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Original article

Assessing the validity and reliability of the Arabic versions of Mini Asthma Quality of life questionnaire and Asthma Control Test in adult patients with asthma: A factor analysis study

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ABSTRACT

Background and objective: Asthma is a common disease that has a significant influence on patients' quality of life. Although Arabic tools for assessing symptom control and quality of life in individuals with asthma are available, no sufficient studies have evaluated the validity of these tools. Therefore, the aim of the current study was to validate the Arabic version of these tools.
Methods: Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were conducted on the Arabic versions of the Asthma Control Test (ACT) and Mini Asthma Quality of Life Questionnaire (Mini AQLQ).
Results: A total of 314 participants (70.1 % females) were enrolled in the current study. The mean age of the participants was 51.47 (±16.37). EFA suggested a three-factor model for Mini AQLQ and a one-factor model for ACT, which was confirmed by CFA analyses. High correlations were found between spirometric values and ACT and Mini AQLQ scores, indicating good concurrent validity. The area under the curve produced by the Roc curve was 0.861 ($p < 0.001$), and the most suitable cut-off point was 4.741.
Conclusion: All analyses conducted showed that the Arabic versions of both Mini AQLQ and ACT are reliable and valid and can be administered to adults with asthma. The application of these validated instruments will improve the management and diagnosis of asthma in Arab countries.

1. Introduction

Asthma is a chronic airway inflammation that results in episodes of coughing, wheezing, tightness in the chest, and shortness of breath that frequently worsen at night or during exercise (Mims, 2015). Around 262 million individuals worldwide suffer from asthma, making it one of the most prevalent and disabling respiratory disorders ("Asthma," n.d.). Children between the ages of 10 and 14 have the highest prevalence of asthma (Ramratnam et al., 2017). Over the past ten years, asthma mortality rates have been steady in wealthy nations, but they have been rising in developing nations (Marcela Batan et al., 2015).

Asthma control is divided into three categories under the Global Initiative for Asthma (GINA) 2021 guidelines: well-controlled, partially controlled, and uncontrolled ("Reports - Global Initiative for Asthma - GINA," n.d.). One of the most commonly used instruments for assessing asthma control is the Asthma Control Test (ACT) (Nathan et al., 2004a, 2004b). The Asthma Control Test (ACT), created by Nathan et al. in 2004, assesses the degree of asthma control using a number of variables, including daytime and overnight symptoms, usage of rescue drugs, activity restrictions, and the rate of asthma control over the previous 4 weeks. According to previous studies, the validity of the ACT score has been established in numerous nations, including Spain, China, South

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Korea, North Africa, Greece, Vietnam, and Turkey (Monteiro De Aguiar et al., 2014; Uysal et al., 2013). Only one study in Arab nations has verified an Arabic translation of ACT, in which the sample size was limited (40 patients) and no factor analysis was done, which has an impact on the validity and generalizability of the findings (Lababidi et al., 2008).

Quality of life (QOL) is the perception of physical and mental health throughout time by an individual or group (Karimi and Brazier, 2016). QOL has already been linked to a variety of health issues, including cancer and dyslipidemia (Jarab et al., 2021; Sharour et al., 2020). Poor asthma symptom control negatively impacts patients' quality of life (QOL) and raises medical expenses for treatment, hospital stays, emergency room visits, missed classes or work days, and disability (Horner, 2020). As measured by disability-adjusted life years, asthma is among the leading causes of years lived, with disability and the burden of disease, as asthma was ranked 16th and 28th, respectively ("Global Asthma Network: The Global Asthma Report, 2018," 2018). Being highly related to mortality and morbidity, asthma needs to be evaluated using reliable tools to ensure the optimal treatment regimen.

The Asthma Quality of Life Questionnaire (AQLQ) (Juniper et al., 1999), the Sydney Asthma Quality of Life Questionnaire (AQLQ-S) (Marks et al., 1992), and the Living with Asthma Questionnaire (LWAQ) (Hyland, 1991) are some of the tools available to assess the quality of life in asthma patients. One of the most widely used questionnaires is the Mini-AQLQ, which is an adaptation of the original 32-item AQLQ. This brief version is less time-consuming and preserves the accuracy of the original questionnaire for measuring asthmatic quality of life. The Mini AQLQ uses symptoms, environmental function, emotional function, and activity limitations to assess the effects of asthma on QOL (Olajos-Clow et al., 2010). No prior published study has validated the Arabic version of Mini AQLQ.

This study aims to assess the validity, reliability, and consistency of the Arabic versions of ACT (Lababidi et al., 2008) and Mini AQLQ ("Qoltech - Measurement of Health-Related Quality of Life & Asthma Control," n.d.) when employed among adults with asthma, which will enhance the management of asthma and can be used to support research efforts and potentially influence healthcare policies in Arab countries, a region with an increasing prevalence of asthma that may be associated with several, factors including air pollution (Al-Qerem et al., 2016).

2. Materials and methods

2.1. Study site and participants

This is a multicenter cross-sectional study that evaluated asthma control and quality of life tools. The study enrolled adult patients with asthma who attended the outpatient respiratory clinics at King Abdullah University Hospital in Irbid, in northern Jordan, and Jordan University Hospital in the capital Amman.

Inclusion criteria included: a diagnosis of asthma based on the Global Initiative for Asthma (GINA) guidelines (Reddel et al., 2022) that was confirmed by a specialist, being 18 or older, and scheduled to perform spirometry at the clinic visit day. Exclusion criteria included patients with illnesses that may influence the spirometry results, including diffuse emphysema or previous history of tuberculosis, chronic obstructive pulmonary disease, chronic kidney disease, congestive heart failure, active gastroesophageal reflux disease, and a history of malignant diseases within five years of the study commencing, in addition to other conditions that may influence patient QoL based on the Charlson Comorbidity Index (Charlson et al., 1987). A list of patients who had appointments at the clinic and met the inclusion criteria based on their medical records was formulated. Patients who were included in the list were approached by the research pharmacist during the outpatient respiratory clinic visit.

2.2. Sample size calculation

The most frequently cited approach to computing the minimal sample required to conduct factor analysis is based on the item-subject ratio. This approach recommends different item-subject ratios; however, the highest recommended commonly used item-subject ratio is 1:20 (Costello and Osborne, 2005). As the longest questionnaire evaluated in the present study was the Mini AQLQ**,** which contains 15 items, the minimum required sample size was 300.

2.3. Study procedure

A total of 388 asthmatic patients attending King Abdullah University Hospital and Jordan University Hospital were approached between September 2021 and April 2022. A total of 314 patients agreed to participate, with a response rate of 80.9 %. All participants were required to sign an informed consent form prior to enrollment in the study. The study objectives were detailed to the participants, and all the participants were informed that their participation in the study was voluntary and that no incentives were provided. Participants were escorted to a private room at the sites of the research and were asked to self-administer the questionnaires. Study ethical approvals were obtained from the King Abdullah University Hospital and Jordan University Hospital ethical committees. The study was conducted in accordance with the Declaration of Helsinki.

2.4. Study instruments

The sociodemographic information was obtained from the patients through a custom-designed questionnaire. The demographic data included age, sex, education level, socioeconomic status, and family history of asthma.

The Mini AQLQ ("Qoltech - Measurement of Health-Related Quality of Life & Asthma Control," n.d.) is a disease-specific self-administered questionnaire that measures the quality of life in asthmatic patients. The instrument includes 15 items distributed in four domains. The domains are symptoms, activity limitation, emotional function, and environmental stimuli. The instrument evaluates respondents' experiences with asthma during the past two weeks. The instrument includes 7-point Likert scale questions, where 7 represents no impairment and 1 indicates significant impairment.

ACT is a self-administered instrument that contains 5-point Likert scale items and evaluates asthma control (Lababidi et al., 2008; Nathan et al., 2004a, 2004b). The responses to the five items ranged from 1 indicating poor control to 5 indicating complete control, with a maximum possible score of 25.

The Arabic versions of the Mini AQLQ and ACT were distributed to 30 patients with asthma who met the inclusion criteria to conduct face validity, and the participants in the pilot study confirmed the clarity of the questionnaires. FEV1% and FVC% were computed for each patient using Al-Qerem et al. equations (Al-Qerem et al., 2019a; Al-Qerem et al., 2019b). These spirometric equations were developed based on data from healthy Jordanian participants to determine accurate spirometry normal values.

2.5. Statistical analysis

All data were analyzed using SPSS version 27 and Amos version 26. Categorical variables are presented as frequency and percentages, and continuous variables are presented as mean ± standard deviation (SD). The suitability of data for exploratory factor analysis (EFA) was assessed using the Kaiser-Meyer-Olkin value (KMO) and Bartlett's test of sphericity. EFA was conducted to evaluate the most suitable models for Mini AQLQ and ACT data. Scree plots and parallel analysis were used to determine the number of factors to extract. Any item with a factor loading of less than 0.4 or with multiple factor loadings above 0.4 was

removed, as was any item with a communality of less than 0.3. Internal consistency of the questionnaires was assessed using Cronbach's alpha, with a value of 0.7 or more considered acceptable (Taber, 2018). The ceiling and floor effects were evaluated by computing the frequencies of participants who scored the maximum possible or lowest possible scores; in order to confirm a lack of ceiling and flooring effects, the frequencies computed must be less than 15 % (McHorney and Tarlov, 1995).

Confirmatory factor analysis (CFA) was applied using the maximum likelihood (ML) approach to the produced models for ACT and Mini AQLQ. The goodness of fit was evaluated by calculating CMIN/DF (minimum discrepancy), GFI (goodness of fit index), CFI (comparative fit index), Tucker–Lewis's index (TLI), and RMSEA (Root Mean Square Error of Approximation). Acceptable values for CMIN/DF are 2–5, for RMSEA are 0.05–0.08, for GFI, CFI, and TLI values closer to 1, and for SRMR $\leq$ 0.05 (Finkelstein, 2005).

Concurrent validity was conducted by examining the correlation between FEV1%, FVC%, and FEV1/FVC% with Mini AQLQ total scores, each factor in Mini AQLQ score and ACT score.

To determine the most suitable cut-off points for the Mini AQLQ, the receiver operating characteristic (ROC) curve was produced by plotting the sensitivity to 1- selectivity using the ACT classification as the state variable and the Mini AQLQ score as the test variable (Hanley and McNeil, 1982). The area produced under the curve was examined, and the cut-off point was determined based on Youden index.

3. Results

3.1. Demographic characteristics of the participants

The study included 314 participants with a mean age of 51.47 years, and most were females (70.1 %). The majority of the patients had some form of education (69.1 %) and had a moderate income. Furthermore, 68.2 % of the patients reported no family history of asthma. The means for FEV1, FVC, and FEV1/FVC% were 2.21, 2.70, and 81.1 %, respectively, while the means for FEV1% and FVC% were 78.10 % and 82.95 %, respectively (Table 1).

3.2. ACT validation

The scree plot (Fig. 1) suggested a three-factor model as three eigenvalue points were above the elbow. The three-factor model was confirmed when conducting parallel analysis. The direct oblimin rotation method was used as the highest correlation between the factors exceeded the cut-off point of 0.32. A KMO value of 0.918 supported the adequacy of the sample, and the significance of Bartlett's test of sphericity ($\chi 2 = 3708.04$; $p < 0.001$) validated the EFA results. The three factors were environmental-related symptoms, emotional-related symptoms, and activity limitations.

As shown in Table 2, the first factor, environmental-related symptoms, included six items. The mean of the six questions ranged from 3.08 to 3.60. Cronbach's alpha (0.92) confirmed good internal consistency. The variable with the highest factor loading and communality was "In general, how much of the time during the last 2 weeks did you feel bothered by or have to avoid dust in the environment?", while the variables with the lowest factor loading and communality were "In general, how much of the time during the last 2 weeks did you feel bothered by coughing?" and "In general, how much of the time during the last 2 weeks did you feel short of breath as a result of your asthma?".

Table 1
Sample demographics and characteristics.

		Frequency (%) or Mean (±SD)
Age		51.47 (±16.37)
Sex	Female	220 (70.1 %)
	Male	94 (29.9 %)
Average income	Low	46 (14.6 %)
	Moderate	227 (72.3 %)
	High	41 (13.1 %)
Family history of asthma	Yes	100 (31.8 %)
	No	214 (68.2 %)
FEV1 (L)		2.21 (±0.74)
FVC (L)		2.70 (±0.79)
FEV1/FVC%		81.10 % (±7.2)
FEV1%		78.10 % (±15.2)
FVC%		82.95 % (±12.7)

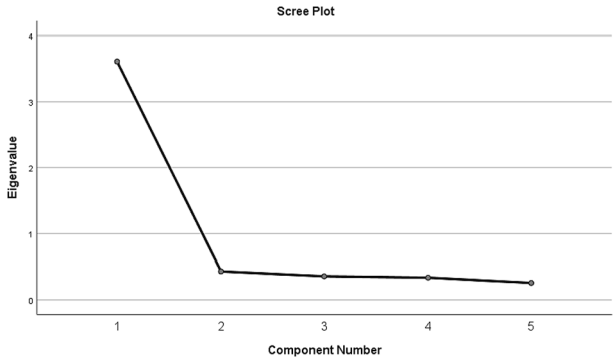

Fig. 1. Scree plot of ACT.

Regarding the second factor, "emotional related symptoms", the mean of the five questions included in the factor ranged from 4.22 to 4.88. Cronbach's alpha (0.85) indicated good internal consistency. The item with the highest factor loading and communality was "In general, how much of the time during the last 2 weeks did you feel frustrated as a result of your asthma?" The item with the lowest loading was "In general, how much of the time during the last 2 weeks did you have difficulty getting a good night's sleep as a result of your asthma?" and the lowest communality was for "In general, how much of the time during the last 2 weeks did you feel afraid of not having your asthma medication available?".

For the last factor "activity limitation", the mean of the 4 questions included in the factor ranged from 3.54 to 5.09, with good internal consistency (Cronbach's alpha = 0.95). The variable with the highest factor loading and communality was "How limited have you been during the last 2 weeks doing these activities as a result of your asthma [work-related activities (such as tasks you have to do at work)]" and the variable with the lowest was "How limited have you been during the last 2 weeks doing these activities as a result of your asthma [strenuous activities (such as hurrying, exercising, running upstairs, sports)]". The ceiling and floor effects were evaluated by computing the percentages of the participants who scored the maximum and minimum possible scores in the total Mini AQLQ and all three factors in the model. None reached the cut-off point of 15 %. CFA confirmed the suitability of the developed three-factor model generated by EFA. The model fitness indices were CMIN/DF = 2.88, GFI = 0.91, CFI = 0.96, TLI = 0.95, and RMSEA = 0.07.

3.3. Concurrent validity

Pearson's correlation was conducted to evaluate the association between FEV1%, FVC%, and FEV1/FVC% with Mini AQLQ total scores, the three factors of Mini AQLQ and ACT score (see Table 4). All the correlations were significant at $p < 0.001$, and Pearson's r values indicated medium to large effects. The highest correlation between spirometric values and Mini AQLQ scores was between the Mini AQLQ score and FEV1% (r = 0.61), while the lowest was between FVC% and activity limitation (r = 0.36). There was also a significant correlation between the Mini AQLQ and the ACT scores (r = 0.76). Significant correlations of $p < 0.001$ were also found between the three Mini AQLQ factors with the highest between environmental-related symptoms and emotional-related symptoms (r = 0.65) and the lowest between activity

Table 2
Items means, factor loadings, communalities, corrected item-total correlation and Cronbach's alpha and Cronbach's alpha if an item deleted of the Mini AQLQ.

Items	Mean (±SD)	Factor loadings	Communalities	Corrected item-total correlation	Cronbach's alpha if item deleted	Cronbach's alpha
Environmental-related symptoms	19.95 (±9.20)					0.92
In general, how much of the time during the last 2 weeks did you: feel short of breath as a result of your asthma?	3.35 (±1.63)	0.63	0.66	0.72	0.92	
In general, how much of the time during the last 2 weeks did you: feel bothered by or have to avoid dust in the environment?	3.08 (±1.82)	0.94	0.82	0.82	0.90	
In general, how much of the time during the last 2 weeks did you: feel bothered by coughing?	3.60 (±1.81)	0.62	0.70	0.75	0.91	
In general, how much of the time during the last 2 weeks did you: experience a feeling of chest tightness or chest heaviness?	3.60 (±1.80)	0.78	0.78	0.83	0.90	
In general, how much of the time during the last 2 weeks did you: feel bothered by or have to avoid cigarette smoke in the environment?	3.15 (±1.91)	0.84	0.69	0.72	0.92	
In general, how much of the time during the last 2 weeks did you: feel bothered by or have to avoid going outside because of weather or air pollution?	3.16 (±1.86)	0.93	0.81	0.82	0.90	
Emotional related symptoms	23.21 (±7.08)					0.85
In general, how much of the time during the last 2 weeks did you: feel frustrated as a result of your asthma?	4.84 (±1.68)	0.89	0.72	0.69	0.81	
In general, how much of the time during the last 2 weeks did you: feel afraid of not having your asthma medication available?	4.88 (±1.77)	0.68	0.53	0.57	0.83	
In general, how much of the time during the last 2 weeks did you: have difficulty getting a good night's sleep as a result of your asthma?	4.61 (±2)	0.53	0.61	0.64	0.82	
In general, how much of the time during the last 2 weeks did you: feel concerned about having asthma?	4.66 (±1.79)	0.83	0.70	0.72	0.80	
In general, how much of the time during the last 2 weeks did you: experience a wheeze in your chest?	4.22 (±1.78)	0.62	0.62	0.65	0.81	
Activity limitation	19.75 (±6.95)					0.95
How limited have you been during the last 2 weeks doing these activities as a result of your asthma [strenuous activities (such as hurrying, exercising, running upstairs, sports)]	4.54 (±1.94)	0.88	0.80	0.81	0.95	
How limited have you been during the last 2 weeks doing these activities as a result of your asthma [moderate activities (such as walking, housework, gardening, shopping, climbing stairs)]	5.09 (±1.85)	0.92	0.90	0.90	0.92	
How limited have you been during the last 2 weeks doing these activities as a result of your asthma [social activities (such as talking, playing with pets/children, visiting friends/relatives)]	5.03 (±1.84)	0.92	0.86	0.87	0.93	
How limited have you been during the last 2 weeks doing these activities as a result of your asthma [work-related activities (such as tasks you have to do at work)	5.08 (±1.85)	0.96	0.91	0.91	0.92	

limitation and environmental-related symptoms (r = 0.46).

3.4. Cut-off points for Mini AQLQ

ROC results revealed that the area under the curve produced by the Roc curve was 0.861 ($p < 0.001$) and the most suitable cut-off point was 4.741.

3.5. Figures, Tables and Schemes

See Tables 1-4 and Figs. 1 and 2.

4. Discussion

The Mini AQLQ questionnaire (15-item) was previously tailored from the original AQLQ 32-item scale. It covers environmental factors related to asthma, important aspects of physical and emotional impairments related to asthma patients, and asthma-related activity limitations (Olajos-Clow et al., 2010). ACT is a well-validated tool to assess the control of asthma based on the cardinal classifiers of asthma severity: frequency of symptoms, use of rescue medications, limitation of activity, and the rate of asthma control in the past 4 weeks (Bime et al., 2012). Both Mini AQLQ and ACT have been translated into many

Table 3
Items means, factor loadings, communalities, corrected item-total correlation, and Cronbach's alpha and Cronbach's alpha if an item deleted of the ACT.

Items	Mean (±SD)	Factor loadings	Communalities	Corrected item-total correlation	Cronbach's alpha if item deleted	Cronbach's alpha
ACT items	16.5 (±4.70)					0.90
In the past 4 weeks, how much of the time did your asthma keep you from getting as much done at work, school or at home?	3.42 (±1)	0.83	0.68	0.73	0.89	
During the past 4 weeks, how often have you had shortness of breath?	3.42 (±1.13)	0.86	0.74	0.77	0.88	
During the past 4 weeks, how often did your asthma symptoms (wheezing, coughing, shortness of breath and chest tightness or pain) wake you up at night or earlier than usual in the morning?	3.28 (±1.20)	0.89	0.79	0.82	0.87	
During the past 4 weeks, how often have you used your rescue inhaler or nebulizer medication (such as albuterol)?	3.29 (±1.19)	0.83	0.68	0.73	0.89	
How would you rate your asthma control during the past 4 weeks?	3.27 (±1.18)	0.85	0.72	0.76	0.88	

Table 4
Correlation between ACT, total Mini AQLQ and each factor scores with spirometry.

	ACT Score	Mini AQLQ	Activity limitation	Environmental related symptoms	Emotional related symptoms	FEV1%	FVC %	FEV1/ FVC
ACT Score	1	–	–	–	–	–	–	–
Mini AQLQ	0.76**	1	–	–	–	–	–	–
Activity limitation	0.51**	0.77**	1	–	–	–	–	–
Environmental related symptoms	0.71**	0.88**	0.46**	1	–	–	–	–
Emotional related symptoms	0.67**	0.86**	0.53**	0.65**	1	–	–	–
FEV1%	0.49**	0.61**	0.47**	0.56**	0.49**	1	–	–
FVC%	0.37**	0.46**	0.36**	0.42**	0.37**	0.94**	1	–
FEV1/FVC	0.46**	0.58**	0.44**	0.54**	0.47**	0.62**	0.36**	1

Note: ** Correlation is significant at the 0.01 level (2-tailed).

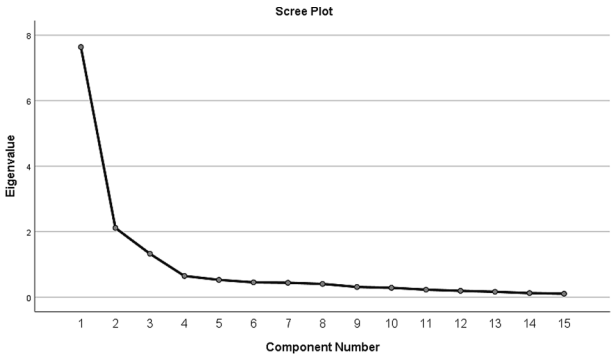

Fig. 2. The scree plot of the Mini AQLQ.

different languages and applied in different geographic areas (Aggarwal et al., 2010; Uysal et al., 2013). Although these questionnaires have been previously translated into Arabic, limitations have been identified. These include a small sample size, a lack of reference standardized asthma assessment measures, and a lack of a factor analysis validation approach.

In the current study, the Arabic versions of both the Mini AQLQ and ACT questionnaires were validated on the sample to ensure the questionnaires were applied properly to measure the intended outcomes reliably with minimum error or bias. The validation process should be conducted using a representative number of samples. In this study, 314 patients answered the questionnaires appropriately.

Scree plot analysis advocated a three-factor model for Mini AQLQ and a one-factor model for ACT Questionnaires, respectively, as illustrated by the produced eigenvalue points. The direct oblimin rotation method was used instead of the varimax rotation method as the correlation between the factors was relatively high. The sample proved adequate for the analysis as the KMO value was high. The EFA results were deemed valid as Bartlett's analysis of sphericity was significant.

CFA results confirmed that the three-factor generated model was suitable and applicable, as indicated by the results of the model fitness indices. The main difference between the structure of original Mini AQLQ and the validated Arabic version was the number of factors, as the original Mini AQLQ contains 4 factors while the Arabic version includes only 3 factors. The 4th factor in the original Mini AQLQ "symptoms" was divided into environmental-related symptoms and emotional-related symptoms. The items from the symptom factors that were included in the newly formulated environmental-related symptoms included: "feel short of breath as a result of your asthma?" and "experience a feeling of chest tightness or chest heaviness?", while "experience a wheeze in your chest?" loaded with emotional-related symptoms. Nevertheless, all items that were included in the original emotional function and environmental stimuli were loaded into the emotional-related symptoms and environmental-related symptoms factors, respectively. Moreover, the activity limitation factor in the Arabic-translated version was identical to the original English version.

Analysis indicated a one-factor model for ACT, as only one obvious eigenvalue point was deemed by scree plot analysis. The data was adequate to perform factor analysis, as illustrated by the KMO value, and the validated EFA analysis was proven by the significant values of Bartlett's test of sphericity. The mean score of the five items ranged from (3.27 to 3.42) and the internal consistency of the questionnaire items was validated as Cronbach's alpha was 0.90. Asthma-related wake-up represented the highest loading and communality, and asthma-related activity limitation and the need for rescue therapy represented the lowest loading and communality, respectively. Furthermore, neither ceiling nor floor effects were demonstrated. The one-factor analysis of ACT variables was deemed valid, with waking up at night being the strongest indicator of asthma control, while limitation of activity due to asthma was reported to have the weakest correlation.

The determinants of each of the Arabic versions of Mini AQLQ factors imply that patients' perceptions related to the quality of life that might be affected by asthma are coherent in "common-sense" terms. For example, a high frequency of asthma attacks in a previous two-week period reflects an inferior quality of life, while reporting less difficulty in having decent quality sleep is related to a better quality of life. Emotional-related symptoms were expressed as being the most important by patients, as illustrated by the highest mean score. Patients reported irritation due to asthma as the most influential variance in this factor, while they were not worried much about the effect of having quality sleep on their quality of life. Environmental-related symptoms were of second importance. Experienced concerns about environmental factors were reported to significantly affect participant quality of life, while cough was of the least concern. The activity limitation factor was the lowest reported score, with work limitation activity being the main concern by participants to affect their quality of life.

4.1. Strengths and limitations

The current research exhibits various strengths that significantly enhance its overall validity and significance. Notably, it stands out as a multicenter study, which enhances the generalizability of its findings. Additionally, a key strength lies in the statistically approved sample size, amplifying both the statistical power and the reliability of the results. Nevertheless, there are several limitations to the current study. Primarily, the data relies on self-reported questionnaires, which can be susceptible to social desirability and recall biases. Furthermore, the validation process exclusively focused on adults with asthma and did not encompass children or adolescents.

5. Conclusion

The present study confirmed that the Arabic versions of the Mini AQLQ and ACT are valid and reliable. The EFA and CFA analyses of the Arabic versions of these two questionnaires further strengthened their validation status and reliability to be used as assessment tools for quality

of life and asthma control, respectively. The study's findings can inform the development of targeted interventions and healthcare policies for asthma management in Arab populations, potentially leading to improved outcomes and better distribution of healthcare resources.

Institutional review board statement

The study was conducted in accordance with the Declaration of Helsinki and approved by Al-Zaytoonah University.

Informed consent statement

Informed consent was obtained from all subjects involved in the study.

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Data availability statement

Will be given upon request.

CRediT authorship contribution statement

Walid Al-Qerem: Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration. **Anan Jarab:** Formal analysis, Data curation, Writing – original draft, Writing – review & editing. **Abdel Qader Al Bawab:** Conceptualization, Writing – original draft, Writing – review & editing. **Alaa Hammad:** Methodology, Data curation, Writing – original draft, Writing – review & editing. **Jonathan Ling:** Conceptualization, Formal analysis, Writing – original draft, Writing – review & editing. **Fawaz Alasmari:** Resources, Writing – original draft, Writing – review & editing, Funding acquisition. **Khaled Al Oweidat:** Writing – review & editing. **Sarah Ibrahim:** .

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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