



# A vaccine literacy scale for childhood vaccines: Turkish validity and reliability vaccine literacy scale

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## Abstract

**Objective** This methodological study aimed to establish the Turkish validity and reliability of the Vaccine Literacy Scale (VLS) for childhood vaccines.

**Materials and methods** The sample consisted of 285 Turkish parents with children 0–4 years of age. Data were collected using a sociodemographic characteristics questionnaire, the VLS, and the Health Literacy Scale (HLS-14). A confirmatory factor analysis (CFA) was performed to analyze the validity of the psychometric properties. Item total score correlation, Cronbach's coefficient ( $\alpha$ ), and parallel form reliability tests were used to analyze the reliability. The data were analyzed using the Statistical Package for Social Sciences (SPSS, IBM, v. 25) and Analysis of Moment Structures (AMOS, v. 21.0) at a significance level of 0.05.

**Results** According to the CFA, the model fit indices were  $\chi^2 = 121.218$ ,  $\chi^2/df = 1.987$ ,  $RMSA = 0.059$ ,  $CFI = 0.974$ ,  $GFI = 0.943$ , and  $AGFI = 0.914$ . The item-total score correlation values ranged from 0.406 to 0.682. The “functional health literacy,” “communicative health literacy,” and “critical health literacy” subscales had Cronbach's alpha values of 0.87, 0.88, and 0.88, respectively. There was a negative correlation between the VLS and HLS-14 ( $r = -0.618$ – $-0.569$ ) ( $p < 0.000$ ).

**Conclusion** The analyses and evaluations show that the Vaccine Literacy Scale is valid and reliable for the Turkish population. It is a valid and reliable instrument that can be used to determine Turkish parents' health literacy regarding childhood vaccines.

**Keywords** Vaccination · Literacy · Health literacy · Scale · Validity · Reliability · Parents

## Introduction

Vaccination is an important public health practice for protecting and promoting health and preventing infectious diseases (World Health Organization (WHO), Global Vaccine Action Plan 2020). Vaccination provides artificial immunity by introducing weakened or killed bacteria and/or viruses into the living body. Vaccination provides both individual and herd immunity. Vaccination also significantly reduces the incidence and prevalence of infectious diseases, mortality rates, economic losses, and disability (Ergür 2020; Al-Regaiey et al.

2022). According to the WHO, 100 million children are vaccinated before one year, preventing 2–3 million child deaths annually (WHO 2019; Yıldızeli et al. 2021).

Vaccine refusal has risen globally for the past ten years despite known vaccine efficacy. According to the WHO, nine out of ten children had access to vaccines, but there were 20 million unvaccinated children in 2019. Moreover, it has been reported that vaccine refusal is rising (WHO Global Vaccine Action Plan 2020). Vaccine refusal is also on the rise in Turkey. Childhood immunization rates have declined since 2008 (TNSA 2018). In 2011, 183 Turkish families refused to vaccinate their children due to vaccine hesitancy. However, this number increased to 12,000 in 2016, 23,000 in 2018, and 40,000 in 2019 (Aygün and Tortop 2020). Vaccine refusal in Turkey increased 125-fold between 2012 and 2019 (Erdoğan et al. 2021). The WHO established the Strategic Advisory Group of Experts on Immunization (SAGE) in response to the global rise in vaccine refusal. SAGE has conducted considerable research on vaccine hesitancy and refusal (Betsch et al. 2018; MacDonald 2015).

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If vaccine refusal rates continue to grow, immunization rates are projected to fall below 80% in the next five years, resulting in epidemics and deaths from childhood diseases, which are a thing of the past (Nas et al. 2020). We must prevent vaccine hesitancy and refusal and improve information and vaccine literacy to protect and sustain public health and prevent infectious diseases (Jones et al. 2012).

Vaccine literacy is based on health literacy. It is defined as the degree to which one can obtain, process, and understand the information that underlies the enormously complex data involved in vaccine science (Biasio et al. 2020). Everyone should have a certain level of vaccine literacy because vaccine technology is complicated (Yıldızeli et al. 2021). People have difficulty accessing the right information and making informed decisions because misinformation and conspiracy theories about vaccines are swirling around online (Yıldızeli et al. 2021). Vaccine literacy is a complex concept that is crucial for the prevention of vaccine hesitancy and refusal. Vaccine literacy is concerned with assessing vaccine knowledge, training and interventions regarding vaccines, and nursing care (Biasio et al. 2020).

Vaccine literacy is an important issue affecting vaccination intention. It is a critical tool for preventing diseases and protecting and improving public health (Ratzan and Parker 2020). We cannot battle against vaccine hesitancy and refusal without assessing vaccine literacy (Lorini et al. 2022; Montagni et al. 2019; Vanderslott and Marks 2021). Valid and reliable measurement tools can help us assess vaccine literacy, identify the factors affecting it, and formulate interventions to increase it (Aharon et al. 2017). However, there are no valid and reliable scales in Turkish for vaccine literacy. Therefore, this study aimed to establish the Turkish validity and reliability of the Vaccine Literacy Scale (VLS) for childhood vaccines.

## Materials and methods

### Research purpose and design

This study adopted a methodological design to adapt the VLS into Turkish.

### Population and sample

The Vaccine Literacy Scale was developed by Aharon et al. (2017) to assess parents' health literacy regarding childhood vaccines. The study population consisted of all parents of children 0–4 years of age because Turkey administers 17 of the 20 vaccines in the first 48 months of life according to the Childhood Vaccination Schedule of the Ministry of Health. A common rule of thumb for scale

development is to have a sample size of five to ten times the number of items on the scale (Seçer 2017). However, a common rule of thumb for scale adaptation is to have a sample size of five to 20 times the number of items on the scale. The Vaccine Literacy Scale consists of 13 items. A sample of 65 to 130 participants would be large enough to develop a scale. However, the sample size should be at least 250–300 participants to satisfy the assumptions of multiple normal distributions in confirmatory factor analysis (CFA). Therefore, the final sample consisted of 285 parents of children 0–4 years of age.

### Research steps

This study adhered to the principles of the International Test Commission (ITC) Guidelines for Translating and Adapting Tests (Gregoire 2018). First, the researchers obtained authorization from the developers of the scale. Second, a translation center with an international quality certificate translated the scale into Turkish. Third, the researchers sent the Turkish version to 19 experts with a Ph.D. in public health nursing and pediatric nursing. They received feedback from 13 experts about the language validity of the scale. They made modifications to the items based on expert feedback. They conducted a pilot study with 30 parents of children 0–4 years of age. None of the participants gave negative feedback about the intelligibility of the items. Afterward, the researchers collected data. After data collection, they assessed the psychometric properties of the scale. They then finalized the scale and established its directive.

### Steps of the adaptation of the VLS to Turkish

- Receiving authorization from the developers of the scale
- Having the scale translated into Turkish by the translation center
- Receiving expert feedback and developing a draft
- Conducting a pilot study and assessing feedback
- Developing the draft scale
- Translating the scale back into English and receiving the approval of its developers
- Assessing the psychometric properties of the scale (validity and reliability)

**Validity analysis** Confirmatory factor analysis

**Reliability analysis** Cronbach's ( $\alpha$ ) reliability coefficient, item-total score correlation, and parallel form reliability

- Finalizing the scale and developing its directive

## Data collection tools

The data were collected using a sociodemographic characteristics questionnaire, the VLS, and the Health Literacy Scale (HLS-14).

## Sociodemographic characteristics questionnaire

The sociodemographic characteristics questionnaire was based on a literature review conducted by the researchers (Aharon et al. 2017; Jones et al. 2012; Nas et al. 2020). The questionnaire consisted of ten items: age, education, spousal education, family income, number of children, getting childhood vaccinations regularly, thoughts on childhood vaccinations, etc.

## Vaccine literacy scale

The Vaccine Literacy Scale was developed based on the HLS-14 by Aharon et al. (2017) to assess parents' literacy on childhood vaccinations. The scale consists of 13 items and three subscales: functional health literacy (five items), communicative health literacy (five items), and critical health literacy (three items). The items are rated on a four-point Likert-type scale (1 Never, 2 Sometimes, 3 Often, 4 Most of the time). The scores of the subscales are calculated separately; therefore, the scale has no total score. Responses in each subscale are divided by the number of items to obtain a score. Lower functional health literacy scores indicate higher health literacy. Higher communicative and critical health literacy scores indicate higher health literacy. The “functional health literacy,” “communicative health literacy,” and “critical health literacy” subscales have Cronbach's alpha values of 0.70, 0.66, and 0.81, respectively (Aharon et al. 2017). The researchers emailed the developers to establish the Turkish validity and reliability of the scale.

## Health Literacy Scale (HLS-14)

The Health Literacy Scale (HLS-14) was developed by Suka et al. (2013) for Japanese adults. The scale consists of 14 items and three subscales: functional health literacy (five items;  $\alpha = 0.83$ ), interactive health literacy (five items;  $\alpha = 0.85$ ), and critical health literacy (four items;  $\alpha = 0.76$ ). The total scale has a Cronbach's alpha of 0.81. The items are rated on a five-point Likert-type scale (1 Strongly Disagree, 2 Disagree, 3 Undecided, 4 Agree, 5 Strongly Agree). The “functional health literacy” subscale items are reverse scored. The total score ranges from 14 to 70, with higher scores indicating higher health literacy. The scale was adapted into Turkish by Türkoğlu and Kılıç (2021). The Turkish version also consists of 14 items and three subscales: functional health literacy (five items;  $\alpha = 0.85$ ),

interactive health literacy (five items;  $\alpha = 0.90$ ), and critical health literacy (four items;  $\alpha = 0.87$ ). The total scale has a Cronbach's alpha of 0.85. The results show that the HLS-14 is a valid and reliable scale for the Turkish population (Türkoğlu and Kılıç 2021). In this study, the “functional health literacy,” “interactive health literacy,” and “critical health literacy” subscales had Cronbach's alpha values of 0.91, 0.90, and 0.87, respectively. The total scale had a Cronbach's alpha of 0.89.

## Data collection

The study was conducted between 25.05.2022 and 25.06.2022. The data were collected both face-to-face and online to recruit as many participants as possible. The online data were collected through Google Forms. All parents were sent a link to the survey through social media platforms (Gmail, WhatsApp, Facebook, Instagram, etc.). All parents were briefed about the research purpose and procedure. Informed consent was obtained from those who agreed to participate. One hundred and forty-eight participants filled out the online survey. The face-to-face data were collected from parents admitted to a family health center. Those parents were invited to the study. Informed consent was obtained from those who agreed to participate. One hundred and thirty-seven participants filled out the survey. It took each participant 3–4 min to fill out the survey. The researchers answered all questions that the participants had in mind.

## Data analysis

The data were analyzed using the Statistical Package for the Social Sciences (SPSS, v.23) and Analysis of Moment Structures (AMOS, v.23) at a significance level of 0.05. Numbers and percentages were used for descriptive statistics. Validity was assessed using CFA and fit indices [Chi-square (CMIN), Minimum Discrepancy Function by Degrees of Freedom Divided (CMINDF/df), Root Mean Square Error of Approximation (RMSEA), Goodness of Fit Index (GFI), Comparative Fit Index (CFI), Normed Fit Index (NFI), Tucker–Lewis index (TLI), and Adjusted Composite Financial Index (AGFI)]. Reliability was assessed using item-total score correlation, Cronbach's alpha reliability coefficient, and parallel form.

## Results

More than half of the participants had bachelor's degrees (55.4%). Most participants had nuclear families (83.2%). Less than half of the participants had a neutral income (income = expense). Most participants had health coverage (87.4%). Most participants had their children vaccinated

according to the national immunization schedule (90.2%) and believed that childhood vaccinations were necessary and useful (84.2%) (Table 1). Participants had mean HLS-14 “functional health literacy,” “communicative health literacy,” and “critical health literacy” subscale scores of  $18.5 \pm 5.7$  (min 5, max 25),  $21.3 \pm 5.7$  (min 5, max 25), and  $17.3 \pm 3.0$  (min 5, max 25), respectively. They had a mean total HLS-14 score of  $57.2 \pm 10.0$  (min 23, max 70).

### Confirmatory factor analysis

A confirmatory factor analysis was performed to determine the validity of the VLS for the Turkish population. First, sample adequacy was examined using the Holter value during the CFA analysis. The results showed that a sample of 188 was large enough at a significance level of 0.05, while a sample of 210 was large enough at a significance level of

0.01. Therefore, it was concluded that a sample of 285 was large enough. The maximum likelihood calculation method was used because the data were normally distributed. The scale items had factor loadings of 0.64 to 0.90, suggesting that the subscales and the items contributed to the scale adequately.  $\chi^2/df$ , CFI, and NFI had a perfect fit for the data, while GFI, AGFI, and RMSEA had an acceptable fit for the data ( $\chi^2 = 121.218$ ,  $\chi^2/df = 1.987$ , RMSEA = 0.059, CFI = 0.974, GFI = 0.943, AGFI = 0.914) (Table 2).

### Reliability

Reliability was assessed using item-total score correlation, Cronbach’s alpha reliability coefficient, and parallel form.

### Item-total score correlation

Table 3 shows the item-total score correlation test results. The items had correlation coefficients of 0.406 to 0.682 (Table 3).

### Cronbach’s alpha reliability coefficient

The “functional health literacy,” “communicative health literacy,” and “critical health literacy” subscales had Cronbach’s alpha values of 0.877, 0.886, and 0.882, respectively. There was no increase in Cronbach’s alpha when any item was deleted (Table 4).

### Parallel form reliability

The Pearson correlation coefficient was used to determine the correlation between the VLS and the HLS-14 (Table 5). The HLS-14 total score, each VLS subscale, and the same subscales in both scales were evaluated. There was a moderate correlation between the VLS and HLS-14 subscales.

**Table 1** Sociodemographic characteristics (n = 285)

Sociodemographic characteristics	n	%
Age (year)	34.7±6.6 (Min 19, Max 58)	
Number of children	1.94±1.00 (Min 1, Max 5)	
Education (degree)		
Primary school	34	11.9
Middle school	26	9.1
High school	67	23.5
Bachelor’s	158	55.5
Spouse’s education (degree)		
Primary school	24	8.4
Middle school	43	15.1
High school	68	23.9
Bachelor’s	150	52.6
Family type		
Nuclear	237	83.2
Extended	38	13.3
Single parent	10	3.5
Employment status		
Housewife	136	47.7
Employed	149	52.3
Family income		
Negative income (income < expense)	87	30.5
Neutral income (income = expense)	136	47.7
Positive income (income > expense)	62	21.8
Health coverage		
Yes	249	87.4
No	36	12.6
Childhood vaccinations		
Regular and complete	257	90.1
Missing	27	9.5
None	1	0.4
Thoughts on childhood vaccinations		
All vaccines are useful and necessary	240	84.2
Vaccines are useful but all are necessary	37	13.0
Vaccines are unnecessary	2	0.7
No idea	6	2.1

**Table 2** Confirmatory factor analysis of the Vaccine Literacy Scale for childhood vaccines

Fit indices estimates	Acceptable fit	Perfect fit	Scale values
$\chi^2/sd$	<5	<2	1.987
GFI	>0.90	>0.95	0.943
AGFI	>0.90	>0.95	0.914
CFI	>0.90	>0.95	0.974
RMSEA	<0.05	<0.08	0.059
RMR	<0.05	<0.08	0.030
NFI	>0.90	>0.95	0.95

$\chi^2$ , Chi-square, sd, Degrees of freedom,  $\chi^2/sd$ , Chi-square/degrees of freedom, GFI, Goodness of Fit Index, AGFI, Adjusted Goodness of Fit Index, CFI, Comparative Fit Index, RMSEA, Root mean square error of approximation, RMR, Root mean square residual, NFI, Normed Fit Index (Assessment was conducted in the default model)

**Table 3** The results of item total score correlation test

Item No	Item correlation	Item No	Item correlation	Item No	Item correlation
1	0.406	6	0.589	11	0.631
2	0.476	7	0.682	12	0.600
3	0.525	8	0.638	13	0.617
4	0.473	9	0.586		
5	0.439	10	0.643		

**Table 4** Reliability analysis of Vaccine Literacy Scale for childhood vaccines ( $n = 285$ )

Item no	Mean	Standard deviation	Cronbach's alpha ( $\alpha$ )	Cronbach's alpha ( $\alpha$ ) when an item deleted
<b>Functional health literacy subscale</b>				
Item 1	3.05	0.98	0.877	0.871
Item 2	2.90	1.05		0.845
Item 3	3.13	0.93		0.829
Item 4	3.09	1.00		0.835
Item 5	3.51	0.86		0.873
<b>Communicative health literacy subscale</b>				
Item 6	3.05	1.02	0.886	0.861
Item 7	3.15	0.96		0.849
Item 8	3.27	0.88		0.872
Item 9	3.32	0.88		0.867
Item 10	3.30	0.86		0.857
<b>Critical health literacy subscale</b>				
Item 11	3.33	0.87	0.882	0.815
Item 12	3.26	0.88		0.799
Item 13	3.48	0.76		0.877

**Table 5** Correlation between VLS and HLS-14 ( $n = 285$ )

		HLS-14			
		Functional health literacy	Communicative health literacy	Critical health literacy	Total literacy
VLS	Functional health literacy				
	Pearson correlation (r)	-0.618**			-0.523**
	p	0.000			0.000
	n	285			285
	Communicative Health Literacy				
	Pearson correlation (r)		0.569**		0.550**
	p		0.000		0.000
	n		285		285
	Critical health literacy				
	Pearson correlation (r)			0.458**	0.553**
	p			0.000	0.000
	n			285	285

\*\*Significance level 0.01

There was also a moderate correlation between the total HLS-14 score and VLS subscale scores (Table 5).

## Discussion

After clean water and sanitation, vaccination is the most effective method for protecting and promoting health and preventing infectious diseases. Globally, vaccines prevent many infant and child deaths each year and significantly reduce disability (WHO Global Vaccine Action Plan 2020). Despite known vaccine efficacy, vaccine hesitancy and refusal are rising, increasing infant and child mortality rates globally. Twenty-eight participants (9.9%) had children who had missed some vaccines ( $n = 27$ ) or had never been vaccinated ( $n = 1$ ). This rate ranges from 11.7% to 21.3% in the United States, Albania, Canada, Romania, etc. (Edwards and Hackell 2016; Dubé et al. 2015; Mayerova and Abbas 2021; Miko et al. 2019). SAGE makes the following recommendations: First, we must develop valid and reliable measurement tools to combat vaccine hesitancy and refusal. Second, healthcare professionals should determine people's vaccine literacy and formulate interventions to help them adopt it (Eskola et al. 2015). Research shows that people with higher vaccine literacy are less likely to hesitate

or refuse to get vaccinated or get their children vaccinated (Baysan et al. 2021; Dubé et al. 2015). Therefore, we should assess people's vaccine literacy to combat vaccine hesitancy and refusal. A psychometric measurement tool must be valid and reliable. Otherwise, it cannot measure the construct it is intended to measure (Seçer 2017). This study established the Turkish validity and reliability of the VLS for the Turkish population.

## Validity

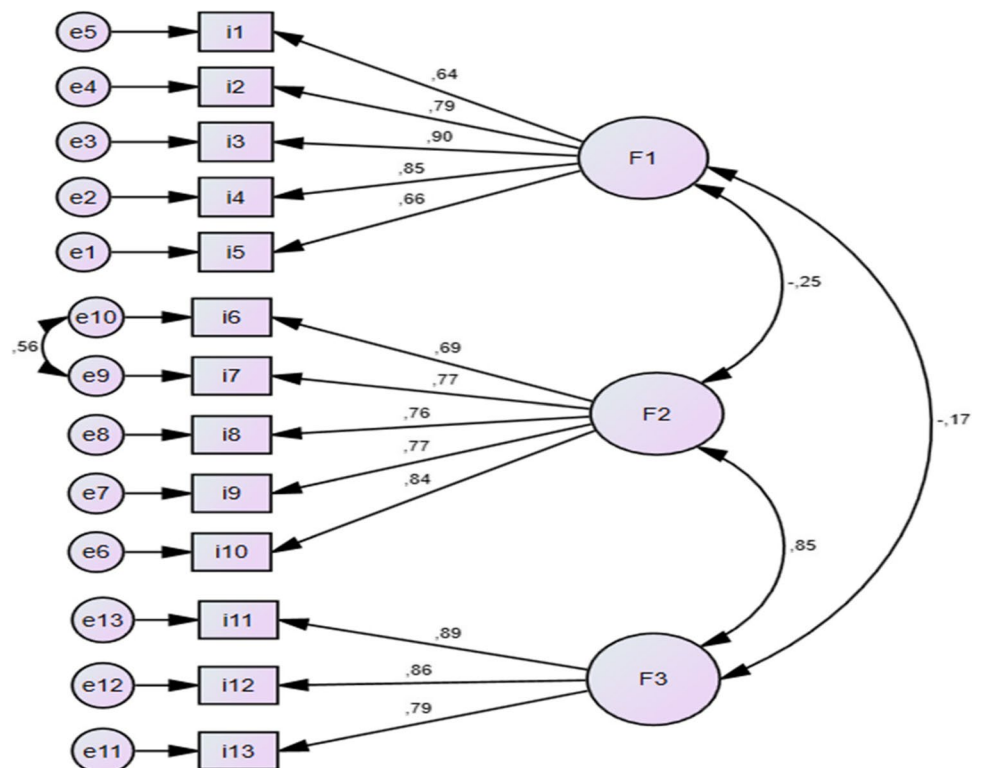
Validity is the extent to which an assessment accurately measures what it intends to measure. Validity is the most important feature that a measurement tool should have. A measurement tool that is not valid fails to yield accurate results even if it is reliable (Alpar 2006). Construct validity is a popular method for assessing the validity of a measurement tool. Construct validity is the degree to which a measurement tool can measure the theoretical construct it is intended to measure. Factor analysis (exploratory factor analysis and/or confirmatory factor analysis) should be used to assess construct validity (Seçer 2017). In this study, a CFA was performed to establish the construct validity of the VLS. Confirmatory factor analysis is a type of structural equation modeling used to examine whether the factor structure of a measurement instrument is consistent with theoretical knowledge (Çapık 2014). Confirmatory factor analysis focuses on fit indices such as  $\chi^2$ ,  $\chi^2/\text{sd}$ , GFI, AGFI,

RMSEA, RMR, SRMR, NFI, and TLI. An  $\chi^2/\text{sd}$  value of  $\leq 2$  indicates an excellent fit. An  $\chi^2/\text{sd}$  value of  $\leq 5$  indicates an acceptable fit. A GFI, CFI, AGFI, and NFI greater than 0.95 indicate an excellent fit. An RMSEA and RMR smaller than 0.05 indicate an excellent fit. An RMSEA and RMR smaller than 0.08 indicate an acceptable fit (Boateng et al. 2018; Çapık 2014; Yaşlıoğlu 2017). In this study,  $\chi^2/\text{sd}$  (1.987), GFI (0.943), AGFI (0.914), CFI (0.974), NFI (0.95), RMSEA (0.059), and RMR (0.030) were acceptable.  $\chi^2/\text{sd}$ , CFI, NFI, and RMR indicated an excellent fit. In confirmatory factor analysis, a scale should consist of items with factor loadings greater than 0.45. Moreover, items should have high loadings on a single factor and low loadings on others (Büyüköztürk 2010; Sönmez and Alacapınar 2016). Our CFA results showed that all items had factor loadings greater than 0.45, ranging from 0.64 to 0.90 (Fig. 1). The CFA results were consistent with the literature. The subscales were consistent with the scale. All items were adequately correlated with their subscales. These results show that the VLS is a valid instrument for the Turkish population.

## Reliability

Reliability is a fundamental characteristic of a measurement tool. A reliable instrument yields consistent results over time that are free from errors. The lower the error rate of a measurement tool, the more reliable it is (Boateng et al. 2018). Different methods (Cronbach's alpha coefficient,

**Fig. 1** The figure of confirmatory factor analysis



Kuder–Richardson 20–21, etc.) are used to determine the reliability of instruments measuring cognitive and affective characteristics. However, Cronbach’s alpha is used to assess the internal consistency of scales with items rated on Likert-type scales. A Cronbach’s alpha of  $0.00 \leq \alpha \leq 0.40$  indicates unreliability. A Cronbach’s alpha of  $0.40 \leq \alpha \leq 0.60$  indicates low reliability. A Cronbach’s alpha of  $0.60 \leq \alpha \leq 0.80$  indicates reliability. A Cronbach’s alpha of  $0.80 \leq \alpha \leq 1.00$  indicates high reliability (Boateng et al. 2018). A reliable instrument should have a Cronbach’s alpha of at least 0.70. The higher the Cronbach’s alpha, the more reliable the instrument (Karakoç and Dönmez 2014; Terwee et al. 2007). In this study, the “functional health literacy,” “communicative health literacy,” and “critical health literacy” subscales had Cronbach’s alpha values of 0.87, 0.88, and 0.88, respectively. These results show that the VLS is a highly reliable instrument.

### Item-total score correlation

An item-total correlation value refers to the correlation between the scale and total scores. The higher the correlation coefficient for each item, the more effectively and adequately it can measure the concept, situation, and/or construct it intends to measure. An item must have a correlation coefficient of at least 0.32. Items with correlation coefficient values smaller than 0.32 should be removed from the scale. Items with item correlation value greater than 0.90 should also be removed from the scale because they measure the same concept, situation, and/or construct (Çokluk 2010). The Vaccine Literacy Scale had item-total correlation values of 0.40 to 0.68. None of the items had an item-total correlation value smaller than 0.32 or greater than 0.90 (Table 3). The results show that the scale items can measure the concept, situation, and/or construct they are intended to measure.

### Parallel form reliability

Parallel form reliability involves administering two similar, but not the same, versions of an instrument and correlating the scores. The correlation coefficient ( $r$ ) examines the relationship between two continuous variables (Seçer 2017). The correlation coefficient ranges from  $-1$  to  $+1$ . The Pearson correlation coefficient measures the strength of a linear association between two variables when data is normally distributed. Spearman’s rank correlation coefficient measures the strength of a linear association between two variables when data is non-normally distributed. A scale is reliable if the correlation coefficient is significant ( $0.00 \leq r \leq 0.19$  very weak;  $0.20 \leq r \leq 0.39$  weak;  $0.40 \leq r \leq 0.69$  moderate;  $0.70 \leq r \leq 0.89$  strong;  $0.90 \leq r \leq 1.00$  very strong) (Ersöz and

Ersöz 2019). In this study, the HLS-14 was used to determine the parallel form reliability of the VLS. The HLS-14 was the scale of choice because it assesses adults’ health literacy and has subscales similar to those of the VLS (functional, communicative, and critical health literacy). The Pearson correlation coefficient was used to determine parallel form reliability because the data were normally distributed. The results showed a moderate correlation between the HLS-14 and the VLS subscales. A moderate correlation was also found between the HLS-14 total score and the VLS subscale scores. The VLS “functional health literacy” had a negative correlation because its items are reverse scored. It is no surprise that the scales have a moderate correlation. Researchers have developed more focused scales on nutrition, environmental, and e-health literacy because health behavior-specific literacy falls short of explaining general health literacy (Atabek Yiğit et al. 2014; Çoşkun and Bebiş 2015; Sonay Türkmen et al. 2017). These results show that the VLS is reliable for assessing parents’ childhood vaccine literacy.

### Conclusion

The Vaccine Literacy Scale is a valid and reliable instrument for assessing Turkish parents’ childhood vaccine literacy. It consists of 13 items and three subscales. Healthcare professionals can use the VLS to determine parents’ health literacy regarding childhood vaccines, assess the effectiveness of training on childhood vaccines, and plan relational and/or interventional interventions to prevent vaccine hesitancy and refusal. Public health experts and policymakers should use the VLS to plan interventions to protect, promote, and sustain public health. The scale will allow researchers to make regional comparisons of parents’ childhood vaccine literacy at the national level. It will also help them compare parents’ childhood vaccine literacy internationally.

### Ethical considerations

Authorization was obtained from the developers to adapt the VLS into Turkish. The study was approved by the ethics committee of Artvin Çoruh University (No: E-18457941-050.99-45390 & Date: 05.04.22). Prior to the study, the institution’s permit was taken (Issue: E-17720518-605.99). All parents were briefed about the research purpose and procedure. Informed consent was obtained from those who agreed to participate. The research was conducted according to the ethical principles of the Declaration of Helsinki.

**Author contributions** All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Deniz S. Yorulmaz and Deniz Kocoglu-Tanyer. The first draft of the manuscript was written by Deniz S. Yorulmaz and Deniz Kocoglu-Tanyer listed as co-first authors. Supervision and consultancy was carried out by Deniz Kocoglu-Tanyer. All authors read and approved the final manuscript.

**Data availability** Data that supports the finding of this article are available from the corresponding author (DSY) upon reasonable request.

**Code availability** Not applicable.

## Declarations

**Ethics committee approval** Artvin Çoruh University (No: E-18457941-050.99-45390 & Date: 05.04.22). The institution's permit Issue: E-17720518-605.99.

**Informed consent** Informed consent was obtained from those who agreed to participate.

**Conflict of interest** The authors declare that they have no conflicts of interest.

## References

- Aharon AA, Nehama H, Rishpon S, Baron-Epel O (2017) Parents with high levels of communicative and critical health literacy are less likely to vaccinate their children. *Patient Educ Couns* 100(4):768–775. <https://doi.org/10.1016/j.pec.2016.11.016>
- Alpar R (2006) Spor bilimlerinde uygulamalı istatistik. Ankara, Turkey
- Al-Regaiey KA, Alshamry WS, Alqarni RA, Albarrak MK, Alghoraiby RM, Alkadi DY, Iqbal M (2022) Influence of social media on parents' attitudes towards vaccine administration. *Human Vaccines & Immunotherapeutics* 18(1):1872340. <https://doi.org/10.1080/21645515.2021.1872340>
- Atabek-Yiğit E, Köklükaya N, Yavuz M, Demirhan E (2014) Development and validation of environmental literacy scale for adults (ELSA). *J Balt Sci Educ* 13(3):425–435
- Aygin E, Tortop HS (2020) Ebeveynlerin aşı tereddüt düzeylerinin ve karışıklık nedenlerinin incelenmesi. *Güncel Pediatri* 18(3):300–316
- Baysan C, Yavaş SP, Karabat MU (2021) Examination of parents refusing administration of childhood vaccinations: Turkey example. *Childs. Health* 16(3):218–224. <https://doi.org/10.22141/2224-0551.16.3.2021.233906>
- Betsch C, Schmid P, Heinemeier D, Korn L, Holtmann C, Böhm R (2018) Beyond confidence: Development of a measure assessing the 5C psychological antecedents of vaccination. *PLoS One* 13(12):e0208601. <https://doi.org/10.1371/journal.pone.0208601>
- Biasio LR, Giambi C, Fadda G, Lorini C, Bonaccorsi G, D'Ancona F (2020) Validation of an Italian tool to assess vaccine literacy in adulthood vaccination: A pilot study. *Ann Ig* 32:205–222. <https://doi.org/10.7416/ai.2020.2344>
- Boateng GO, Neilands TB, Frongillo EA, Melgar-Quinonez HR, Young SL (2018) Best practices for developing and validating scales for health, social, and behavioral research: a primer. *Front Public Health* 6:149. <https://doi.org/10.3389/fpubh.2018.00149>
- Büyüköztürk Ş (2010) Sosyal bilimler için veri analizi el kitabı. Ankara, Turkey
- Çapık C (2014) Geçerlik ve güvenilirlik çalışmalarında doğrulayıcı faktör analizinin kullanımı. *Anadolu Hemşirelik ve Sağlık Bilimleri Dergisi* 17(3):196–205
- Çokluk Ö (2010) Lojistik Regresyon analizi: kavram ve uygulama. *Educational Sciences: Theor & Practice*. 10(3):1357–1407
- Coşkun S, Bebiş H (2015) Adölesanlarda e-sağlık okuryazarlığı ölçeği: Türkçe geçerlik ve güvenilirlik çalışması. *Gülhane Tıp Dergisi* 57(4):378–384. <https://doi.org/10.5455/gulhane.157832>
- Dubé E, Vivion M, MacDonald NE (2015) Vaccine hesitancy, vaccine refusal and the anti-vaccine movement: influence, impact and implications. *Expert Review of Vaccines* 14(1):99–117. <https://doi.org/10.1586/14760584.2015.964212>
- Edwards KM, Hackell JM (2016) Countering vaccine hesitancy. *Pediatrics* 138(3):e20162146. <https://doi.org/10.1542/peds.2016-2146>
- Erdoğan A, Güven K, Şahin AR, Okyay RA (2021) Understanding the approach of family physicians in Turkey to the problem of vaccine rejection. *Human Vaccines & Immunotherapeutics* 17(6):1693–1698. <https://doi.org/10.1080/21645515.2020.1843335>
- Ergür A (2020) Social causes of vaccine rejection-vaccine indecision attitudes in the context of criticisms of modernity. *Eurasian J Med* 52(2):217–23. <https://doi.org/10.5152/eurasianjmed.2020.20132>
- Ersöz F, Ersöz T (2019) SPSS ile istatistiksel veri analizi. Ankara, Tukey
- Eskola J, Duclos P, Schuster M, MacDonald NE (2015) How to deal with vaccine hesitancy? *Vaccine* 33(34):4215–4217. <https://doi.org/10.1016/j.vaccine.2015.04.043>
- Gregoire J (2018) ITC guidelines for translating and adapting tests. *Int J Test* 18(2):101–134
- Jones AM, Omer SB, Bednarczyk RA, Halsey NA, Moulton LH, Salmon DA (2012) Parents' source of vaccine information and impact on vaccine attitudes, beliefs, and nonmedical exemptions. *Advances in Preventive Medicine* 2012. Article ID:932741, 8 pages. <https://doi.org/10.1155/2012/932741>
- Karakoç FY, Dönmez L (2014) Ölçek geliştirme çalışmalarında temel ilkeler. *Tıp Eğitimi Dünyası* 13(40):39–49. <https://doi.org/10.25282/te.228738>
- Lorini C, Collini F, Galletti G, Ierardi F, Forni S, Gatteschi C, Bonaccorsi G (2022) Vaccine Literacy and Source of Information about Vaccination among Staff of Nursing Homes: A Cross-Sectional Survey Conducted in Tuscany (Italy). *Vaccines* 10(5):682. <https://doi.org/10.3390/vaccines10050682>
- MacDonald NE (2015) Vaccine hesitancy: Definition, scope and determinants. *Vaccine* 33(34):4161–4164. <https://doi.org/10.1016/j.vaccine.2015.04.036>
- Mayerová D, Abbas K (2021) Childhood immunisation timeliness and vaccine confidence by health information source, maternal, socioeconomic, and geographic characteristics in Albania. *BMC Public Health* 21(1):1–17. <https://doi.org/10.1186/s12889-021-11724-6>
- Miko D, Costache C, Colosi HA, Neculicioiu V, Colosi IA (2019) Qualitative assessment of vaccine hesitancy in Romania. *Medicina* 55(6):282. <https://doi.org/10.3390/medicina55060282>
- Montagni I, Cariou T, Tzourio C, González-Caballero JL (2019) “I don't know”, “I'm not sure”, “I don't want to answer”: a latent class analysis explaining the informative value of nonresponse options in an online survey on youth health. *Int J Soc Res Methodol* 22(6):651–667. <https://doi.org/10.1080/13645579.2019.1632026>
- Nas MA, Atabay G, Şakiroğlu F, Cayir Y (2020) Vaccine Rejection in A University's Training Family Health Centers. *Konuralp Medical Journal* 12(3):430–434. <https://doi.org/10.18521/ktd.744687>
- Ratzan SC, Parker RM (2020) Vaccine literacy—helping everyone decide to accept vaccination. *J Health Commun* 25(10):750–752. <https://doi.org/10.1080/10810730.2021.1875083>
- Seçer İ (2017) SPSS ve LISREL ile pratik veri analizi. Ankara, Turkey
- Sonay Türkmen A, Kalkan İ, Filiz E (2017) Adölesan beslenme okuryazarlığı ölçeğinin türkçe'ye uyarlanması: geçerlilik ve güvenilirlik çalışması. *International Peer-Reviewed Journal of*



- Nutrition Research 10:1–20. <https://doi.org/10.17362/DBHAD.2017.2.01>
- Sönmez V, Alacapınar FS (2016) Sosyal bilimlerde ölçme aracı hazırlama. Ankara, Turkey
- Suka M, Odajima T, Kasai M, Igarashi A, Ishikawa H, Kusama M, Sugimori H (2013) The 14-item health literacy scale for Japanese adults (HLS-14). *Environ Health Prev Med* 18(5):407–415. <https://doi.org/10.1007/s12199-013-0340-z>
- Terwee CB, Bot SD, de Boer MR, van der Windt DA, Knol DL, Dekker J, de Vet HC (2007) Quality criteria were proposed for measurement properties of health status questionnaires. *J Clin Epidemiol* 60(1):34–42. <https://doi.org/10.1016/j.jclinepi.2006.03.012>
- Türkiye Nüfus ve Sağlık Araştırması (2018) [www.sck.gov.tr/wp-content/uploads/2020/08/TNSA2018\\_ana\\_Rapor.pdf](http://www.sck.gov.tr/wp-content/uploads/2020/08/TNSA2018_ana_Rapor.pdf)
- Türkoğlu N, Kılıc D (2021) Sağlık okuryazarlığı ölçeği'nin Türkçe'ye uyarlanması: geçerlilik ve güvenilirlik çalışması. *Anadolu Hemşirelik ve Sağlık Bilimleri Dergisi* 24(1):25–33. <https://doi.org/10.17049/ataunihem.662054>
- Vanderslott S, Marks T (2021) Charting mandatory childhood vaccination policies worldwide. *Vaccine* 39(30):4054–4062. <https://doi.org/10.1016/j.vaccine.2021.04.065>
- World Health Organization (2019) National immunization coverage scorecards estimates for 2018. National Immunization Coverage Scorecards Estimates for 2018 ([who.int](http://who.int))
- World Health Organization, Global Vaccine Action Plan (2020) Global Vaccine Action Plan ([who.int](http://who.int))
- Yaşlıoğlu MM (2017) Sosyal bilimlerde faktör analizi ve geçerlilik: Keşfedici ve doğrulayıcı faktör analizlerinin kullanılması. *İstanbul Üniversitesi İşletme Fakültesi Dergisi* 46:74–85 369427 ([dergi.park.org.tr](http://dergi.park.org.tr))
- Yıldızeli F, Alabaz D, Gözüyeşil E (2021) Determining the relationship of parents, knowledge and attitudes and health literacy about the admission or refusal of childhood immunization. *J Pediatr Infect* 15(2):e88–e96. <https://doi.org/10.5578/ced.202119816>

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