living in the Ramallah District.

Psychometric properties

Adding the extra options in HAS-A-AR that are relevant for the Palestinian context did not change the factor structure. The initial step of validation of the Arabic version of HAS-A-AR was testing the factorial structure [45]. EFA revealed that HAS-A-AR has a similar structure to the original HAS-A, which supports the usage of similar scoring methods. Solid and stable factors

need to have minimum factor loadings between 0.4 and 0.5 [12 28]. All of the factor loadings were >0.5 except two, which were ≥0.4. Therefore, we retained all the original HAS-A items. Around 57% of the variance is explained by the three retained factors, which is close to 60%, the value that Hair et al. reported as acceptable to consider the construct to be valid [37]. This pattern of factor loadings and model fit suggests that the HAS-A-AR has adequate construct validity.

Cronbach's alpha values suggest that HAS-A-AR has good internal consistency. Compared to the reliability testing of the original HAS-A [11], the Arabic version showed a higher (α) for the communication and confusion subscales and was similar for the functional health literacy subscale. However, in the literature, there is some debate regarding the adequacy of Cronbach's alpha (α) to assess the reliability of scales, especially those with ordinal items, as this may bias the measured reliability of the tested scale [46]. Alternatives were suggested such as MacDonald's omega test (ω) [35], and greatest lower bound (GLB) [36] as preferable to (α). Since authors are recommended to report reliability estimates other than (α) [47], we measured ω, GLB, and α (for comparability with other studies). Values of reliability measures, which are higher than 0.7, indicate that the scale is reliable [34 43 44]. Therefore, our results suggest that HAS-A-AR is a reliable instrument to be used in this population.

Furthermore, the average inter-item correlations also indicate good internal consistency. The recommended range of average inter-item correlation is between 0.15-0.5 [48]. The confusion and functional health literacy subscales' average inter-item correlations were within the recommended range, while the communication subscale's average inter-item correlation was slightly higher than 0.5. This indicates that items in the confusion and functional health literacy and to a lower extent, the communication subscale, are homogenous, enough to describe the same construct but still have their unique variance that distinguishes one from the other. In general, these results provide additional support for the reliability of the measure.

Health literacy

In this study, the percentage of adolescents choosing the added responses, which expressed a lack of active involvement with their health care, was relatively high in most questions. We expected such a pattern, as it emphasizes a gap in interaction and communication between the Palestinian adolescents and their health care professionals (HCPs). The quality of communication with HCPs is also essential, especially to the subsequent empowerment of individuals, as the way of communicating can be a facilitator or a barrier for health information exchange [49]. Neuroscience research indicates that adolescents can possess adequate communication skills essential for their ability to make medical or health-related decisions [49]. Good communication between the Palestinian adolescents and their HCPs has to be created to enhance adolescents' health literacy competencies, which may impact on the received health care services quality.

Moreover, adolescents in this study showed a low level of health literacy. Compared to American adolescents [11], the adolescents of this study had similar levels of functional health literacy, but reported lower communication skills and were more likely to be confused regarding health information. This could be because Palestinian adolescents lack the autonomy to participate actively in decision making regarding their health. Parents usually have the power to communicate directly with HCPs and make health-related decisions on behalf of their children. However, it is worth noting that being in control can enhance the feeling of confidence, which in turn will contribute to an active role and involvement in health [50]. The age of 12 might be when adolescents start to possess the competencies for that enable to have an active role in medical or health-related decision making [49]. In the Netherlands, 12-17 years old adolescents expressed their desire to be involved in health-related decision making with advice from their parents [51]. For adolescents, this is not only a matter of taking the right decision, it is about the feeling of autonomy and having control over their own health [52]. For example, patient-centered communication with 10-15 year-old type 1 diabetic adolescent patients increased the adolescents and parents perceptions of competence, self-efficacy, and perceived control, which led to increased adherence and metabolic control [53]. Therefore, encouraging shared decision making between parents and their adolescent children may help in improving adolescent health literacy levels.

Strengths and limitations

Using a representative sample of Palestinian adolescents from Ramallah district, including all social groups who live in urban, rural and refugee camps is strength of this study. We were unable to include adolescents from other cities in the West Bank or Gaza Strip due to financial and political considerations. However, residents from all over the West Bank and to a lower extent from the Gaza strip tend to move to live and work in Ramallah since it is an economic center in Palestine. This can, to some extent, overcome the issue of including just the Ramallah district in our study. HAS-A-AR can be used among 11-16 years old Palestinian adolescents. However, the original HAS-A targeted a wider age group (12-19 years), and since the exploratory factor analysis revealed that HAS-A-AR has a similar structure to the original HAS-A, we may consider that the HAS-A-AR is an appropriate instrument to use among this age group of Palestinian adolescents.

The meticulous translation process that involved experts with multiple revisions, and the fact that adolescents faced no problems in understanding questions during interviews is another strength of this study. The addition of the extra options to the questionnaire to make it relevant to the Palestinian context and maybe to other countries in the Arab region is also strength of this study. Since concerns regarding the reliability of self-reported scales were noted [11], conducting face-to-face interviews could be one of the reasons for the high response rate in our study especially that interviews were with adolescents who may not have completed a self-

administered questionnaire as required. We used various tests which showed that HAS-A has good psychometric properties. However, we could not perform test-retest reliability due to time and financial constraints. Additionally, we could not perform a criterion validity test as well due to the lack of a gold standard tool. Even though we performed CFA to confirm the results of EFA, we need to perform CFA using different samples in the future.

Conclusion

Health literacy research in Palestine is limited, and a locally validated tool for use among adolescents has been unavailable until now. This study demonstrates that HAS-A-AR has good construct validity and reliability. Thus, the HAS-A-AR is now available for use among adolescents in Palestine and the surrounding Arab countries that have similar characteristics as Palestine, including language, culture, and political instability. Further research is needed to check for the other psychometric properties of the tool or to use the scale to evaluate and have a better understanding of adolescent health literacy and its associated factors. Moreover, it is important to conduct interventions or programs (within school-settings for example) which aim to improve adolescent health literacy. It also seems necessary to invest in interventions targeting parents and doctors to improve how they communicate and deliver health information to adolescents and involve the adolescents in the process of taking decisions related to their health.

Footnotes

Contributorship statement

Study design: MBAS, RF, MJ, RG. Direct supervision on data collection: MBAS, RG. Development and revision of methods and measures: MBAS, HSS, RF, MJ, RG. Data analysis: MBAS. Revision of statistical analysis: HSS. Interpretation: MBAS, HSS, RF, MJ, RG. Writing of the first and final version of the manuscript: MBAS. Revision for important intellectual content: MBAS, HSS, RF, MJ, RG. All authors approved the final version for publication.

Funding

This work was supported by JSPS KAKENHI Grant Number 16KT0039.

Competing interests

None declared.

Ethics approval

We obtained ethical approvals from the Research Ethics Committee of the Graduate School of Medicine, the University of Tokyo (Ethical approval nr: 11545-(1)), and The Research Ethics Committee (REC) of Birzeit University (Ethical approval nr: 161013).

Provenance and peer review

Not commissioned; externally peer-reviewed.

Data availability statement

Data are available upon reasonable request.

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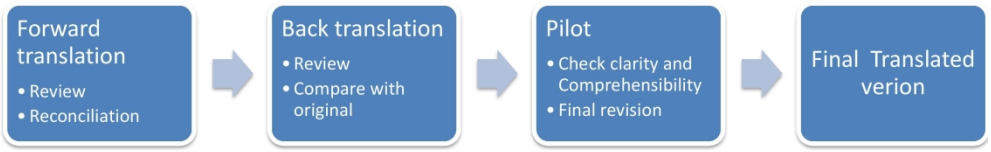

Figure 1 Process for translating and adapting HAS-A-AR

254x190mm (300 x 300 DPI)

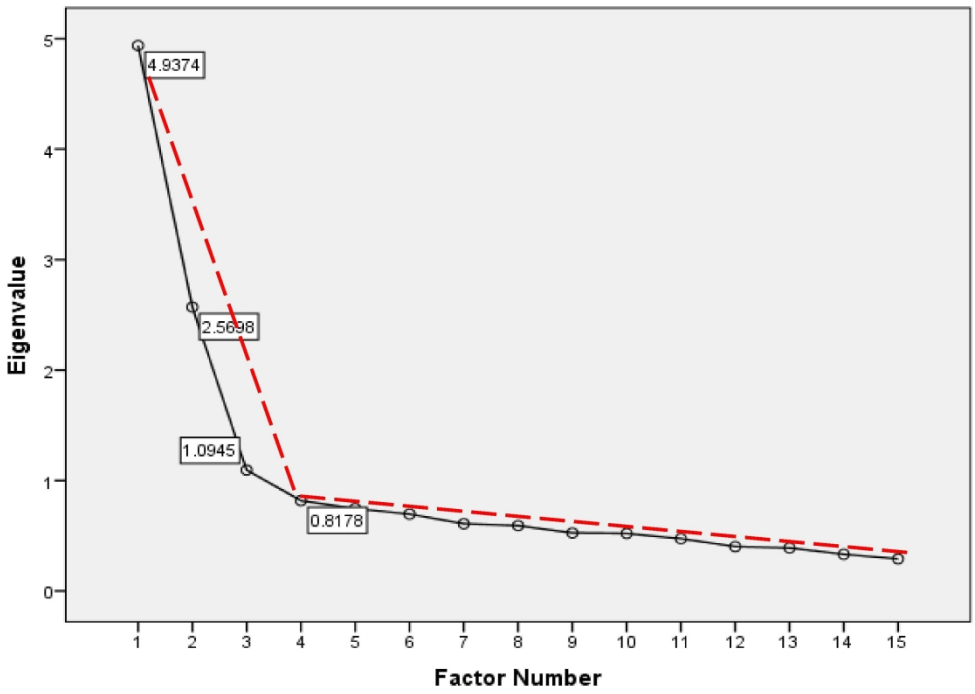

Figure 2 Scree Plot and the eigenvalues of the three retained factors and one non-retained factor

254x190mm (300 x 300 DPI)

Psychometric properties of an Arabic-language health literacy assessment scale for adolescents (HAS-A-AR) in Palestine

Supplement 1: Inter-item correlations of the factors retained

Factor 1 Spearman Correlations

		1.1	1.2	1.3	1.4	1.5
1.1	Spearman's rho	—				
	p-value	—				
	Upper 95% CI	—				
	Lower 95% CI	—				
1.2	Spearman's rho	0.569	—			
	p-value	< .001	—			
	Upper 95% CI	0.606	—			
	Lower 95% CI	0.530	—			
1.3	Spearman's rho	0.468	0.574	—		
	p-value	< .001	< .001	—		
	Upper 95% CI	0.511	0.611	—		
	Lower 95% CI	0.422	0.535	—		
1.4	Spearman's rho	0.421	0.524	0.570	—	
	p-value	< .001	< .001	< .001	—	
	Upper 95% CI	0.466	0.564	0.607	—	
	Lower 95% CI	0.373	0.481	0.530	—	
1.5	Spearman's rho	0.452	0.538	0.527	0.620	—
	p-value	< .001	< .001	< .001	< .001	—
	Upper 95% CI	0.496	0.577	0.567	0.654	—
	Lower 95% CI	0.406	0.496	0.485	0.584	—

Factor 2 Spearman Correlations

		3.1	3.2	3.3	3.4	3.5	3.6
3.1	Spearman's rho	—					
	p-value	—					
	Upper 95% CI	—					
	Lower 95% CI	—					
3.2	Spearman's rho	0.347	—				
	p-value	< .001	—				
	Upper 95% CI	0.395	—				
	Lower 95% CI	0.296	—				
3.3	Spearman's rho	0.381	0.354	—			
	p-value	< .001	< .001	—			
	Upper 95% CI	0.428	0.403	—			

	Lower 95% CI	0.331	0.304	—			
3.4	Spearman's rho	0.373	0.357	0.480	—		
	p-value	< .001	< .001	< .001	—		
	Upper 95% CI	0.420	0.405	0.522	—		
	Lower 95% CI	0.323	0.306	0.435	—		
3.5	Spearman's rho	0.284	0.267	0.303	0.332	—	
	p-value	< .001	< .001	< .001	< .001	—	
	Upper 95% CI	0.335	0.319	0.354	0.382	—	
	Lower 95% CI	0.231	0.213	0.251	0.281	—	
3.6	Spearman's rho	0.375	0.326	0.328	0.391	0.430	—
	p-value	< .001	< .001	< .001	< .001	< .001	—
	Upper 95% CI	0.423	0.375	0.378	0.438	0.475	—
	Lower 95% CI	0.325	0.274	0.277	0.342	0.383	—

Factor 3 Spearman Correlations

		2.1	**2.2**	**2.3**	**2.4**
2.1	Spearman's rho	—			
	p-value	—			
	Upper 95% CI	—			
	Lower 95% CI	—			
2.2	Spearman's rho	0.389	—		
	p-value	< .001	—		
	Upper 95% CI	0.436	—		
	Lower 95% CI	0.340	—		
2.3	Spearman's rho	0.413	0.545	—	
	p-value	< .001	< .001	—	
	Upper 95% CI	0.458	0.584	—	
	Lower 95% CI	0.364	0.504	—	
2.4	Spearman's rho	0.335	0.421	0.553	—
	p-value	< .001	< .001	< .001	—
	Upper 95% CI	0.384	0.466	0.591	—
	Lower 95% CI	0.283	0.373	0.513	—

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4,5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	7,8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	
Bias	9	Describe any efforts to address potential sources of bias	N/A
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7,8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7,8
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	N/A
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	7,8
		(*e*) Describe any sensitivity analyses	N/A
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7,8 (only participants number)
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	9-14 (tables 2, 3and 4)
Outcome data	15*	Report numbers of outcome events or summary measures	10-14
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	N/A
		(*b*) Report category boundaries when continuous variables were categorized	10,11 (table 3)
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	10-14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16,17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14, 16
Generalisability	21	Discuss the generalisability (external validity) of the study results	16
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Psychometric properties of an Arabic-language health literacy assessment scale for adolescents (HAS-A-AR) in Palestine

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2019-034943.R2
Article Type:	Original research
Date Submitted by the Author:	10-Mar-2020
Complete List of Authors:	Sarhan, Mohammed; The University of Tokyo, Graduate School of Medicine, Department of Community and Global Health Shannon, Harry ; McMaster University Fujiya, Rika; Keio University, Faculty of Nursing and Medical Care Jimba, Masamine; The University of Tokyo, Graduate School of Medicine, Department of Community and Global Health Giacaman, Rita; Birzeit University Institute of Community and Public Health
Primary Subject Heading:	Public health
Secondary Subject Heading:	Global health
Keywords:	PUBLIC HEALTH, Community child health < PAEDIATRICS, STATISTICS & RESEARCH METHODS

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Psychometric properties of an Arabic-language health literacy assessment scale for adolescents (HAS-A-AR) in Palestine

Mohammed B A Sarhan BDS, MPH [1], Harry S Shannon PhD [2], Rika Fujiya PhD [3], Masamine Jimba * MD, MPH, PhD [4], Rita Giacaman PharmD, MPhil [5].

[1] Department of Community and Global Health, Graduate School of Medicine, The University of Tokyo, Japan, PhD student, mohammed.ba.sarhan@gmail.com.

[2] McMaster University, Canada, Professor Emeritus, shannonh@mcmaster.ca.

[3] Faculty of Nursing and Medical Care, Keio University, Kanagawa, Japan, Assistant Professor, rfujiya@sfc.keio.ac.jp.

[4] Department of Community and Global Health, Graduate School of Medicine, The University of Tokyo, Japan, Professor, mjimba@m.u-tokyo.ac.jp.

[5] Institute of Community and Public Health, Birzeit University, Birzeit, Palestine, Professor, rita@birzeit.edu.

* Corresponding author: Masamine Jimba, Department of Community and Global Health, Graduate School of Medicine, The University of Tokyo TEL: +81-3-5841-3698 E-mail: mjimba@m.u-tokyo.ac.jp

Word count (4350)

Number of tables (4)

Number of figures (2)

Number of supplements (1)

Abstract

Objectives: Health literacy research in Palestine is limited, and a locally validated tool for use among adolescents has been unavailable until now. Therefore, this study aimed to adapt health literacy assessment scale for adolescents (HAS-A) into Arabic language (HAS-A-AR) and Palestinian context and to investigate its psychometric properties.

Design: We conducted a cross-sectional household survey using a stratified random sample and household face-to-face interviews.

Setting and participants: We conducted 1,200 interviews with 6th to 9th graders in the Ramallah and al-Bireh district of the West Bank, Palestine in 2017.

Methods: We translated and adapted HAS-A to be sensitive to the Palestinian context and tested its psychometric properties. We evaluated face and content validity during the back-translation process and checked for construct validity through exploratory factor analysis (EFA). We tested for internal consistency using Cronbach's alpha, MacDonald's omega test and the greatest lower bound (GLB). Furthermore, we calculated the scale's average inter-item correlation.

Results: EFA revealed that HAS-A-AR has a similar structure to the original HAS-A. It extracted three factors (communication, confusion and functional health literacy) whose eigenvalues were >1. Together they explained 57% of the total variance. The proportions of adolescents with high levels of communication, confusion and functional health literacy were 45%, 68%, and 80%, respectively. Cronbach's alpha, MacDonald's omega and the GLB values for communication subscale were 0.87, 0.88 and 0.90, and they were 0.78, 0.77 and 0.79 for confusion subscale, while for functional healthy literacy subscale, they were 0.77, 0.77 and 0.80, respectively. The average-inter-item correlation for the subscales ranged between 0.36 and 0.59.

Conclusion: HAS-A-AR is a valid and reliable health literacy measuring instrument with appropriate psychometric properties. HAS-A-AR is now available for use among adolescents in Palestine and the surrounding Arab countries with similar characteristics as Palestine, including language, culture, and political instability.

Word count: 298

Keywords: Public health, health literacy, community child health, psychometric properties statistics and research methods

Strengths and limitations of this study

- This is the first study in Palestine which aimed to assess Palestinian adolescent health literacy.
- We validated the Arabic version of a health literacy assessment scale (HAS-A-AR) by adding an extra option to each item of the original questionnaire to be sensitive to the Palestinian context.
- We used various tests to measure HAS-A-AR psychometric properties including face, content and construct validity.
- For internal consistency, we used Cronbach's alpha (α), MacDonald's omega (ω), and the greatest lower bound (GLB); however, we did not perform test-retest reliability analysis.
- We did not perform a criterion validity test due to the lack of a gold standard tool.

Introduction

Health literacy is gaining attention globally, and is becoming a priority to governments, health sectors and researchers [1 2]. It can help individuals engage in health-promoting activities, participate in screening programs and use preventive services [3]. Sørensen et al. stated that "health literacy entails people's knowledge, motivation and competencies to access, understand, appraise, and apply health information in order to make judgments and take decisions in everyday life concerning healthcare, disease prevention and health promotion to maintain or improve quality of life during the life course" [4]. In this definition, they captured all the essential aspects of the health literacy concept by focusing on public health and medical approaches and emphasizing on health literacy's vital skills that are necessary to navigate through the complex demands of health in the current modern societies [3]. These required skills should be more than basic reading and numeracy skills, as emphasized by some of the available health literacy measures [5]. Health literacy has to be more comprehensive by including communication, understanding, problem solving and decision-making skills [5].

Health literacy needs to be approached from a public health perspective [6], an approach that has been recognized by the World Health Organization (WHO) in 2016, which considered health literacy as a public health goal to be achieved [7]. Consequently, the education system –besides the health system and society- is increasingly becoming a central piece of developing students' health literacy [8]. It is believed that health education within schools is necessary to equip students with knowledge, skills and competencies [8], which is designed to change their behaviors and attitudes [9]. In other words, including health literacy in school programs can ensure that students acquire what they need to take care of their own health [10].

Adolescents gain more autonomy at this stage of their lives [11], becoming more aware of their rights and more ready to take decisions on their own [11 12]. Combining these changes with improvements in adolescents' health literacy may not only influence their critical thinking and decision making abilities, health status and well-being, it may also bring benefits to the local community by helping students to be responsible and productive citizens and become more efficient users of services [10 13], especially medical services by learning the necessary skills to navigate the health care system, critically assess health information and receive better health care [14].

Despite its increase in the past decade, health literacy research related to adolescents is still limited in the literature [11 15 16,] likely because good quality tools to measure it are not available for this age group [15]. In the Middle East, health literacy research has increased recently, as well. However, few studies have focused on testing the psychometric properties of health literacy instruments, and have measured health literacy levels among adolescents [17-19]. For example, the Health Literacy Measure for Adolescents (HELMA) [17], and the Health Literacy for School-Aged Children (HLSAC-T) scale [19] were developed and tested for their psychometric properties

in Persian and Turkish languages respectively. However, health literacy research is under-researched in the Arab world, which reflects the unavailability of validated tools in the Arabic language which measure and assess adolescent health literacy [1]. In Lebanon, a study validated the Arabic versions of the Rapid Estimate of Adult Literacy in Medicine revised (REALM-R) and the Short Test of Functional Health Literacy for Adults (S-TOFHLA) [1]. In Saudi Arabia, a study validated the Arabic Rapid Estimate of Adult Literacy in Dentistry (AREALD-30) [20], while an Iraqi survey validated the Newest Vital signs (NVS) and S-TOFHLA in Iraq [21]. Moreover, in Egypt, a study used the Arabic versions of the Swedish Functional Health Literacy Scale (S-FHL scale) and the European Health Literacy Survey Questionnaire (HLS-EU-Q16) among patients older than 15 years attending a tertiary health care facility [22]. Finally, the health literacy of Palestinian adult patients with type 2 diabetes mellitus was studied recently in Palestine [23 24]. In the Arab World, the adapted health literacy scales are mainly targeting adults, not adolescents.

The Health Assessment Scale for Adolescents (HAS-A) is a self-reported scale for assessing the health literacy of adolescents. HAS-A is a tool generated by including children from both clinical and community settings and was validated in New York. The main difference between HAS-A and other health scales such as HELMA or HLSAC-T is that HAS-A evaluates specifically adolescent ability to navigate the health care system, including the communication process with their doctors about health issues or knowledge regarding medicines or illnesses. Moreover, the original English-language HAS-A was validated among a group of adolescents with a wide range of ages (12-19 years old). According to Manganello et al., using the HAS-A to assess adolescents' health literacy in medical or school settings could help to provide adequate health promotion and health care activities [11].

In Palestine, adolescents suffer from the negative impacts of chronic political conflict [6], such as chronic stress and mental health problems. They may also suffer from various health-related problems, including malnutrition, accidents, disabilities, and compromised accessibility to health care [25]. Health literacy may help Palestinian adolescents to reduce the negative health impact of chronic exposure to violence [6]. However, the paucity of work on health literacy in adolescents and the scarcity of the validated Arabic-language health literacy scales for adolescents in Palestine limit the possibilities to address health literacy and its determinants among the Palestinian adolescents. Therefore, this study was conducted to (i) translate the HAS-A into Arabic; (ii) adapt the scale to be sensitive to the Palestinian socio-economic context; and (iii) measure the psychometric properties of the new scale among Palestinian adolescents.

Methods

Measurement of demographic and socioeconomic characteristics

We measured demographic and socioeconomic characteristics by asking adolescents about their sex, age, grade finished last year academic year, school average description (student's

self-report of performance), educational level of mother and father, occupation of mother and father, family financial status and access to the internet.

Health literacy assessment scale for adolescents (HAS-A)

HAS-A includes 15 questions divided into three subscales; communication, confusion and functional health literacy. Communication subscale focuses on oral communication and comfort when asking questions to health care professionals (HCPs), confusion subscale which focuses on the degree of confusion about received health information and functional health literacy, which evaluates reading ability and numeracy. For each subscale, adolescents had to choose among one of the following options (always=4, usually=3, sometimes=2, rarely=1, and never=0) for each item of the HAS-A. However, to adapt the HAS-A to the Palestinian context, we added a sixth option to each item to reflect the fact that HCPs tend to talk about the adolescent health with parents rather than directly with the adolescent. For example, we added the option "Doctor does not ask me" to the question "How often your doctor seems to understand you when you answer a question he or she asks?". These added responses were given the same value as "Never" for calculating scores. We calculated scores by summing responses of the items. The range of the possible scores for each subscale is "0 to 20" for communication subscale, "0-16" for confusion subscale and "0 to 24" for functional health literacy subscale. Having a higher score in the communication subscale indicates having better communication skills and better health literacy. A higher score in the confusion subscale means that adolescents have a greater confusion about health information, which suggests having lower health literacy levels. For the functional health literacy subscales, a higher score indicates lower health literacy as a result of lower ability to read health information and understand numbers. We considered those who scored "15 to 20" in the communication subscale, "0 to 7" in the confusion subscale and "0 to 11" in the functional health literacy subscale as having a "high health literacy level" [11].

Translation and adaptation of HAS-A.

We based our translation methods and cultural adaptation of scales on the model created by Wild et al. [26] (figure 1). In our study, the research team held several discussions to obtain an in-depth understanding of the HAS-A and to translate and culturally adapt it. Following the preparation stage, a native Arabic speaker who is fluent in English translated the scale into Arabic, and then two main researchers from Palestine reviewed the Arabic translation separately, followed by several discussions until they reached agreement and reconciliation of the two revisions, which produced the final forward translated version of the HAS-A.

We followed the same approach in the back translation process, as a native English speaker who is fluent in Arabic, back-translated the reconciled Arabic version into English. Again two main researchers reviewed the back translation separately, reaching an agreement as to its appropriateness. The two researchers met to compare the back-translated version with the

original HAS-A version, agreeing that the final translated version was conceptually equivalent to the original one. Next, we piloted the Arabic version among 30 adolescents (15 boys and 15 girls) who were in 6th to 9th grades in 2017. We ensured they came from all localities (urban, rural and refugee camps). We measured the duration of interviews and checked questions for clarity and comprehensibility. This was done by taking into consideration reading the interviewer's report on the interviews and by asking the adolescents if they found any difficulty in understanding or answering any questions. Based on the pilot results and expert opinions, we made final adjustments to the questionnaire.

Figure 1 The followed process for translating and adapting the Arabic Health Literacy Assessment Scale for Adolescents (HAS-A-AR) here

Design and Sampling

This survey targeted Palestinian households with adolescents who finished 6th to 9th grade in 2017 and who were living in the Ramallah and al-Bireh district of the West Bank. We followed a cross-sectional household survey design. To identify a representative sample, we divided the Ramallah and al-Bireh district into three strata according to locality type: urban, rural, and refugee camps. We obtained a list of all locations within each locality type from the Palestinian Central Bureau of Statistics (PCBS). We chose a random sample of urban, rural, and Palestinian refugee camp locations to include in the study. Each location was divided into geographic cells to facilitate the process of data collection; each cell contained almost 150 households. We then chose a random sample of cells from each selected location. We included 60 cells in the study, 23 urban, 22 rural and 15 refugee camps, randomly choosing 20 households from each cell. Whenever we found more than one child between the ages of 12-15 in the household, we used the Kish grid method to choose one child randomly. As the number of Palestinian refugee camp residents was low compared to urban and rural areas, we oversampled respondents from refugee camps. The final sample of 1,200 consisted of 460 urban, 440 rural, and 300 camp households. Given the unequal probabilities of selecting respondents, we calculated sample weights. The overall probability of choosing any adolescent was the product of the probabilities of choosing a cell within the locality (P_c), choosing a household within the cell (P_h), choosing a household including at least one age-eligible child (P_e), and choosing the child within the household (P_a). The sample weight was the inverse of this overall probability.

$$\textbf{Probability of choosing an adolescent } (P_{tot}) = P_c * P_h * P_e * P_a$$

Evaluation of the psychometric properties of HAS-A-AR

To evaluate the psychometric properties of HAS-A-AR, we used different validity methods. First, we evaluated face and content validity during the translation process. A group of experts revised the HAS-A several times during the back-translation process [27]. Those experts were

members of the research team and an official from the Ministry of Education. To check the construct validity, we performed an exploratory factor analysis (EFA) [28 29]. We used the entire data set for EFA. We did not do a formal sample size calculation in advance, but a sample of 1000 or more is considered to be excellent for EFA [30]. For sampling adequacy of the EFA, we used the Kaiser-Meyer-Olkin (KMO) test (KMO>0.50), and Bartlett's test of sphericity (*p* value<0.05) [31]. To check for the absence of multicollinearity, we checked if the determinant value was higher than 0.00001 [32]. Moreover, we used anti-image correlations to determine if reliable factors could be generated (cut-off>0.5) [32]. To determine the number of factors, we used a scree plot and Kaiser's criterion (eigenvalues>1), which states that items with eigenvalues greater than one should be retained [32]. However, we also performed a confirmatory factor analysis (CFA) on the same sample to check the overall goodness fit of model [33]. To evaluate the overall model fitness, we calculated the chi-square statistic, which should have a *p* value> 0.05. We also measured root mean square error of approximation (RMSEA) which has to be lower than 0.6. Additionally, we looked at the values of the Tucker-Lewis index (TLI) and comparative fit index (CFI), both have to ≥0.9. Finally, we calculated the standardized root mean square residual (SRMR), which is preferable to be < 0.1 [28]. To determine the reliability we used various measures: we tested for internal consistency using Cronbach's alpha (α) [34], MacDonald's omega test (ω) [35], and greatest lower bound (GLB) [36]. Furthermore, we calculated inter-item correlations [37 38], average inter-item correlation [39 40] and item-rest correlations [37 41] (table 1). We followed complete case analysis (exclude listwise) to deal with missing data during the analysis process [42].

Table 1. Reliability criteria for this study

Reliability statistics	Criteria
Cronbach's alpha (α)	Greater than 0.7 [32 43 44]
MacDonald's omega (ω)	
Greatest lower bound (GLB)	
Inter-item correlations	Greater than 0.3 [33]
Average inter-item correlation	Between 0.15-.50 [36]
Item-rest or item-to-total correlations	Greater than 0.4 [37]

Statistical analysis

We used the JASP 0.9.2.0 software to calculate MacDonald's omega and greatest lower bounds (GLB); while we used IBM SPSS V24 software to perform all other statistical analytic procedures including the descriptive analysis of the sample characteristics, HAS-A-AR scores and health literacy levels, taking in consideration the sampling weights.

Ethical approvals

We obtained ethical approvals from the Research Ethics Committee of the Graduate School of Medicine, the University of Tokyo, and The Research Ethics Committee (REC) of Birzeit

University. We informed adolescents of what the study was about, why we were conducting this study; that they were not obliged to participate in the study if they did not wish to; that they were able to refuse to answer any question they did not want to answer; and that they could withdraw from the study at any time they wished. We obtained adolescent's oral consent following disclosure and explanation, with field workers signing the disclosure form confirming they have read the disclosure form and that they have obtained oral consent from participants. Oral consent (in non-invasive procedures) is what the REC at Birzeit University guidelines stipulate, given that local experience indicates that people become suspicious and ill at ease if you ask them to sign their names on paper.

Patient and Public Involvement

It was not appropriate or possible to involve patients or the public in the design, or conduct, or reporting, or dissemination of our research.

Results

Sample characteristics

Almost 99% of approached households agreed to participate in this study. Fifty-one per cent of the adolescents in this study were females, with an average age of 13.5 (1.1) years. The majority had completed at least the 6th grade (primary school) at the time of interviews. More than half of them (61%) reported having "very good" or "excellent" school averages. Almost 30% and 26% of their mothers and fathers had higher than high school education, respectively. The majority (92%) reported that their fathers were currently employed, compared to 72% of mothers who were working outside the home (employed). Internet was available to almost 87% of households (table 2).

Table 2 Sociodemographic characteristics of adolescents		N	% $^{+}$
Gender	Male	590	49
	Female	610	51
Age group	11-12 years	21	1.8
	12 - <13	399	33.2
	13 - <14	272	22.7
	14 - <15	292	24.3
	15-16	216	18.0
The class graduated from last year N=1,197	6th grade	374	31.3
	7th grade	277	23.2
	8th grade	285	23.8
	9th grade	254	21.2
	Left school	7	0.6
School average description	Excellent	292	24.4

N=1,197	Very good	444	37.1
	Good	315	26.3
	Fair	110	9.2
	Poor	35	2.9
Mother's educational level N=1,136	Not educated	37	3.2
	Educated till high school	756	66.5
	Higher than high school	343	30.2
Father's educational level N=1,199	Not educated	41	3.8
	Educated till high school	775	70.4
	Higher than high school	285	25.9
Mother has job	Yes	359	29.9
	No	839	69.9
	Do not know	2	.2
Father has job N=1,199	Yes	1103	92.0
	No	90	7.5
	Do not know	6	0.5
Internet access	Yes	1038	86.5
	No	162	13.5
[+] Weighted percentages			

Arabic health literacy assessment scale for adolescents (HAS-A-AR)

We summarized the results of HAS-A-AR in tables 3 and 4. The HAS-A scales results showed that only 45% of adolescents had a high level of health literacy in terms of interpersonal communication. However, almost 68% of them showed high levels of health literacy according to HAS-A-AR confusion subscale, while 80% showed high health literacy in their ability to read and understand health information (table 3). The context-related categories that we added to HAS-A scale items showed a wide range of frequencies. Some items had relatively low rates such as "How often does your doctor seem to understand you when you answer a question he or she asks?", with around 7% responding that their doctor does not ask them any questions. Others showed high frequencies as "How often do you think the forms you complete at your doctor's office are confusing?" where 54% of the adolescents reported that they do not complete forms at the doctor's office (table 4).

Table 3 Descriptive results and reliability of three subscales of HAS-A-AR [++]

	Communication	Confusion [+]	Functional health literacy [++]
Mean	13 (5.3) [†]	5.4 (3.8) [†]	7 (4.9) [†]
Median	14	5	6
Minimum possible	0	0	0
Maximum possible	20	16	24

High health literacy ‡	539 (44.9%) †	826 (68.8%) †	960 (80.3%) †
Low health literacy	661 (55.1%) †	374 (31.2%) †	236 (19.7%) †
Cronbach's α	0.87	0.78	0.77
McDonald's ω	0.88	0.77	0.77
Greatest lower bound (GLB)	0.90	0.79	0.80
Average Inter-item correlation	0.59	0.45	0.36

+ N=1,199, ++ N=1,196

‡ High health literacy subscales' scores: communication (15-20), confusion (0-7), and functional health literacy (0-11)

† weighted means and percentages

†† HAS-A-AR: An Arabic translated version of HAS-A

Psychometric properties of HAS-A-AR

Validity

Face and content validity testing revealed that all items were understandable with minor modifications made. Based on the Scree plot and eigenvalues, we decided to retain three factors (figure 2). We performed EFA using the principal axis factoring method of extraction. The overall KMO statistic was 0.89, while Bartlett's test of sphericity was significant ($\chi 2$ (1200) = 6505.6, p<0.001). Anti-image correlation matrix diagonal values were all > 0.8. We found that our sample did not have the issue of multicollinearity. Factor 1 (Communication) included five items that explained 33% of the variance with factor loadings range from 0.62 to 0.82. Factor 2 (functional health literacy) included six items that explained 17% of the total variance with loadings range between 0.40 and 0.76, while factor 3 (confusion) included four items that explained 7% of the total variance with loadings between 0.47 and 0.83. Even though the p-value for the chi-square statistic was low ($X^2 = 426.42$, $p < 0.001$), other goodness of fit measures showed that the model had a good fit. Root mean square error of approximation (RMSEA) was 0.57. Tucker-Lewis index (TLI) and comparative fit index (CFI) values were 0.95 and 0.94, respectively, while standardized root means square residual (SRMR) was 0.038.

Figure 2 Scree Plot and the eigenvalues of the three retained factors and one non-retained factor here

Reliability analysis

Reliability analysis showed that HAS-A-AR, which consists of 15 items, is a reliable scale (α = 0.85, ω=0.88, GLB=0.90) (for details on α, ω and GLB of HAS-A-AR subscales, see table 3). Inter-item correlations for all items of factors 1 and 3 were more than 0.3, while in factor 2, inter-item correlations between item 3.5 and both items 3.1 and 3.2 were slightly below 0.3

(Supplement 1). Average Inter-item correlation for all HAS-A-AR scales combined is 0.28. The average-inter-item correlation for the subscales range was between 0.36 and 0.59. Item-rest correlations were all above 0.4 (Table 4).

Table 4 HAS-A-AR items and their psychometric properties

	HAS-A items with the added responses			Factor loading			Reliability
	Items ++	Added response	Weighted % of added response	F1+	F2*	F3+	IRC†
1.1	How often is it easy for you to ask your doctor questions about your health? N=1,200	There is no special doctor	18.6	0.62			0.61
1.2	How often does your doctor understand what you mean when you ask him or her, a question about your health? N=1,200	I don't ask the doctor	9.6	0.81			0.75
1.3	How often can you easily describe a health problem you have to your doctor? N=1,200	Not me who describes my health problem for the doctor	10.4	0.82			0.73
1.4	How often does your doctor seem to understand you when you answer a question he or she asks? N=1,200	The doctor doesn't ask me	7.2	0.79			0.72
1.5	How often do you understand the answers your doctor gives to your questions? N=1,199	I don't ask the doctor any questions	8.1‡	0.79			0.72

2.1	How often do you get confused because you find different information about the same health topic? N=1,200	I don't search/find information	15.3			0.47	0.49
2.2	How often do you get confused when your doctor tells you about taking medicine? N=1,200	The doctor doesn't talk with me about medicine	14.3			0.72	0.58
2.3	How often do you get confused when your doctor tells you about possible side effects from a medicine or treatment? N=1,199	The doctor doesn't tell me about possible side effects from a medicine or treatment	22.9 ‡			0.83	0.66
2.4	How often do you get confused when your doctor tells you about test results, like results of an X-ray? N=1,199	The doctor doesn't tell me about test results, like results of an X-ray	28.1 ‡			0.56	0.55
3.1	How often do you get confused when reading instructions for medicine? N=1,200	I don't read instructions for medicine	29.1		0.40		0.5
3.2	How often do you have problems learning about an illness or health topic because of difficulty understanding the written information you get? N=1,199	I don't get information about illness or health topic	22.7 ‡		0.47		0.49
3.3	How often do you think the forms you complete at your doctor's office are confusing? N=1,199	I don't complete forms at my doctor office	54.1 ‡		0.55		0.54

3.4	How often are you confused by health information that has a lot of numbers and statistics? N=1,198	I don't read such health information	37.8 ‡‡		0.62		0.55
3.5	When you talk to people other than your doctor about health issues, how often are you confused by what they tell you? N=1,200	I don't talk to other people than my doctor	22.7		0.54		0.46
3.6	When reading brochures or hand-outs about health issues, how often do you need someone to help you read them? N=1,200	I don't read brochures or hand-outs about health issues	30.3		0.76		0.53

† IRC: Item-rest correlation (item-total correlation)

++ HAS-A original English-language questions

Note. Of the observations, † 1,199 were used, 1 was excluded listwise, * 1,196 were used, 4 were excluded listwise, and 1,200 were provided.

‡ 1 missing case, ‡‡ 2 missing cases

-Eigenvalue: factor 1= 4.937 (33% of variance), factor 2= 2.570 (17% of variance), factor 3= (7% of variance)

-Extraction Method: Principal Axis Factoring.

-Rotation Method: Promax with Kaiser Normalization.

-Determinant = 0.04

-Kaiser-Meyer-Olkin Measure of Sampling Adequacy= 0.886

-Bartlett's Test of Sphericity = 6505.6 (p<.0.001)

Discussion

In this study, we applied published methods for translation of the HAS-A to provide an Arabic version of this tool (HAS-A-AR). Adolescents clearly understood the translated version, and testing its psychometric properties showed that HAS-A-AR is a valid and reliable tool to be used for measuring health literacy among Palestinian adolescents living in the Ramallah District.

Psychometric properties

Adding the extra options in HAS-A-AR that are relevant to the Palestinian context did not change the factor structure. The initial step of validation of the Arabic version of HAS-A-AR was testing the factorial structure [45]. EFA revealed that HAS-A-AR has a similar structure to the original HAS-A, which supports the usage of similar scoring methods. Solid and stable factors

need to have minimum factor loadings between 0.4 and 0.5 [12 28]. All of the factor loadings were >0.5 except two, which were ≥0.4. Therefore, we retained all the original HAS-A items. Around 57% of the variance is explained by the three retained factors, which is close to 60%, the value that Hair et al. reported as acceptable to consider the construct to be valid [37]. This pattern of factor loadings and model fit suggests that the HAS-A-AR has adequate construct validity.

Cronbach's alpha values suggest that HAS-A-AR has good internal consistency. Compared to the reliability testing of the original HAS-A [11], the Arabic version showed a higher (α) for the communication and confusion subscales and was similar for the functional health literacy subscale. However, in the literature, there is some debate regarding the adequacy of Cronbach's alpha (α) to assess the reliability of scales, especially those with ordinal items, as this may bias the measured reliability of the tested scale [46]. Alternatives were suggested such as MacDonald's omega test (ω) [35], and greatest lower bound (GLB) [36] as preferable to (α). Since authors are recommended to report reliability estimates other than (α) [47], we measured ω, GLB, and α (for comparability with other studies). Values of reliability measures, which are higher than 0.7, indicate that the scale is reliable [34 43 44]. Therefore, our results suggest that HAS-A-AR is a reliable instrument to be used in this population.

Furthermore, the average inter-item correlations also indicate good internal consistency. The recommended range of average inter-item correlation is between 0.15-0.5 [48]. The confusion and functional health literacy subscales' average inter-item correlations were within the recommended range, while the communication subscale's average inter-item correlation was slightly higher than 0.5. This indicates that items in the confusion and functional health literacy and to a lower extent, the communication subscale, are homogenous, enough to describe the same construct but still have their unique variance that distinguishes one from the other. In general, these results provide additional support for the reliability of the measure.

Health literacy

In this study, the percentage of adolescents choosing the added responses, which expressed a lack of active involvement with their health care, was relatively high in most questions. We expected such a pattern, as it emphasizes a gap in interaction and communication between the Palestinian adolescents and their health care professionals (HCPs). The quality of communication with HCPs is also essential, especially to the subsequent empowerment of individuals, as the way of communicating can be a facilitator or a barrier for health information exchange [49]. Neuroscience research indicates that adolescents can possess adequate communication skills essential for their ability to make medical or health-related decisions [49]. Good communication between the Palestinian adolescents and their HCPs has to be created to enhance adolescents' health literacy competencies, which may impact on the received health care services quality.

Moreover, adolescents in this study showed a low level of health literacy. Compared to American adolescents [11], the adolescents of this study had similar levels of functional health literacy, but reported lower communication skills and were more likely to be confused regarding health information. This could be because Palestinian adolescents lack the autonomy to participate actively in decision making regarding their health. Parents usually have the power to communicate directly with HCPs and make health-related decisions on behalf of their children. However, it is worth noting that being in control can enhance the feeling of confidence, which in turn will contribute to an active role and involvement in health [50]. The age of 12 might be when adolescents start to possess the competencies for that enable to have an active role in medical or health-related decision making [49]. In the Netherlands, 12-17 years old adolescents expressed their desire to be involved in health-related decision making with advice from their parents [51]. For adolescents, this is not only a matter of taking the right decision; it is about the feeling of autonomy and having control over their own health [52]. For example, patient-centered communication with 10-15-year-old type 1 diabetic adolescent patients increased the adolescents and parents perceptions of competence, self-efficacy, and perceived control, which led to increased adherence and metabolic control [53]. Therefore, encouraging shared decision making between parents and their adolescent children may help in improving adolescent health literacy levels.

Strengths and limitations

Using a representative sample of Palestinian adolescents from Ramallah district, including all social groups who live in urban, rural and refugee camps is a strength of this study. We were unable to include adolescents from other cities in the West Bank or Gaza Strip due to financial and political considerations. However, residents from all over the West Bank and to a lower extent from the Gaza strip tend to move to live and work in Ramallah since it is an economic center in Palestine. This can, to some extent, overcome the issue of including just the Ramallah district in our study. HAS-A-AR can be used among 11-16 years old Palestinian adolescents. However, the original HAS-A targeted a wider age group (12-19 years), and since the exploratory factor analysis revealed that HAS-A-AR has a similar structure to the original HAS-A, we may consider that the HAS-A-AR is an appropriate instrument to use among this age group of Palestinian adolescents.

The meticulous translation process that involved experts with multiple revisions and the fact that adolescents faced no problems in understanding questions during interviews is another strength of this study. The addition of the extra options to the questionnaire to make it relevant to the Palestinian context and maybe to other countries in the Arab region is also a strength of this study. Since concerns regarding the reliability of self-reported scales were noted [11], conducting face-to-face interviews could be one of the reasons for the high response rate in our study especially that interviews were with adolescents who may not have completed a self-

administered questionnaire as required. We used various tests which showed that HAS-A has good psychometric properties. However, we could not perform test-retest reliability due to time and financial constraints. Additionally, we could not perform a criterion validity test as well due to the lack of a gold standard tool. Even though we performed CFA to confirm the results of EFA, we need to perform CFA using different samples in the future.

Conclusion

Health literacy research in Palestine is limited, and a locally validated tool for use among adolescents has been unavailable until now. This study demonstrates that HAS-A-AR has good construct validity and reliability. Thus, the HAS-A-AR is now available for use among adolescents in Palestine and the surrounding Arab countries that have similar characteristics as Palestine, including language, culture, and political instability. Further research is needed to check for the other psychometric properties of the tool or to use the scale to evaluate and have a better understanding of adolescent health literacy and its associated factors. Moreover, it is important to conduct interventions or programs (within school-settings, for example) which aim to improve adolescent health literacy. It also seems necessary to invest in interventions targeting parents and doctors to improve how they communicate and deliver health information to adolescents and involve adolescents in the process of taking decisions related to their health.

Footnotes

Contributorship statement

Study design: MBAS, RF, MJ, RG. Direct supervision on data collection: MBAS, RG. Development and revision of methods and measures: MBAS, HSS, RF, MJ, RG. Data analysis: MBAS. Revision of statistical analysis: HSS. Interpretation: MBAS, HSS, RF, MJ, RG. Writing of the first and final version of the manuscript: MBAS. Revision for important intellectual content: MBAS, HSS, RF, MJ, RG. All authors approved the final version for publication.

Funding

This work was supported by JSPS KAKENHI Grant Number 16KT0039.

Competing interests

None declared.

Ethics approval

We obtained ethical approvals from the Research Ethics Committee of the Graduate School of Medicine, the University of Tokyo (Ethical approval nr: 11545-(1)), and The Research Ethics Committee (REC) of Birzeit University (Ethical approval nr: 161013).

Provenance and peer review

Not commissioned; externally peer-reviewed.

Data availability statement

Data are available upon reasonable request.

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Figures legend

Figure 1: The followed process for translating and adapting the Arabic Health Literacy Assessment Scale for Adolescents (HAS-A-AR)

Figure 2: Scree Plot and the eigenvalues of the three retained factors and one non-retained factor

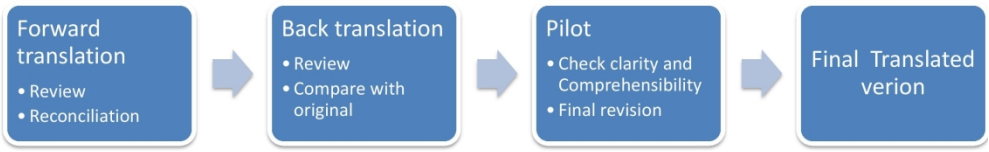

Figure 1 The followed process for translating and adapting the Arabic Health Literacy Assessment Scale for Adolescents (HAS-A-AR)

254x190mm (300 x 300 DPI)

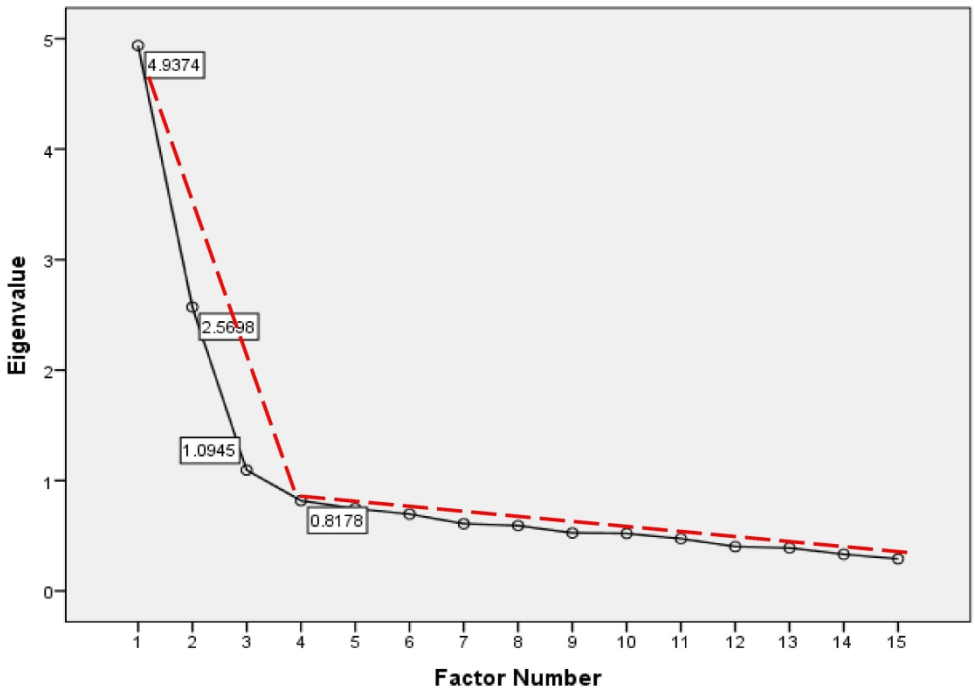

Figure 2 Scree Plot and the eigenvalues of the three retained factors and one non-retained factor

254x190mm (300 x 300 DPI)

Psychometric properties of an Arabic-language health literacy assessment scale for adolescents (HAS-A-AR) in Palestine

Supplement 1: Inter-item correlations of the factors retained

Factor 1 Spearman Correlations

		1.1	1.2	1.3	1.4	1.5
1.1	Spearman's rho	—				
	p-value	—				
	Upper 95% CI	—				
	Lower 95% CI	—				
1.2	Spearman's rho	0.569	—			
	p-value	< .001	—			
	Upper 95% CI	0.606	—			
	Lower 95% CI	0.530	—			
1.3	Spearman's rho	0.468	0.574	—		
	p-value	< .001	< .001	—		
	Upper 95% CI	0.511	0.611	—		
	Lower 95% CI	0.422	0.535	—		
1.4	Spearman's rho	0.421	0.524	0.570	—	
	p-value	< .001	< .001	< .001	—	
	Upper 95% CI	0.466	0.564	0.607	—	
	Lower 95% CI	0.373	0.481	0.530	—	
1.5	Spearman's rho	0.452	0.538	0.527	0.620	—
	p-value	< .001	< .001	< .001	< .001	—
	Upper 95% CI	0.496	0.577	0.567	0.654	—
	Lower 95% CI	0.406	0.496	0.485	0.584	—

Factor 2 Spearman Correlations

		3.1	3.2	3.3	3.4	3.5	3.6
3.1	Spearman's rho	—					
	p-value	—					
	Upper 95% CI	—					
	Lower 95% CI	—					
3.2	Spearman's rho	0.347	—				
	p-value	< .001	—				
	Upper 95% CI	0.395	—				
	Lower 95% CI	0.296	—				
3.3	Spearman's rho	0.381	0.354	—			
	p-value	< .001	< .001	—			
	Upper 95% CI	0.428	0.403	—			

	Lower 95% CI	0.331	0.304	—			
3.4	Spearman's rho	0.373	0.357	0.480	—		
	p-value	< .001	< .001	< .001	—		
	Upper 95% CI	0.420	0.405	0.522	—		
	Lower 95% CI	0.323	0.306	0.435	—		
3.5	Spearman's rho	0.284	0.267	0.303	0.332	—	
	p-value	< .001	< .001	< .001	< .001	—	
	Upper 95% CI	0.335	0.319	0.354	0.382	—	
	Lower 95% CI	0.231	0.213	0.251	0.281	—	
3.6	Spearman's rho	0.375	0.326	0.328	0.391	0.430	—
	p-value	< .001	< .001	< .001	< .001	< .001	—
	Upper 95% CI	0.423	0.375	0.378	0.438	0.475	—
	Lower 95% CI	0.325	0.274	0.277	0.342	0.383	—

Factor 3 Spearman Correlations

		2.1	**2.2**	**2.3**	**2.4**
2.1	Spearman's rho	—			
	p-value	—			
	Upper 95% CI	—			
	Lower 95% CI	—			
2.2	Spearman's rho	0.389	—		
	p-value	< .001	—		
	Upper 95% CI	0.436	—		
	Lower 95% CI	0.340	—		
2.3	Spearman's rho	0.413	0.545	—	
	p-value	< .001	< .001	—	
	Upper 95% CI	0.458	0.584	—	
	Lower 95% CI	0.364	0.504	—	
2.4	Spearman's rho	0.335	0.421	0.553	—
	p-value	< .001	< .001	< .001	—
	Upper 95% CI	0.384	0.466	0.591	—
	Lower 95% CI	0.283	0.373	0.513	—

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4,5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	7,8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	
Bias	9	Describe any efforts to address potential sources of bias	N/A
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7,8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7,8
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	N/A
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	7,8
		(*e*) Describe any sensitivity analyses	N/A
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7,8 (only participants number)
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9, 10
		(b) Indicate number of participants with missing data for each variable of interest	9-14 (tables 2, 3and 4)
Outcome data	15*	Report numbers of outcome events or summary measures	10-14
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	N/A
		(*b*) Report category boundaries when continuous variables were categorized	10,11 (table 3)
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	10-14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14, 16
Generalisability	21	Discuss the generalisability (external validity) of the study results	16
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.