

Exploring Psychometric Properties of Scales Measuring Social Handwashing Behavior, Habits, and Attitudes - Health Students

Sosyal El Yıkama Davranış, Alışkanlık ve Tutum Ölçeklerinin Psikometrik Özelliklerinin Belirlenmesi – Sağlık Öğrencileri

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ÖZ

Aim: Purpose of this study was to explore the psychometric properties of the Social Handwashing Behavior Scale (SHBS), the Social Handwashing Habit Scale (SHHS), and the Social Handwashing Attitude Scale (SHAS).

Method: This was a methodological study. The data collection phase of the study was completed between December 15 and March 25, 2020, and 420 college students agreed to participate. The data were analyzed on the R program.

Results: The results produced the following fit indices: $\chi^2/df < 2$, RMSEA < 0.08 , GFI > 0.90 , and NNFI > 0.90 (SHBS); $\chi^2/df < 3$, RMSEA < 0.08 , GFI > 0.85 , and NNFI > 0.80 (SHHS), and $\chi^2/df < 2$, RMSEA < 0.08 , GFI > 0.95 , and NNFI > 0.90 (SHAS).

Conclusion: The results showed that the three measurement tools designed to measure handwashing behavior, habits, and attitudes are valid and reliable scales for the sample group recruited.

Keywords: Reliability, social handwashing behavior, social handwashing habit, social handwashing attitude, validity.

ABSTRACT

Amaç: Bu çalışmanın amacı, Sosyal El Yıkama Davranışı Ölçeği (SEYDÖ), Sosyal El Yıkama Alışkanlığı Ölçeği (SEYAÖ) ve Sosyal El Yıkama Tutum Ölçeği'nin (SEYTÖ) psikometrik özelliklerini araştırmaktır.

Yöntem: Bu çalışma metodolojik bir çalışmadır. Çalışmanın veri toplama aşaması 15 Aralık - 25 Mart 2020 tarihleri arasında tamamlanmış ve 420 üniversite öğrencisi katılmayı kabul etmiştir. Veriler R programında analiz edilmiştir.

Bulgular: Sonuçlar belirtilen uyum indekslerini vermiştir: $\chi^2/sd < 2$, RMSEA $< 0,08$, GFI $> 0,90$ ve NNFI $> 0,90$ (SEYDÖ); $\chi^2/sd < 3$, RMSEA $< 0,08$, GFI $> 0,85$ ve NNFI $> 0,80$ (SEYAÖ) ve $\chi^2/sd < 2$, RMSEA $< 0,08$, GFI $> 0,95$ ve NNFI $> 0,90$ (SEYTÖ).

Sonuç: El yıkama davranışını, alışkanlıklarını ve tutumlarını ölçmek için tasarlanan üç ölçüm aracı; çalışmada yer alan örneklem grubu için geçerli ve güvenilirlerdir.

Anahtar Kelimeler: Güvenirlilik, sosyal el yıkama davranışı, sosyal el yıkama alışkanlığı, sosyal el yıkama tutumu, geçerlilik.

Introduction

The increase in the economic burden of infections, the complexity of treatments, and the severity of multi-drug-resistant pathogen infections are the factors proving the importance of handwashing (1). Despite high mortality rates, disease burden, and economic losses in the pandemic, approximately 81.0% of the world population still do not wash

their hands after bathroom/fecal contact (2). While improper handwashing increases the incidence of maternal and newborn/adult infections and fatal diseases (3), half of the diarrheal illnesses, a quarter of acute respiratory infections, and half of all child deaths are attributed to handwashing-related factors (1). Ignorance of handwashing, the primary means of breaking infection transmission (4) poses a danger of infections and transmission to healthcare workers and patients in healthcare institutions (5). Previous laboratory studies determined that microorganisms may remain in healthcare workers' hands for 2-60 minutes (6). It is also estimated that about half of the infection cases originating from healthcare institutions are accounted for by their hands (7). Yet, proper handwashing behavior is rare among healthcare workers. While the risk of transmission from their hands is 2-20 times higher, especially in

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neonatal and intensive care units, only one out of 10 healthcare workers in intensive care units in some low-income countries wash their hands properly (8).

Undergraduate students enrolling in health-related departments frequently contact patients and spend a long time during their practices (9). Previous studies found handwashing frequency among these students during their practical training to vary between 17.0% and 75.0% (10-13), which may be due to the students' lack of knowledge, ignoring the risks, and misconceptions or inadequate handwashing behavior in their learning environments. Yet, learning environments should contribute to teaching, evaluating, and maintaining proper handwashing behavior and attitudes and creating a handwashing culture (14).

The literature hosts several scales orienting to hygiene (15, 16) or general hygiene behavior, including hand hygiene (17-19). These scales often measure participants' handwashing knowledge, beliefs, practices (15), behavior (17, 18) habits (19), skills, and motivation (16). The common feature of the scales is that they often focus on handwashing behavior and habits but do not contain items for handwashing attitudes (20). Although handwashing behavior, habits, and attitudes are different concepts, many factors associated with handwashing behavior are also related to handwashing attitudes. People's attitudes towards handwashing also affect their handwashing habits (20). Thus, handwashing behavior, habits, and attitudes should be considered intertwined concepts and measured together to evaluate the handwashing characteristics of individuals.

The relevant literature seems to have a shortage of measurement tools (for the public healthcare professionals or other groups) covering variables related to social handwashing, such as knowledge, practice, behavior, skills, and attitudes. Therefore, the study aimed to develop comprehensive scales that cover handwashing behavior, habits, and attitudes and can be used both together and separately. In other words, the ultimate purpose of this study was to explore the psychometric

properties of the Social Handwashing Behavior Scale (SHBS), the Social Handwashing Habit Scale (SHHS), and the Social Handwashing Attitude Scale (SHAS).

Material & Methods

Design

This was a methodological study.

Sample

The literature emphasizes that a sample with 400 and 300 people is needed to be able to perform statistical reliability and validity analyses of a Likert-type scale, respectively (21). Considering possible missing data and non-responded items on the scale forms, a total of 420 individuals aged 18 years and over, enrolled at a school of health sciences, were conveniently selected for the study (22). The participants were also reminded that the study would be carried out in two phases and that the data collection tools might be readministered to those participating in the study.

Item Pooling

The literature was first reviewed to designate the items to be included in the draft forms (19, 23-26). Then, an item pool of 73 items was created, including 12 items for social handwashing behavior, 37 items for social handwashing habits, and 24 items for social handwashing attitudes (12 negatively worded items / reverse coded items). Following comprehensive review and editing of the items, the researchers agreed on all the 73 items in the draft measurement tool.

The draft form was sent by e-mail to 20 public health and measurement and evaluation specialists to obtain expert opinions. Among them, 16 specialists evaluated each item and gave their feedback. Then, the researchers calculated the Content Validity Ratio (CVR) and Content Validity Index (CVI) values for the scales. Upon these calculations and expert opinions, some items were removed from the scales. Overall, the final forms had a total of 53 items (12 for handwashing behavior, 22 for handwashing habits, and 19 for handwashing attitude (8 negative items).

Data Collection Tools

The data collection tools of the study consisted of a demographic information form (10 questions), the SHBS (12 items), the SHHS (22 items), the SHAS (19 items).

Data Collection

The data were collected between December 15 and March 25, 2020. For the test-retest phase, 120 people (28.6%) were asked to fill out the questionnaire forms once again two weeks later the first data collection. All participants have completed the questionnaire. All the data were collected through Google Forms from the students just before their distance education classes. The procedure took 20-25 minutes for each participant.

Data Analysis

The data were analyzed on the R program using relevant validity (CVR and CVI coefficients, criterion validity analysis, exploratory factor analysis (EFA), and confirmatory factor analysis (CFA)) and reliability (internal consistency and test-retest reliability) analyses.

Ethical Considerations

The Ethics Committee of a university granted ethical approval to the study (Meeting No: 2020/12, Decision No: GO 2020/328), and the researchers obtained written consent from students agreeing to participate in the study.

Results

Sample Characteristics

About three-thirds (74.5%) of the participants were females; 65.7% perceived their monthly income as moderate; 52.1% lived in the city center; 76.2% were enrolled at the Department of Emergency Aid and Disaster Management.

Data Suitability

It was found that correlations between the items on the SHBS varied between 0.23 and 0.75; therefore, there was no multicollinearity problem between the items. Except for the correlation

between items 10 and 12, all items showed the lowest correlation with item 2, indicating that item 2 might conceptually differ from others.

There was also no multicollinearity problem on the SHHS since correlation coefficients of the items varied between 0.06 and 0.78. In general, inter-item correlations were low or moderate, and the lowest correlation was revealed between items 1 and 12 with 0.06, followed by items 3 and 20 with 0.08.

Finally, the researchers did not find a multicollinearity issue between the items because inter-item correlations ranged between -0.88 and 0.75. The lowest correlations were between items 1, 3, and 7. Moreover, there were some negative inter-item correlations in the dataset.

Validity Analyses

Following expert opinions, the researchers first calculated CVR and CVI values of 73 items to explore validity-related properties of the scales. Accordingly, on the initial 12-item form of the SHBS, while CVI was calculated to be 0.82, CVR was found to be the lowest in item 10 item with 0.37 (0.62-1.00 for all other items). On the 37-item SHHS, CVI was 0.80, and items 7, 12, and 10 produced the lowest CVR values with 0.12, 0.25, and 0.37, respectively (0.50-1.00 for all other items). Then, while CVI was found to be 0.74, items 4, 5, 8, 10, 16, 23, and 24 yielded the lowest CVR values (0.00, 0.37, -0.12, 0.37, 0.25, 0.12, and 0.37, respectively) on the SHAS (0.50-1.00 for all other items). Although item 10 was removed from the SHBS, a new item was added on the scale upon expert opinions. On the SHHS, the researchers removed items 7 and 12 corrected the statement in item 10. Moreover, 15 items were removed from the scale upon expert opinions. Finally, items 8, 16, 23, and 24 were removed from the SHAS, while items 4, 5, and 10 were edited. Apart from these corrections, a total of 5 items were removed from the scale upon recommendations.

Table 1. EFA Results, Burdur-2020

SHBS		SHHS		SHAS	
Items	Factor Loading	Items	Factor Loading	Items	Factor Loading
SHB1	0.628	SHH2	0.520	SHA2	0.75
SHB2	0.466	SHH4	0.472	SHA4	0.79
SHB3	0.698	SHH5	0.603	SHA5	0.59
SHB4	0.711	SHH6	0.623	SHA6	0.62
SHB5	0.766	SHH7	0.653	SHA8	0.86
SHB6	0.851	SHH8	0.371	SHA10	0.68
SHB7	0.740	SHH9	0.836	SHA11	0.77
SHB8	0.798	SHH10	0.750	SHA12	0.32
SHB9	0.745	SHH11	0.397	SHA13	0.77
SHB10	0.649	SHH14	0.654	SHA14	0.54
SHB11	0.858	SHH15	0.725	SHA18	0.56
SHB12	0.635	SHH16	0.706		
		SHH17	0.770		
		SHH18	0.841		
		SHH19	0.640		
		SHH20	0.564		
		SHH21	0.632		
		SHH22	0.633		
<i>Total Variance Explained =0.518</i> <i>KMO value= 0.853</i> <i>Bartlett's test= 291.41 p<0.0001</i>		<i>Total Variance Explained =0.417</i> <i>KMO test= 0.769</i> <i>Bartlett's test= 1408.1 p<0.0001</i>		<i>Total Variance Explained =0.460</i> <i>KMO test= 0.840</i> <i>Bartlett's test= 656.66 p<0.0001</i>	

EFA: Exploratory Factor Analysis, SHBS: Social Handwashing Behavior Scale, SHHS: Social Handwashing Habits Scale, SHAS: Social Handwashing Attitudes Scale.

Next, the researchers performed EFA and CFA to explore and confirm the factorial structures of the scales. The data of 200 out of 420 participants were used in EFA. Accordingly, the calculated Kaiser-Mayer-Olkin (KMO) values (0.853, 0.769, and 0.840, respectively) showed the adequacy of the sample size for each scale. Then, Bartlett's tests of sphericity yielded the following results: 291.41 (df = 11, p < 0.0001), 1408.1 (df = 21, p < 0.0001), and 656.66 (df = 18, p < 0.0001), respectively, documenting the factorability of the scales (Table 1).

The EFA results showed that item 2 had the lowest item loadings with 0.46, while item 11 had the highest with 0.85. In general, the items had quite high factor loadings on the SHBS. The 12-item single-factor structure of the scale explained approximately 52% of the variance (Table 1).

Items 12 and 13 of the SHHS clustered under more than a factor with relatively similar factor loadings were excluded from the dataset, and EFA

was replicated. The two replications of the analysis yielded that items 1 and 3 gave similar loadings to more than a factor, respectively, and these items were also removed from the dataset. Overall (after items 1, 3, 12, and 13 were removed), a single factor structure emerged with 18 items with factor loadings varying between 0.37 and 0.84, and this structure explained approximately 42% of the variance (Table 1).

Initial EFA analysis for the SHAS revealed that items 1, 3, 7, 9, 15, 16, and 19 had negative factor loadings or clustered under more than a factor. Then, these items were removed one by one from the dataset, and the analysis was replicated several times. In the final analysis, item 17 was excluded from the dataset since giving relatively similar factor loadings to more than one dimension. Finally, it was found that the factor loadings of the items varied between 0.32 and 0.86, and the 11-item single-factor structure of the scale (8 positive – 3 negative) explained about 46% of the variance (Table 1).

Figure 1. Standardized Regression Weights of the Items (SHBS) , Burdur-2020

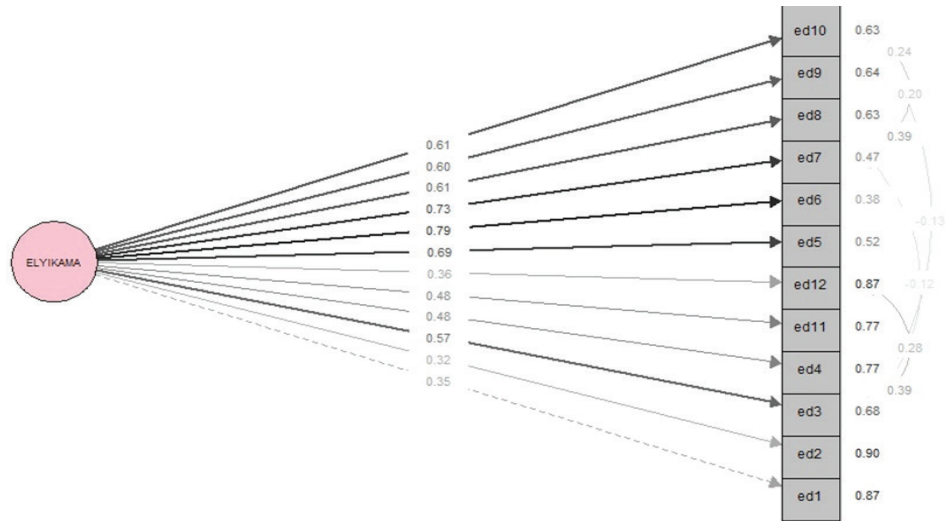
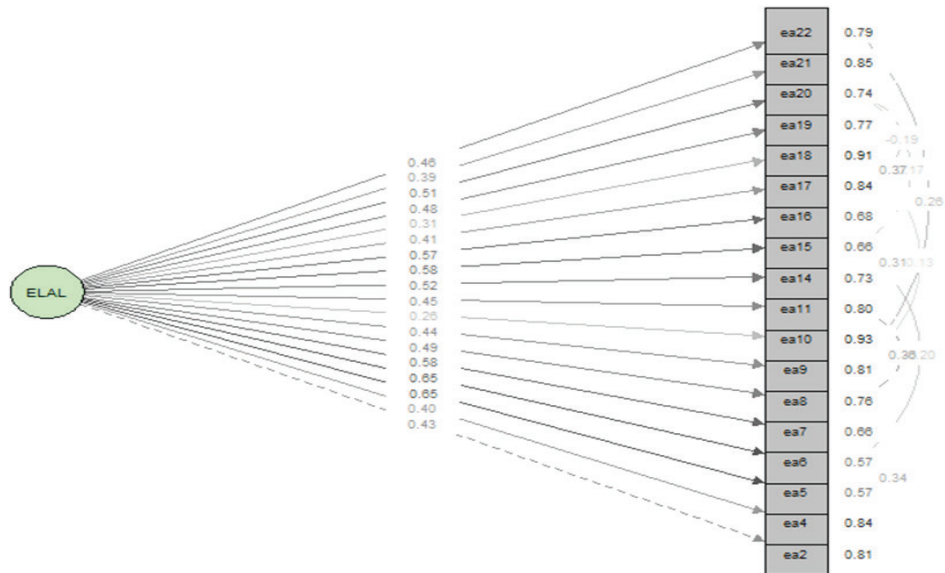


Figure 2. Standardized Regression Weights of the Items (SHHS) , Burdur-2020



Path diagrams (standardized solution values) built using the items were also examined with CFA. The analysis was replicated considering the suggested modifications to obtain a better model for the SHBS, and the researchers linked the error covariances between the relevant items (item 3 ↔ items 4, 7, 10, and 12; item 7 ↔ items 8 and 10; item 9 ↔ item 10). Following modifications, it was found that standardized regression values of the items varied between 0.32 and 0.79 and that there was no item with an item error variance above 0.90 (Figure 1). Similarly, the suggested modifications were considered while exploring the structural model of the SHHS, and error covariances were linked between the relevant items (item 8 ↔ item 11; item 15 ↔ items 6, 14, and 20; item 18 ↔ items 9 and 17; item 5 ↔ item 6; item 9 ↔ item 22; item 17 ↔ item 20). The replicated analysis yielded that the standardized regression weights of the items ranged between 0.26 and 0.65. After the modifications, the error

variances of items 10 and 18 were found to be 0.93 and 0.91, respectively (Figure 2).

Finally, CFA was performed to confirm the factorial structure of the SHAS. The researchers minded the suggested modifications for the model and linked the error variances of the relevant items (item 1 ↔ item 8; item 12 ↔ item 18; item 10 ↔ item 14). Then, it was found that the standardized regression weights of the items varied between 0.78 and 2.04. Besides, the error variances of items 12 and 15 were found to be 1.47 and 1.00, respectively. (Figure 3). This resulted in standardized regression coefficients greater than 1, such as positive correlations between multiple predictor variables. The CFA results also revealed the following mean variance and squared multiple correlation values for the scales, respectively: 0.248 and 0.023 for SHBS; 0.549 and 0.023 for SHHS; 0.30 and 0.009 for SHAS.

Figure 3. Standardized Regression Weights of the Items (SHAS) , Burdur-2020

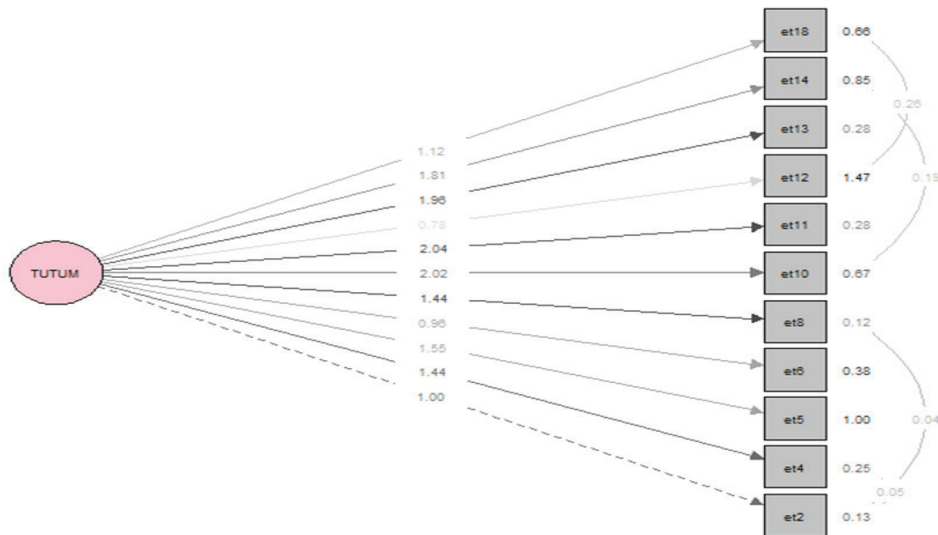


Table 2. Fit Indices, Burdur-2020

No	Index	Reference values [†]					
		Weak Fit	Acceptable Fit	Excellent Fit	SHBS	SHHS	SHAS
1	p^*		$p > 0.05$	$p > 0.05$	0.007	0.000	0.000
2	χ^2/df		< 5	< 3	1.57	2.08	1.92
3	RMSEA	< 0.10	< 0.08	< 0.05	² 0.051	² 0.070	² 0.053
4	RMR	< 0.10	< 0.08	< 0.05	³ 0.034	³ 0.042	³ 0.028
5	SRMR	< 0.10	< 0.08	< 0.05	² 0.052	² 0.067	³ 0.040
6	GFI [§]	> 0.85	> 0.90	> 0.95	² 0.945	¹ 0.887	³ 0.963
7	AGFI [§]	> 0.80	> 0.90	> 0.95	² 0.908	¹ 0.846	² 0.939
8	NFI [§]	> 0.85	> 0.90	> 0.95	² 0.917	⁴ 0.772	² 0.927
9	NNFI [§]	> 0.85	> 0.90	> 0.95	³ 0.954	¹ 0.835	² 0.944
10	CFI [§]	> 0.85	> 0.90	> 0.95	³ 0.967	¹ 0.864	³ 0.959

[†]See 35, 36, 37 for reference fit values.

SHBS: Social Handwashing Behavior Scale, SHHS: Social Handwashing Habits Scale, SHAS: Social Handwashing Attitudes Scale.

^{*} χ^2 is desired to be insignificant, but it often turns out to be significant. Therefore, χ^2/df is considered when describing the data.

[§]Takes a value between 0 and 1. ¹Weak fit, ²Acceptable fit, ³Excellent fit, ⁴Unacceptable.

The data of 220 out of 420 participants were used in CFA, and the fit indices revealed after CFA were as follows: $p=0.007$, $\chi^2=74.152$, $df=47$, $\chi^2/df=1.57$, $RMSEA=0.05$, $RMR=0.03$, $SRMR=0.05$, $GFI=0.94$, $AGFI=0.90$, $NFI=0.91$, $NNFI=0.95$, and $CFI=0.96$ (SHBS); $p=0.000$, $\chi^2=260.529$, $df=125$, $\chi^2/df=2.08$, $RMSEA=0.07$, $RMR=0.04$, $SRMR=0.06$, $GFI=0.88$, $AGFI=0.84$, $NFI=0.77$, $NNFI=0.83$, and $CFI=0.86$ (SHHS); $p=0.000$, $\chi^2=78.837$, $df=41$, $\chi^2/df=1.92$, $RMSEA=0.05$, $RMR=0.02$, $SRMR=0.04$, $GFI=0.96$, $AGFI=0.93$, $NFI=0.92$, $NNFI=0.94$, and $CFI=0.95$ (SHAS) (Table 2).

Reliability Analyses

Considering the item-total correlations, the items contributing the least and the most to the model were item 2 (0.22) and item 11 (0.74), respectively, on the SHBS. When it comes to the SHHS, while it

was found that item 8 showed the least correlation with the scale (0.14), it was vice versa for item 18 (0.71). Finally, it was discovered that items 12 (0.10) and 8 (0.74) were those correlating the least and the most with the SHAS. A single-factorial structure emerged in each of the scales, and the Cronbach's alpha internal consistency coefficients for these three scales were found to be 0.846, 0.841, and 0.754, respectively.

On the other hand, test-retest correlation coefficients (r) of the SHBS, the SHSS, and the SHAS were found to be 0.98, 0.978, and 0.89, respectively ($p<0.001$).

Discussion

This study aimed to develop three separate scales that measure social handwashing behavior, habits, and attitudes and that can be used both separately or together in a questionnaire booklet.

While carrying out their practices in healthcare institutions, college students enrolled in health-related programs inevitably contact with patients, diseases, and microorganisms (9). Thus, handwashing education seems important in preventing the spread of microorganisms and diseases via hands and reducing the patient-disease burden on healthcare systems (14). Furthermore, the relevant handwashing education in colleges may contribute to preventing the spread of infection through students during their hospital practices. Besides, such students with proper handwashing knowledge and habit may be role models for their peers, families, and society (27). For these reasons, the sample selected in this study consisted of students studying at health-related departments of a university. Exploring the handwashing situation among these students and carrying out interventions to compensate for the identified deficiencies may contribute to their health, the environment, and public health.

Initially, the researchers pooled a total of 73 items considered to be associated with handwashing behavior, habits, and attitudes, respectively. Then, CVR and CVI were calculated after obtaining expert opinions for the items. The rule of thumb in the literature is that the number of experts to give opinions for a Likert-type scale should be between 5-40 and that the lowest CVR value should be 0.49 ($p < 0.05$) for a measurement tool evaluated by 15 experts (21). Upon calculated CVR and CVI values and recommendations from the experts, a total of 20 items were removed from the scales, some items were corrected, and the final versions of the Likert-type scales consisted of 53 items. CVI values of the SHBS, the SHHS, and the SHAS were found to be 0.82, 0.80, and 0.74, respectively, and these values are higher than the cut-off value suggested in the literature (0.67) (21).

A finalized form of a Likert-type scale usually consists of 20-25 items. For this reason, it is recommended to write more items in the draft item pool, considering that some items will be removed from the scale (28). The item pooling for the SHBS did not overlap such a recommendation since there were 12 items in its initial form, which

may be since handwashing is considered a process to be completed in a few simple steps. Therefore, it was thought that these steps could be measured with a few items as well.

It is often recommended to use positive-negative statements together and in equal numbers in attitude scales (29, 30). Using only negative items may complicate a measurement model, but preparing the scales to include both negative and positive statements may contribute to the model's psychometric properties (30). The SHAS with the equal numbers of positive-negative attitude statements turned into a scale covering eight positive and three negative items due to removing non-working items upon expert evaluations and the relevant analyses. On the scale, the negative items may have complicated the measurement model; both experts and participants may have difficulty understanding the negative statements.

In this study, the researchers calculated the inter-item correlations for each scale to test the item redundancy. The results showed that no inter-item correlation coefficient exceeded 0.80 in any of the scales, meaning that items did not fall in the multicollinearity problem (31). In the SHBS, all items had the lowest correlation with item 2 (I wash my hands removing my jewelry such as ring, watch, and bracelet). The researchers designed the scale to include the steps required for handwashing in order. Although item 2 gave a low correlation in the model, it was deemed appropriate to remain on the scale since being behavior in the theoretical structure. Similarly, items giving low correlations were found in the SHHS (item 1 ↔ item 12; item 3 ↔ item 20) and the SHAS (the weakest correlations with items 1, 3, and 7). Since there was no multicollinearity problem, these items were not removed from the scales. However, due to the incompatibilities discovered during EFA in the following stages, all the items mentioned on the SHHS (except for item 20) and the SHAS were removed, respectively.

EFA was performed for the scales to explore their further validity. The items in the three scales had the following factor loadings: 0.46-0.85 (the SHBS; explaining 52% of the total variance),

0.37-0.84 (the SHHS; explaining 42% of the total variance), and 0.32-0.86 (the SHAS; explaining 46% of the total variance). A single factor emerged on all three scales, and there was no item with a factor loading value below 0.32, which is the cut-off value shown in the literature. Overall, the single-factor structures and factor loading values on the scales are compatible with what is suggested in the literature (32). Besides, there are different suggestions in the literature that the variance explained in EFA should be between 40% and 60% (32) or should provide a value of at least 60% (33). Although the factorial structures of the scales did not produce higher percentages of explained variance, the values were within the acceptable levels.

The researchers also performed CFA and examined path diagrams (standardized solution values) of the scales' factorial structures yielded by EFA. The results proposed some modifications for all scales. Following the modifications, there were inconsistencies in the standardized regression weights and error variances of some items. In general, an item's standardized regression weight is required to be 0.50 and above (34), while its error variance should not exceed 0.90 (35). Although there was an item with a standardized weight of less than 0.50 on the SHBS, error variances of any items did not exceed 0.90. On the SHHS, there were some items with a standardized weight below 0.50 and an error variance above 0.90. When it comes to the SHAS, there was no item with a standardized weight below 0.50, but there were items with an error variance above 0.90. Besides, the results produced the following fit indices: $\chi^2/df < 2$, RMSEA < 0.08 , RMR < 0.05 , GFI > 0.90 , NNFI > 0.90 , and CFI > 0.95 (SHBS); $\chi^2/df < 3$, RMSEA < 0.08 , RMR < 0.05 , GFI > 0.85 , NNFI > 0.80 , and CFI > 0.85 (SHHS), and $\chi^2/df < 2$, RMSEA < 0.08 , RMR < 0.05 , GFI > 0.95 , NNFI > 0.90 , and CFI > 0.95 (SHAS). Despite inconsistencies in the standardized regression weights and error variances of some items following modifications, the fit indices satisfied the acceptable data-model fit criteria (36, 37). Upon these acceptable fit indices, the researchers decided to keep these inconsistent

items not to narrow the scope of the scales.

In this study, Cronbach's α value and item-total correlation coefficients were calculated for each scale for reliability concerns. The item-total correlations ranged between 0.22 - 0.74 for the SHBS, 0.14 - 0.71 for the SHHS, and 0.10 - 0.74 for the SHAS. It is often emphasized in the literature that an item-total correlation coefficient should be at least 0.25 (38). However, the items showing a correlation below the cut-off value were not removed from the scales since there were no other problems regarding these items in other analyses (except for item 2 of the SHBS). The researchers also thought that keeping these items would contribute to the content validity of the scales. Besides, Cronbach's α coefficients of all the three scales were above 0.70 (0.84 for the SHBS, 0.84 for the SHHS, and 0.75 for the SHAS) (21).

Finally, the researchers explored the test-retest reliability of the scales and calculated the following coefficients (r): 0.98 for the SHBS, 0.97 for the SHHS, and 0.89 for the SHAS. These results showed that the scales had quite high test-retest reliability (0.70-0.89 = strong reliability; 0.90-1.00 = very strong reliability) (21).

Limitations of the Study

This study has some limitations inherent in other methodological studies. First, the study was conducted only with college students enrolled at health-related departments. Second, it was assumed that the participants filled out the questionnaire appropriately. Finally, the researchers could not examine parallel forms reliability of the scales because not finding a valid and reliable scale in the Turkish language measuring the same constructs with the scales.

Conclusion

The study aimed to develop three scales to measure handwashing behavior, habits, and attitudes, respectively. For this purpose, the researchers performed relevant validity (CVR and CVI calculations following expert opinions, item statistics, EFA, and CFA) and reliability (internal

consistency and test-retest reliability) analyses for the draft forms. After removing redundant items and making necessary corrections in some items, the researchers concluded three tools to measure the mentioned constructs: the SHBS (12 items), the SHHS (18 items), and the SHAS (11 items).

In this study, the researchers explored the psychometric properties of the SHBS, the SHHS, and the SHAS. The results showed that the three measurement tools designed to measure handwashing behavior, habits, and attitudes are valid and reliable scales for the sample group recruited (Burdur/Turkey, college students aged 18 years and over). These scales were created to be used together or separately, which may provide ease of use for researchers.

It is believed that the scales whose statistical properties were documented may be useful in measuring the handwashing characteristics of college students, prospective healthcare professionals. Moreover, measuring handwashing behavior, habits, and attitudes may help identify students' inadequacies in handwashing and plan comprehensive handwashing education for them. In this way, it can be ensured that students become role models in handwashing both in their current practices and professional careers.

Informed Volunteer Consent/Approval Form

Informed consent was obtained from all participants.

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Conflicts of Interest

The authors declare that they have no conflict of interest.

Data Availability Statement

The data that support the findings of this study are openly available in "figshare" at 10.6084/m9.figshare.17712089.

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