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Original Article

Development of an Allergen-Exposure Avoidance Scale and Inhaler Use Scale for Patients with Asthma: A Reliability and Construct Validity Study

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Abstract

OBJECTIVES: The present study aimed to evaluate the reliability of the allergen-exposure avoidance scale (AEAS) and inhaler use scale (IUS) in patients with asthma.

MATERIALS AND METHODS: The present study was performed as a methodological design. The study included 130 patients with asthma. Each scale of allergen-exposure avoidance and inhaler use comprised 13 items. Cronbach's alpha and total item correlation were performed to calculate internal consistency of the scales, and the Kaiser-Meyer-Olkin, Bartlett's, and exploratory factor analysis tests were performed to assess construct validity.

RESULTS: The Cronbach's alpha coefficients were 0.724 for IUS and 0.624 for AEAS. After exploratory factor analysis, the factors with eigenvalues >1.00 in the analysis (eigenvalues for IUS were 3.790, 1.793, and 1.789 and for AEAS were 2.990, 2.195, and 1.291) were considered. In the results of the analysis, three factors emerged in parallel with the theoretical structure. These three factors explained 52.087% of the total variance in IUS (29.151%, 13.790%, and 9.145%, respectively) and 53.960% of the total variance in AEAS (24.916%, 18.289%, and 10.754%, respectively).

CONCLUSION: Inhaler use scale and AEAS were determined to be reliable and construct valid scales. They can be used to measure factors affecting the behavioral intentions toward individuals with asthma.

KEYWORDS: Planned behavior theory, asthma, validity, reliability, scale

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INTRODUCTION

Asthma is a serious health problem that influences the quality of life and leads to disability and an increase in healthcare costs [1]. According to the Global Asthma Report (2014), as many as 334 million people have asthma worldwide [2]. The treatment goal is to control asthma by correctly using inhaler devices, identifying asthma triggers, and helping patients acquire avoidance behavior toward allergen exposure [3-5]. In order to achieve a behavior change in patients with asthma, we need to understand their knowledge levels, beliefs, attitudes, and learning styles [6].

The theory of planned behavior (TPB) is one of the most commonly used models to explain human behavior [7]. TPB provides guidelines to identify how willing the individual is to change his/her behavior, attitude toward the behavior, and /her motivation level; in other words, his/her intention. According to TPB, to exhibit a target behavior, first of all, the individual should have an intention (purpose for a behavior) to perform it. Further, the intention is influenced by three factors, which are attitude toward behavior (ATB), subjective norm (SN), and perceived behavioral control (PBC) [8]. ATB is a person's favorable or unfavorable evaluation regarding a specific behavior while performing it. SN is the perceived social pressure to engage in a behavior. PBC is defined as the individual's belief concerning how easy or difficult the behavior is [9,10]. Studies conducted using TPB have shown that the model is effective in planning personal interventions for factors affecting their behaviors [11,12].

New measurement tools should be developed to test the models used to improve the effectiveness of educational programs for patients in the healthcare field. After a literature search, no suitable measurement tool based on TPB can be found for patients with asthma. The present study aims to develop two Likert-type scales interrogating the beliefs of patients with asthma, their attitudes and perceptions toward inhaler use, and their avoidance behavior against allergen exposure, from a

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broad perspective. The scales are considered to be used in clinical practices and researches, in developing educational plans, and in evaluating education outcomes.

The present study was planned to develop the allergen-exposure avoidance scale (AEAS) and the inhaler use scale (IUS) based on TPB for patients with asthma and to examine the reliability and construct validity of the scales.

MATERIALS AND METHODS

Study Design and Participants

The present study was conducted using a methodological design. The study population comprised patients treated for asthma in chest clinics from two public hospitals. To determine sample size for the reliability and construct validity of questionnaires, it is accepted that factor analysis requires a minimum of 5-10 times the number of items as there are subjects [13]. With regard to this criterion, the sample size of the present study was calculated as 130, which was 10 times the number of items. Inclusion criteria of the study were as follows: diagnosed with asthma, age 18 years or older, use of an inhaler, ability to communicate, and agreement to participate in the study. Exclusion criteria were as follows: diagnosed with any neuropsychiatric diseases, any disorders that affect human respiration (such as malignancy, cor pulmonale, and sleep apnea), and having vision or hearing loss.

Data Collection Instruments

Formulating items for the scales

The items were created in accordance with the relevant literature [5,12,14-16] and the manual of "Constructing scales based on the theory of planned behavior" [17]. When constructing the scales, we created a pilot scale to measure attitudes. The pilot scale comprised 33 items, 17 of which were favorable and 16 were unfavorable. We showed attention to formulate items that assessed general intent (1 item) and its three components, which were ATB (8 items), SN (16 items), and PBC (8 items).

Content validity

We consulted five faculty members who were specialists in their field for the scales, to assess the items in terms of intelligibility and linguistic suitability. The opinions of these specialists were evaluated based on the Davis technique. In accordance with these opinions obtained for the content validity, two 13-item attitude scales were derived from the 33-item pilot scale.

Inhaler use scale and allergen-exposure avoidance scale

Inhaler use scale (Appendix 1) and allergen-exposure avoidance scale (Appendix 2) were developed within the frame of TPB for individuals with asthma, to measure the factors affecting behavioral intention. Each scale had three subgroups, which were ATB, SN, and PBC. IUS comprised 13 items and AEAS comprised 12. Each item was rated on a 5-point Likert-type scale (strongly agree: 5, agree: 4, undecided: 3, disagree: 2, and strongly disagree: 1).

Of the 13 items included in IUS, the first item represented the general intent; items 3, 7, and 9 represented ATB; items 2, 4, 6, 8, 11, and 13 represented SN; and items 5, 10, and 12 represented PBC. Of the 12 items included in AEAS, the first item represented the general intent; items 3 and 8 represented ATB; items 2, 4, 6, 7, 10, and 12 represented SN; and items 5, 9, and 11 represented PBC.

To obtain the scores for each scale, the subgroup scores were separately calculated by deriving the arithmetic mean of their related items. The subgroup scores were the sum of item scores for each subgroup divided by the number of items in the subgroup. Only item 7 in the ATB subgroup of IUS was negatively keyed and reverse-scored.

The score of item 1 that measured the general intent indicated behavioral intention. The minimum and maximum scores for each subgroup were 1 and 5, respectively. When the scales were evaluated, the item scores rated by the patients were calculated as explained above, and a decision was then taken on the effect level of the factors influencing the patients' intent toward behavior. Accordingly, it was inferred that the higher the score on ATB, the more favorable the patient perceived the behavior; the higher the score on SN, the more environmental pressure the patient experienced to perform the target behavior; the higher the score on PBC, the more powerful the patient's control was to perform the behavior; the higher the score on the general intent, the more willing the patient was to perform the behavior.

Data Collection

Data were collected between June 13 and December 2, 2016. While filling in the data collection forms, the researcher read the statements in the scale to the patients and asked them to what extent they agreed or disagreed with the statement. It took approximately 10-15 minutes to fill in each scale.

Ethical Consideration

Ethics committee approval and institutional permission were obtained from the Ethic Committee of Gazi University to conduct the study. After explaining the aim of the study and reading the informed consent to the patients who agreed to participate the study, we obtained their written and oral consents.

Statistical Analysis

Data were analyzed using IBM Statistical Package for Social Science version 20.0 (IBM Corp.; Armonk, NY, USA) statistical software program. Cronbach's alpha and total item correlation were performed to calculate the internal consistency of the scales, and the Kaiser-Meyer-Olkin (KMO), Bartlett's, and exploratory factor analysis (Principal Component Analysis) tests were performed to assess construct validity.

RESULTS

The mean patient age was 49.81±13.83 years. It was determined that 46.9% of the patients were in the age range of 50-64 years; 52.3% were women, 36.2% were housewives, and 22.3% were farmers (Table 1).

Reliability of IUS and AEAS

Internal consistency analysis

In the present study conducted in patients with asthma (n=130), internal consistency of the scales was measured using Cronbach's alpha coefficient. Cronbach's alpha coefficients were 0.724 for IUS and 0.624 for AEAS.

Item total correlation

In the present study, when an item was removed from the scales, Cronbach's alpha was recalculated, and the contribution of the Cronbach's alpha coefficients to the scale was revealed (Table 2,3). No item was excluded from IUS, because there was no item with an item total correlation <0.25 and negatively keyed [18]. However, 4 items (7, 9, 11, and 13) were found to have an item total correlation <0.25 in AEAS. We first excluded item 7, because of an increase in the Cronbach's alpha value. Items 9, 11, and 13 were not excluded, because their exclusion did not affect much the Cronbach's alpha value. After excluding item 7, the Cronbach's alpha coefficient of AEAS was 0.659.

Table 1. Patient characteristics

Variable	n	%
Age (years)		
18-39	32	24.6
40-49	21	16.2
50-64	61	46.9
65 and over	16	12.3
Gender		
Female	68	52.3
Male	62	47.7
Employment status		
Housewife	47	36.2
Farmer	29	22.3
Worker	26	20.0
Officer	13	10.0
Pensioner	12	9.2
Student	32	24.6

Table 2. IUS item total correlation and internal consistency analysis

Item number	Item total correlation	Cronbach's alpha if item deleted
1	0.457	0.697
2	0.286	0.716
3	0.411	0.712
4	0.272	0.717
5	0.513	0.682
6	0.472	0.708
7	0.328	0.709
8	0.379	0.713
9	0.367	0.684
10	0.510	0.719
11	0.246	0.681
12	0.523	0.719
13	0.290	0.739

IUS: inhaler use scale

Validity of IUS and AEAS

Construct validity (factor analysis)

The KMO values, which indicate whether the sample size is adequate for factor analysis, were 0.763 for IUS and 0.679 for AEAS. In addition, the Bartlett's test value, which shows whether there is enough correlation among the study variables to perform a factor analysis, was significant (p<0.001). As the required conditions were fulfilled to perform factor analysis, the results of the analysis were interpreted (Table 4).

We used exploratory factor analysis (principal component analysis) as the analysis method and considered the factors with eigenvalues >1.00 in the analysis (eigenvalues for IUS were 3.790, 1.793, and 1.789 and for AEAS were 2.990, 2.195, and 1.291).

In the results of the analysis, three factors emerged in parallel with the theoretical structure. These three factors explained 52.087% of the total variance in IUS (29.151%, 13.790%, and 9.145%, respectively) and 53.960% of the total variance in AEAS (24.916%, 18.289%, and 10.754%, respectively). When the contributions of the factors to the variance were

Table 3. AEAS item total correlation and internal consistency analysis

Item number	Item total correlation	Cronbach's alpha if item deleted
1	0.366	0.586
2	0.311	0.609
3	0.343	0.607
4	0.240	0.609
5	0.419	0.570
6	0.275	0.609
7	-0.159	0.659
8	0.255	0.608
9	0.205	0.614
10	0.453	0.561
11	0.132	0.622
12	0.497	0.544
13	0.247	0.615

AEAS: allergen-exposure avoidance scale

Table 4. Kaiser-Meyer-Olkin and Bartlett's test results

		IUS	AEAS
KMO			
Measure of sampling Adequacy		0.763	0.679
Bartlett's test of sphericity	Approximately Chi-square	434.337	372.455
	df	78	66
	Significance	<0.001	<0.001

KMO: Kaiser-Meyer-Olkin; IUS: inhaler use scale; AEAS: allergen-exposure avoidance scale

separately looked at, it was observed that the contribution decreased, and that the difference was too close as from factor 3. Thus, it was revealed that there were three factors in parallel with the theoretical structure. The three factors that were revealed by performing factor rotation overlapped with the subgroups or were interrelated factors. Tables 5, 6 show the evaluation of statements, which were constructed in accordance with the model in the general intent item and in three subgroups, which constituted the intent, according to the subgroups, which were formed with the factor analysis.

Items 5, 10, and 12 representing PBC in IUS and AEAS were found in factor 2. Among the items representing SN in IUS, items 2, 4, and 6 were found in factor 3, and items 8, 11, and 13 were in factor 1. Among the items representing SN in AEAS, items 2, 4, 6, and 8 were found in factor 1, and items 11 and 13 were found in factor 3. Among the items representing ATB in IUS, item 3 was found in factor 3, item 7 was found in factor 2, and item 9 was found in factor 1. Among the items representing ATB in AEAS, item 3 was found in factor 1 and item 9 was found in factor 3. Item 1 indicating the general intent was found in factor 1 for IUS and in factor 2 for AEAS.

Table 5. IUS exploratory factor analysis results

Component			
Item number	**Factor 1**	**Factor 2**	**Factor 3**
11	0.728		
13	0.635		
1	0.627		
8	0.622		
9	0.600		
12		0.859	
10		0.832	
5		0.678	
7		0.468	
6			0.725
3			0.691
4			0.689
2			0.570

IUS: inhaler use scale

Table 6. AEAS exploratory factor analysis results

Component			
Item number	**Factor 1**	**Factor 2**	**Factor 3**
8	0.746		
3	0.695		
4	0.645		
2	0.570		
6	0.507		
12		0.840	
10		0.828	
5		0.790	
1		0.399	
9			0.850
13			0.763
11			0.685

AEAS: Allergen-exposure avoidance scale.

DISCUSSION

Asthma is one of the commenest adulthood disease and is mostly affected by occupational conditions [18,19].

For patients with asthma to be able to change their behaviors, it is first necessary to intend to change the behavior. Intent shows the individual's level of motivation toward achieving the target behavior. The stronger the individual's intention to achieve the target behavior, the higher is the performance. It is not enough that only the intention exists for the target behavior to be exhibited. To perform the behavior depends on the individual's attitude toward the behavior, the provision of effective factors (such as money, time, skill, and social support), and PBC. In the present study, two scales were developed to identify the attitudes of patients with asthma toward inhaler use and allergen-exposure avoidance behaviors.

According to the reliability analysis of IUS and AEAS, the Cronbach's alpha values were 0.724 and 0.624, respectively. Literature states that Cronbach's alpha coefficient ranges between 0 and 1, and when it is between 0.60 and 0.79 for a scale, the scale is considered as relatively reliable [20]. Hence, IUS and AEAS developed in the present study are relatively reliable. This result indicates that the items in each scale and data collected are reliable. In other words, as the homogeneity of the scale items is at an acceptable level, data collected with each scale will be interrelated, coherent, intelligible, adequate, and will have the quality to reveal the truth of the study.

As reliability is a measure of the consistency and a proportion of truth, it is important for all the items constituting a scale to have an enhancing effect on reliability [21]. Reliability analysis is used to determine each item's power in terms of measuring what is wished to be measured using an instrument (such as intent, ATB, SN, and PBC) and to make the instrument more reliable using results [20,22]. Including or excluding an item is decided according to the results of this analysis. When an item is excluded from an instrument, if the recalculated Cronbach's alpha coefficient value is lower than the Cronbach's alpha coefficient value for the whole instrument, the item is considered to play a role in improving reliability, and it is included in the instrument. On the other hand, if the value is higher, then the item is excluded from the instrument, because it adversely affects internal consistency [20-22]. If the correlation coefficient value is not negative and is >0.25 between the item excluded and total of the other items, it indicates that contribution of the concerned item to the whole instrument is high, and that the item should be included in the instrument [20,22]. When examining our study results in accordance with this information, we decided to exclude one item from AEAS. We concluded that the 13-item IUS and the 12-item AEAS were

reliable scales. The reliability of the scales developed in the present study is important in terms of determining the patient's attitudes and beliefs to treatment and disease management. It is believed that the scales will contribute to determining the positive or negative attitudes of patients with asthma toward inhaler use and avoidance of allergen exposure. Family plays a pivotal role in maintaining disease management in asthma. In the present study, the social environment (parents, siblings, spouses, and friends) on the scales developed is evaluated for the effect of the patient on exhibiting the target behaviors. In the studies, it was found that there is a strong relationship between use of medication and advice of family and friends of patients with asthma, and that social support has positive effects on disease control and quality of life [23,24].

The KMO and Bartlett's tests are used to evaluate the adequateness of sample size for factor analysis. In the present study, as the KMO and Bartlett's test values were found to be >0.60, which is the lower limit, the sample size was considered to be adequate for factor analysis. Thus, the factor analysis was performed to identify subgroups. Factor loads were examined to see which items loaded onto which factors. According to literature, factor loads should be >0.30 [20-22]. In the present study, three factors were constructed in parallel with the theoretical structure at the end of the factor rotation. It was revealed that these three factors overlapped with the subgroups or were interrelated. Among the subgroups, which were intent and components of the intent (ATB, SN, and PBC), only PBC was found to load onto the same factor. The other subgroups loaded onto different factors. It is considered that this situation results from the interrelated/interacting feature of the items in the subgroups owing to the general structure of the theory. The more the patients with asthma believe in the benefits of target behaviors, the more they will increase their control over it. It is believed that determining the attitudes of the use of proper inhaler and avoidance of allergen exposure that cause attacks will lead to better results in disease control and treatment compliance in patients with asthma.

The attitudes of patients with asthma to disease and treatment are influencing treatment compliance. Patients with asthma think that they are cured when there are no symptoms and cease treatment. Side effects of drugs and worry about addiction are the factors that reduce treatment compliance in patients with asthma [25]. For this reason, the attitudes of the patients need to be evaluated to increase treatment compliance.

Strength and limitation

This scale is the first reliable and construct valid instrument based on TPB for individuals with asthma. The limitation of this study is that the consistencies of IUS and AEAS over time have not been measured using the test-retest method and that the same test has not been administered to the same sample on different occasions. Further, we have not tested the cross-sectional construct, convergent, and discriminant validities and the screening accuracy and responsiveness of the questionnaires.

To conclude, IUS and AEAS developed based on TPB are reliable and construct valid instruments to determine factors influencing behavioral intention of individuals with asthma. Depending on the study results, to assess the reliability of IUS and AEAS over time, it is recommended to conduct a test-retest study on the same group and to conduct validity studies in different patient groups.

Ethics Committee Approval: Ethics committee approval was received for this study from Gazi University Ethical Committee (Approval Date: 03.06.2016; Approval Number: 77082166-604.01.02)

Informed Consent: Written informed consent was obtained from the patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author contributions: Concept - D.Ş., S.A.A.; Design - D.Ş., S.A.A.; Supervision - S.A.A.; Resource - D.Ş.; Materials - D.Ş., S.A.A.; Data Collection and/or Processing - D.Ş.; Analysis and/or Interpretation - D.Ş., S.A.A.; Literature Search - D.Ş.; Writing - D.Ş., S.A.A.; Critical Reviews - D.Ş., S.A.A.

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APPENDIX

Appendix 1. Theory of Planned Behavior Inhaler Use Scale

Please take a few minutes to tell us what you think about the use of a proper inhaler. This scale was prepared to measure the intent to behave toward the use of the inhaler. Scale results will be used to determine attitudes in this area. There are 13 items on this scale.

After you have read each statement, mark the thoughts that come to mind immediately. There are no right or wrong responses; we are merely interested in your personal opinions. It is important to mark the situation that is most appropriate to you.

After reading each of the following statements, put a cross (X) inside the box that is in the middle of the statement, indicating the extent to which you are participating in this statement.	**Strongly agree**	**Agree**	**Undecided**	**Disagree**	**Strongly disagree**
1 I intend to use a proper inhaler within the next 3 months					
2 My family (parents and siblings) thinks that I should use a proper inhaler					
3 It is useful for me to use a proper inhaler within the next 3 months					
4 Health professionals think that I should use a proper inhaler					
5 Use of a proper inhaler is under my control					
6 My close friends think that I should use a proper inhaler					
7 It is difficult for me to use a proper inhaler within the next 3 months					
8 In general, I give importance to my family's (parents and siblings) thoughts about the use of a proper inhaler					
9 It is very important for me to use a proper inhaler within the next 3 months					
10 If I want, I'm confident that I can use a proper inhaler within the next 3 months					
11 In general, I give importance to my friends' thoughts about the use of an inhaler					
12 Proper or improper use of an inhaler is under my control					
13 In general, I give importance to the health professionals' thought about the use of an inhaler					

Appendix 2. Theory of Planned Behavior Allergen-Exposure Avoidance Scale

Please take a few minutes to tell us what you think about the avoidance of allergen exposure. This scale was prepared to measuring the intent to behave toward the use of the inhaler. Scale results will be used to determine attitudes in this area. There are 12 items on this scale.

After you have read each statement, mark the thoughts that come to mind immediately. There are no right or wrong responses; we are merely interested in your personal opinions. It is important to mark the situation that is most appropriate to you.

After reading each of the following statements, put a cross (X) inside the box that is in the middle of the statement, indicating the extent to which you are participating in this statement.	**Strongly agree**	**Agree**	**Undecided**	**Disagree**	**Strongly disagree**
1 I intend to avoid allergen exposures that cause attacks within the next 3 months					
2 My family (parents and siblings) thinks that I should avoid allergen exposures that cause attacks					
3 It is useful for me to avoid allergen exposures that cause the attacks within the next 3 months					
4 Health professionals think that I should avoid allergen exposures that cause attacks					
5 Avoidance of allergen exposures that cause attacks is under my control					
6 My close friends think that I should avoid allergen exposures that cause attacks					
7 In general, I give importance to my family's (parents and siblings) thoughts about avoiding allergen exposure					
8 It is very important for me to avoid allergen exposures that cause attacks within the next 3 months					
9 If I want, I'm confident that I can avoid allergen exposures that cause attacks within the next 3 months					
10 In general, I give importance to my friends' thoughts about avoidance of allergen exposures that cause attacks					
11 Avoidance or not-avoidance of allergen exposures that cause attacks is under my control					
12 In general, I give importance to health professionals' thoughts about the avoidance of allergen exposures that cause attacks					