


Reliability and Validity of Pharmacy Research Knowledge Questionnaire in Saudi Arabia

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Received: 13-07-2019;

Accepted: 05-11-2019

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www.ptbreports.org

DOI:
10.5530/PTB.2020.6.12

ABSTRACT

Objectives: To declare reliability and validity of pharmacy research knowledge survey in Saudi Arabia.

Methods: It is a cross-section survey developed by the authors and the researcher team. It's based on the updated literature and national and international accreditation standards organizations. The internal consistency reliability through, inter-rater reliability, item-item coloration, item-total coloration, split half reliability (Gutmann's λ_6), McDonald's ω and Cronbach alpha. The validity contained of face content validity, construct validity through exploratory factorial analysis and confirmatory factor analysis. All analysis had been done through Statistical Package of Social Sciences (SPSS), Statistical Package of Social Sciences-Analysis of Moment Structures (SPSS-Amos) and Jeffrey's Amazing Statistics Program (JASP). **Results:** A total of 209 pharmacists responded. The majority of responders were Saudi 185 (88.52%). The among responders were males 108 (61.77%) and females 101 (48.33%). The three tests had been done with reliability of 21 questions. The completed number of responders (188) (mean \pm SD) was 3.179 \pm 0.436 and McDonald's ω , Cronbach alpha and Gutmann's λ_6 were 0.983, 0.983 and 0.988, respectively with CI 95% (0.979-0.986) and the item-total coloration >0.7 , McDonald's ω , Cronbach alpha and Gutmann's λ_6 value if deleted was >0.98 . By using Exploratory Factor Analysis (EFA), the Kaiser-Meyer-Olkin measure of sampling adequacy was (0.966) and Bartlett's test of sphericity with approximate chi-square was <0.001 . The commonalities extraction for all questions were >0.583 , the related components were one with the rotated component matrix >0.763 of all 21 questions in component 1 as suggested. They were established by confirmatory with statistically significant ($p<0.001$) of the factor model, by factor analysis, by scree plot, pathway analysis and fit with the original survey. The confirmatory factor index was 0.878, Tucker-Lewis Index (TLI) was 0.865, Goodness of fit index (GFI) was 0.862 and Expected cross validation index (ECVI) 5.101. The collinearity of 21 questions was the auto-correlation was 0.010 with not statically significant ($p=0.816$). The majority of 21 question had Enjuone value had close to number 1, while 12 questions only had condition index more than 30. All 16 of the questions had the Variance inflation factor (VIF) less than 10 and had tolerance more than 0.1.

Conclusion: The reliability and validity of the pharmacy research knowledge survey in the Kingdom of Saudi Arabia were high. The researcher can use it in the future with the same goal and acceptable sample size.

Key words: Reliability, Validity, Pharmacy, Research, Knowledge, Survey, Saudi Arabia.

INTRODUCTION

The validity progressions guidelines was used for a long time around the world. While validation in the pharmacy practice, including the survey development of pharmacy research or pharmacy services not well recognized yet. The literature describes the validation or validity is defined as "the degree to which the researcher has measured what he has set out to measure".¹ There are several advantages of utilizing this concept in pharmacy research with an emphasis on survey development. The validation processes to keep the accuracy of the survey, the present of collection between questions, to make all questions with demand outcomes to keep construct of the survey. The validation is part of quality management processes, while the processes not widely used in the pharmacy practice or research and need education and training during implementation for pharmacy research. The validity had multiple types, while the most used in the research content or face validation and construct validity. While the reliability is defined as "scale or test is reliable to the extent that repeat measurements made by it under constant conditions will give the same

result".¹ Four methods to test the reliability that's including test-retest reliability, parallel form reliability, inter-rater reliability and internal consistency reliability by using several biostatistical analysis including Cronbach alpha, McDonald's ω and Butman. The measurements of the reliability had several advantages, including the currency of the survey, reduction of mistakes and it easy for execution.

The pharmacist applied the pharmaceutical care concept in the Kingdom of Saudi Arabia since the 2000s when the pharmacy strategic plan occurred.² The pharmacist delivers several administrative and patients centered clinical activities including pharmacy researches.³⁻⁵ There were multiple kinds of pharmacy research, for instance, experimental and non-experimental studies. The most popular pharmacy research in Saudi Arabia was observational studies, with the most extensive research was cross-sectional through a survey distributed to the responders. Various studies used the survey for the first time.^{6,7} Those questions demand reliability and validation of the survey. Recently, the authors

and his colleagues published various research about pharmacy research knowledge in Saudi Arabia. The knowledge discussed several points included basic knowledge of pharmacy research, biostatistics knowledge in the research, proposal of pharmacy research and evidence-based resources that was used in the research.⁸⁻¹⁰ Few studies locally or in the Gulf and Middle East countries discussed the reliability and validity in such details of the pharmacy survey used in research.¹¹⁻¹⁵ The authors, based on their knowledge were not familiar with any publications about the validation or reliability of pharmacist knowledge of a research survey in the Kingdom of Saudi Arabia. The aim of the current study is to declare the validity and reliability of the survey of the basic knowledge of pharmacy in Saudi Arabia.

METHODS

Survey Development

It is a cross-section survey established by the authors and hit the researcher team. It based on the updated literature, national and international accreditation standards organizations.¹⁶⁻¹⁹ The survey contained of two parts, the first section of demographic data about responders that including genders, nationality with dichotomous data and age with ordinal data. The rest of the data as ordinal information that's including the responder's qualifications, background education, the board of pharmaceutical certificate, the current job and experience. The other section of demographic information was the hospital data with ordinal data and comprised hospital bed capacity based on the Ministry of health classification; the university updated hospital accreditation status from national and international accreditation institutions. The second part of the survey about patient satisfaction of pharmacy services. The section divided into several domains and each domain had several questions related to the domains. The answers of the domains were likely with 1 (I do not need this knowledge), 2 (I do not have knowledge), 3 (Weak knowledge), 4 (Incomplete knowledge) and 5 (Complete knowledge). A pilot study was done through the authors and the team allocates electronically or manually to target responders 20-30 as a pilot. Sometimes they interview patients to promise all the questions clear and understood by the responders. All comments brought for discussion. The correction of the survey was done based on the agreement of most research members.²⁰ The research team tested the McDonald's ω and Cronbach alpha for internal reliability in the pilot responders by using Statistical Package of Social Sciences (SPSS), Statistical Package of Social Sciences-Analysis of Moment Structures (SPSS-Amos) and Jeffrey's Amazing Statistics Program (JASP).²¹

Internal Consistency Reliability

Item-item Correlation

The method was used to measure each question to another one, with high coloration results in more than 0.7 that high internal consistency reliability survey.^{1,21}

Item-total Correlation

The method was used to measure the total questions allocates with each question alone. The results of high results more than 0.7, the high correlate internal consistency reliability of the survey.^{1,21}

Split Half Reliability (Gutmann's λ_6)

The method was used through the SPSS and JASP program with the scale option and reliability section. The test used a split-half option. The SPSS or JASP will split the question into two-half and measure the coloration of the two groups. The high results of more than 0.9 of coloration means the high reliability with internal consistency.^{20,22,23}

McDonald's ω , Cronbach Alpha

The research team applied McDonald's ω and Cronbach alpha for internal reliability by using SPSS and JASP. All questions with scale or ordinal data included in the analysis. The scale more 0.9; it will be excellent internal consistency, 0.7-0.9 means good reliability, 0.3-0.6 means not acceptable reliability and the score less than 0.3 means weak reliability.^{20,24,25}

Face Content Validity

The principle authors intended the survey and the team research revised independently. Each member revised all survey content questions based on the updated literature and experience. Any violations had been sent to all research team for further discussion and agreements. The survey had been corrected and agreement from the research team. One of the team members transferred all surveys to the Arabic language and double-checked by all team members again for content and accurate translation.^{1,20}

Construct Validity

Exploratory Factorial Analysis

The method was used for the construct validity of the survey. The factor was used univariate description and Kaiser-Myer-Olin measure of sampling adequacy and Bartlett's test sphericity. The extraction was used principal components analysis, the Eigen values greater than 1 with the maximum iteration of convergence 25 and display through un-rotated faction solution and scree plot. The rotation used Varimax.^{18,23}

Confirmatory Factor Analysis

The test was done through SPSS-Amos and JASP software programs with factor variances, R-Sequated, fit measurements, factor loading, without emulation, error calculated with CI 95% and robust method, it was with the auto-estimator and without standardization, it was with pathway analysis.^{18,23}

Collinearity

The test was done through JASP with linear regression for collinearity diagnostics including Eigen value and condition index, the coefficient used with CI 95% tolerance and variance inflation factor, the model fit through ANOVA and auto-correlation with Durbin-Watson.²⁶

Statistical Analysis

Various biostatistical analysis had been done in the current study like the McDonald's ω , Cronbach alpha and Gutmann's λ_6 for calculation reliability. The Kaiser-Meyer-Olkin measure of sampling adequacy and Bartlett's test of sphericity with approximate chi-square for Exploratory Factor Analysis (EFA) was also used. The factor variances, R-Sequated, fit measurements, factor loading, without emulation, error calculated with CI 95% and robust method, it was with the auto-estimator and without standardization, it was with scree plot and pathway analysis. Collinearity had been diagnostician through linear regression the variance inflation factor was calculated, the model fit through ANOVA and auto-correlation with Durbin-Watson. All biostatistical analysis was done by the Statistical Package of Social Sciences (SPSS), SPSS-AMOS and Jeffrey's Amazing Statistics Program (JASP).

RESULTS

A total of 209 pharmacists responded. The majority of responders were Saudi 185 (88.52%). The among responders were males 108 (61.77%) and females 101 (48.33%). Most of the responders were in age (18-29) years and age (30-44) years were 104 (49.67%) and 78 (37.32%), respectively. The majority of responders had a doctor of pharmacy and a Bachelor's degree in pharmacy was 92 (44.32%) and 81 (38.94%), respectively. Most of the pharmacists had not 16 (8%) certified of pharmaceuticals

Table 1: Scale Reliability Statistics.

scale	mean	sd	McDonald's ω	Cronbach's α	Guttman's λ_6	95.0% Confidence Interval		Average inter-item correlation	Greatest lower bound	If item dropped	29 responders				If item dropped											
						Lower	Upper				mean	sd	item-rest correlation	Cronbach's α	Guttman's λ_6	McDonald's ω	Cronbach's α	Guttman's λ_6	McDonald's ω							
3.639	0.116	0.983	0.988	0.983	0.988	0.979	0.986	0.73	0.992		3.897	1.145	0.804	0.978	0.977	0.996										
Note. Of the observations, 188 were used, 22 were excluded pairwise and 210 were provided.																										
3.762	0.158	0.979	0.997	0.978	0.997	0.964	0.988	0.683	0.996		3.533	1.224	0.847	0.977	0.976	0.997										
Note. Of the observations, 29 were used, 1 were excluded pairwise and 30 were provided.																										
Item Reliability Statistics																										
											188 responders				If item dropped				29 responders				If item dropped			
											mean	sd	item-rest correlation	McDonald's ω	Cronbach's α	Guttman's λ_6	McDonald's ω	Cronbach's α	Guttman's λ_6	McDonald's ω	mean	sd	item-rest correlation	Cronbach's α	Guttman's λ_6	McDonald's ω
Q1	Formulating and delimiting the problem					3.779	1.007	0.74	0.983	0.983	3.897	1.145	0.804	0.987	0.983	0.987	0.983	0.987	0.983	0.987	3.897	1.145	0.804	0.978	0.977	0.996
Q2	Searching the literature in efficient way					3.759	1.018	0.781	0.982	0.982	3.833	1.085	0.826	0.987	0.982	0.987	0.982	0.987	0.982	0.987	3.833	1.085	0.826	0.978	0.977	0.997
Q3	Reviewing the related literature					3.813	1.044	0.802	0.982	0.982	3.933	1.048	0.803	0.987	0.982	0.987	0.982	0.987	0.982	0.987	3.933	1.048	0.803	0.978	0.977	0.997
Q4	Developing a theoretical framework					3.475	1.066	0.823	0.982	0.982	3.533	1.224	0.847	0.987	0.982	0.987	0.982	0.987	0.982	0.987	3.533	1.224	0.847	0.977	0.976	0.997
Q5	Formulating hypothesis					3.447	1.132	0.844	0.982	0.982	3.533	1.224	0.889	0.987	0.982	0.987	0.982	0.987	0.982	0.987	3.533	1.224	0.889	0.977	0.976	0.997
Q6	Selecting a research design					3.573	1.131	0.837	0.982	0.982	3.500	1.280	0.832	0.987	0.982	0.987	0.982	0.987	0.982	0.987	3.500	1.280	0.832	0.978	0.977	0.997
Q7	Identifying the population and sample to be studied					3.703	1.168	0.855	0.982	0.982	3.733	1.202	0.835	0.987	0.982	0.987	0.982	0.987	0.982	0.987	3.733	1.202	0.835	0.978	0.977	0.997
Q8	Specifying methods to collect the research data					3.681	1.073	0.892	0.982	0.982	3.967	1.098	0.853	0.987	0.982	0.987	0.982	0.987	0.982	0.987	3.967	1.098	0.853	0.977	0.976	0.997
Q9	Designing the sampling plan					3.556	1.073	0.86	0.982	0.982	3.767	1.135	0.804	0.987	0.982	0.987	0.982	0.987	0.982	0.987	3.767	1.135	0.804	0.978	0.977	0.998
Q10	Power of the study					3.611	1.111	0.818	0.982	0.982	3.600	1.248	0.570	0.987	0.982	0.987	0.982	0.987	0.982	0.987	3.600	1.248	0.570	0.980	0.979	0.997

Q11	Determine appropriate sample size	3.546	1.06	0.84	0.982	0.982	0.982	0.982	0.982	0.987	3.700	1.022	0.821	0.978	0.977	0.997
Q12	Determining outcome measures (variables)	3.659	1.092	0.912	0.981	0.981	0.981	0.986	0.986	0.986	3.933	1.143	0.899	0.977	0.976	0.997
Q13	Designing a data collection form	3.686	1.107	0.9	0.982	0.982	0.986	0.986	0.986	0.986	3.867	1.167	0.877	0.977	0.976	0.997
Q14	Conducting the pilot study	3.449	1.078	0.83	0.982	0.982	0.987	0.987	0.987	0.987	3.600	1.133	0.795	0.978	0.977	0.997
Q15	Collecting the quantitative and qualitative data	3.702	1.12	0.885	0.982	0.982	0.986	0.986	0.986	0.986	3.967	1.098	0.756	0.978	0.977	0.997
Q16	Preparing the data for analysis	3.68	1.07	0.909	0.981	0.981	0.986	0.986	0.986	0.986	3.967	0.999	0.845	0.977	0.977	0.997
Q17	Analyzing the data	3.596	1.031	0.833	0.982	0.982	0.987	0.987	0.987	0.987	3.800	0.961	0.787	0.978	0.977	0.997
Q18	Interpreting the result	3.621	1.127	0.863	0.982	0.982	0.987	0.987	0.987	0.987	3.633	1.159	0.848	0.977	0.976	0.997
Q19	Conflict of interest	3.519	1.142	0.812	0.982	0.982	0.987	0.987	0.987	0.987	3.600	1.221	0.723	0.978	0.978	0.997
Q20	Discussion of research	3.688	1.1	0.876	0.982	0.982	0.986	0.986	0.986	0.986	3.800	1.126	0.866	0.977	0.976	0.997
Q21	Conclusion of research	3.87	1.118	0.874	0.982	0.982	0.986	0.986	0.986	0.986	3.833	1.085	0.875	0.977	0.976	0.997

specialties 193 (92%).

Reliability

The three tests had been done with reliability of 21 questions for the initial 29 responders mean \pm SD was 3.762 ± 0.158 , McDonald's ω , Cronbach alpha and Gutmann's λ_6 were 0.979, 0.978 and 0.997, respectively with CI 95% (0.964-0.988), while inter-item coloration was 0.683. After the completed number of responders (188), mean \pm SD was 3.179 ± 0.436 , McDonald's ω , Cronbach alpha and Gutmann's λ_6 were 0.983, 0.983 and 0.988, respectively with CI 95% (0.979-0.986) and inter-item coloration was 0.73 among the 30 responders and item-total coloration >0.57 , McDonald's ω , Cronbach alpha and Gutmann's λ_6 value if deleted was >0.97 , while with responders' number 188, the item-total coloration >0.7 , McDonald's ω , Cronbach alpha and Gutmann's λ_6 value if deleted was >0.98 (Table 1). The split-half reliability of 188 valid cases and 21 items; the Cornbrash's Alpha of part 1 was 0.966, while part 2 was 0.974, the correlation between forms was 0.923. The Spearman-Brown Coefficient of unequal length was 0.960 and Guttman Split-Half Coefficient was 0.959 (Table 2).

Validity

By using Exploratory Factor Analysis (EFA), the Kaiser-Meyer-Olkin measure of sampling adequacy was 0.966 and Bartlett's test of sphericity with approximate chi-square was <0.001 . The commonalities extraction for all the questions were >0.583 and the related components were one with the rotated component matrix >0.763 of all 21 questions in component 1 as suggested with scree plot (Figure 1). They were confirmed by confirmatory with statistically significant ($p<0.001$) of the factor model, by factor analysis, by pathway analysis and fit with the original survey (Figure 2). The confirmatory factor index was 0.878, Tucker-Lewis Index (TLI) was 0.865, Goodness of fit index (GFI) was 0.862 and Expected cross validation index (ECVI) 5.101. Other results Bentler-Bonett Non-

normed Fit Index (NNFI) was 0.865, Bentler-Bonett Normed Fit Index (NFI) was 0.848, Parsimony Normed Fit Index (PNFI) was 0.763, Bollen's Relative Fit Index (RFI) was 0.831, Bollen's Incremental Fit Index (IFI) was 0.879, Relative Noncentrality Index (RNI) was 0.878, Root mean square error of approximation (RMSEA) was 0.134 and Standardized root mean square residual (SRMR) was 0.039 (Table 3 and 4). The square, multiple correlations of the questions R2 were from 0.552 to 0.854, while factor loading was all the questions >0.88 and it was a range (0.887-1.022) with $p<0.001$. In the pathway analysis, each latent factor and observed coloration with >0.7 with $p<0.001$ as discovered in the pathway analysis (Figure 2).

Collinearity

The correlation coefficients of 21 questions was R2 (0.908) and RMSE was 0.37 with statistically significant ($p<0.001$), while the auto-correlation was 0.010 with not statically significant ($p=0.816$). The majority of

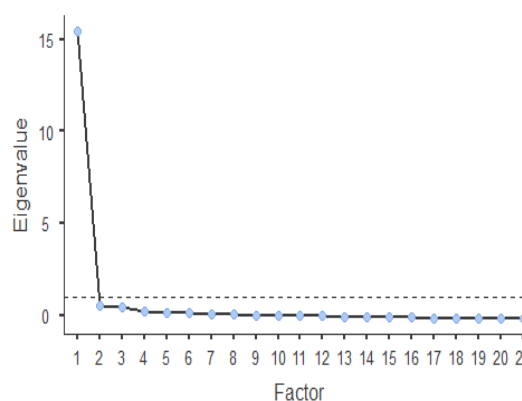


Figure 1: Exploratory Factor Analysis Scree Plot.

Table 2: Split-Half reliability.

Case Processing Summary			
		N	%
Cases	Valid	188	89.5
	Excluded ^a	22	10.5
	Total	210	100.0
a. Listwise deletion based on all variables in the procedure.			
Reliability Statistics			
Cronbach's Alpha	Part 1	Value	.966
		N of Items	11 ^a
	Part 2	Value	.974
		N of Items	10 ^b
Total N of Items		21	
Correlation Between Forms			.923
Spearman-Brown Coefficient	Equal Length		.960
	Unequal Length		.960
Guttman Split-Half Coefficient			.959
a. The items are: Formulating and delimiting the problem, Searching the literature in efficient way, Reviewing the related literature, Developing a theoretical framework, Formulating hypothesis, Selecting a research design, Identifying the population and sample to be studied, Specifying methods to collect the research data, Designing the sampling plan, Power of the study, Determine appropriate sample size.			
b. The items are: Determining outcome measures (variables), Designing a data collection form, Conducting the pilot study, Collecting the quantitative and qualitative data, Preparing the data for analysis, Analyzing the data, Interpreting the result, Conflict of interest, Discussion of research, Conclusion of research.			

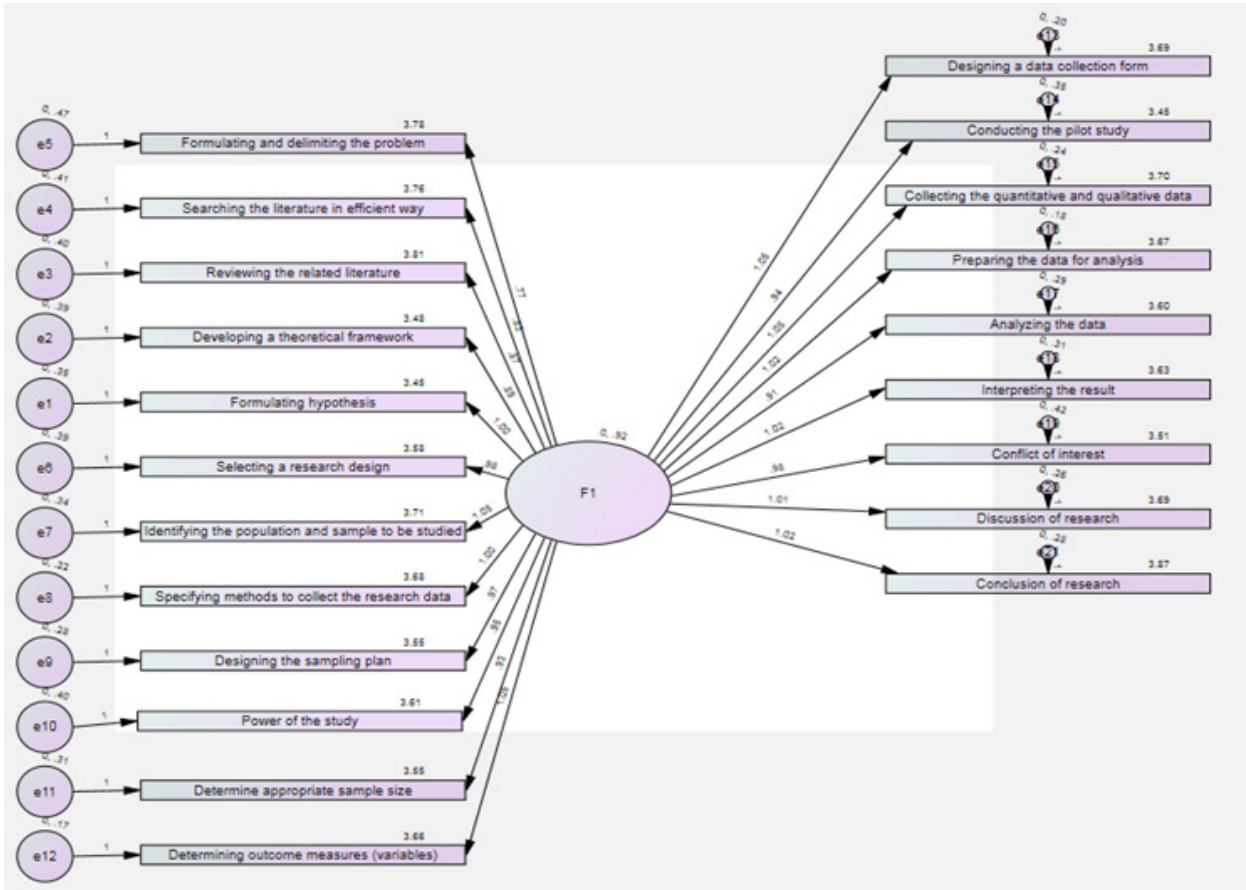


Figure 1: confirmatory analysis pathway diagram

Table 3: Scale of Validity.

		Exploratory Factor Analysis (EFA)		Confirmatory Factor Analysis (CFA)				
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.			.966	CFI	0.878			
KMO and Bartlett's Test								
		Approx. Chi-Square	5222.122	Chi-square test				
Bartlett's Test of Sphericity		df	210	Baseline model	5186.302	136	P	
		Sig.	.000	Factor model	770.743	119	< .001	
Items		Communalities	Rotated Component Matrix ^a	Squared Multiple Correlations	Factor loading (F1)	95% Confidence Interval		
		Extraction	Component 1	R ²		Lower	Upper	p
Q1	Formulating and delimiting the problem	.583	.763	0.552	0.743	0.628	0.858	< .001
Q2	Searching the literature in efficient way	.648	.805	0.613	0.799	0.684	0.914	< .001
Q3	Reviewing the related literature	.697	.835	0.663	0.850	0.738	0.962	< .001
Q4	Developing a theoretical framework	.701	.837	0.665	0.862	0.753	0.971	< .001
Q5	Formulating hypothesis	.763	.873	0.743	0.966	0.874	1.057	< .001
Q6	Selecting a research design	.723	.850	0.696	0.934	0.83	1.038	< .001

Q7	Identifying the population and sample to be studied	.776	.881	0.764	1.022	0.922	1.122	< .001
Q8	Specifying methods to collect the research data	.816	.903	0.811	0.953	0.857	1.049	< .001
Q9	Designing the sampling plan	.782	.884	0.774	0.938	0.844	1.032	< .001
Q10	Power of the study	.705	.840	0.687	0.918	0.82	1.016	< .001
Q11	Determine appropriate sample size	.729	.854	0.719	0.887	0.78	0.993	< .001
Q12	Determining outcome measures (variables)	.852	.923	0.858	1.006	0.917	1.094	< .001
Q13	Designing a data collection form	.830	.911	0.835	0.994	0.903	1.085	< .001
Q14	Conducting the pilot study	.705	.840	0.686	0.879	0.781	0.976	< .001
Q15	Collecting the quantitative and qualitative data	.802	.896	0.803	0.993	0.901	1.085	< .001
Q16	Preparing the data for analysis	.850	.922	0.854	0.987	0.901	1.073	< .001
Q17	Analyzing the data	.731	.855	0.732	0.887	0.79	0.984	< .001
Q18	Interpreting the result	.771	.878	0.757	0.968	0.883	1.054	< .001
Q19	Conflict of interest	.691	.831	0.680	0.943	0.849	1.037	< .001
Q20	Discussion of research	.805	.897	0.802	0.971	0.88	1.061	< .001
Q21	Conclusion of research	.776	.881	0.770	0.972	0.874	1.071	< .001

Table 4: The validity analysis test.

Index	Value	normal value
Comparative Fit Index (CFI)	0.878	>0.9
Tucker-Lewis Index (TLI)	0.865	>0.9
Bentler-Bonett Non-normed Fit Index (NNFI)	0.865	>0.9
Bentler-Bonett Normed Fit Index (NFI)	0.848	>0.9
Parsimony Normed Fit Index (PNFI)	0.763	>0.9
Bollen's Relative Fit Index (RFI)	0.831	>0.9
Bollen's Incremental Fit Index (IFI)	0.879	>0.9
Relative Noncentrality Index (RNI)	0.878	>0.9
Root mean square error of approximation (RMSEA)	0.134 CI 90% (0.125-0.144) P<0.001	>or= 0.08
Standardized root mean square residual (SRMR)	0.039	> 0.04
Hoelter's critical N ($\alpha = .05$)	51.157	
Hoelter's critical N ($\alpha = .01$)	54.561	
Goodness of fit index (GFI)	0.862	>0.9
McDonald fit index (MFI)	0.181	
Expected cross validation index (ECVI)	5.101	

Table 5: The Collinearity analysis test.

Collinearity								95% CI			
	Eigenvalue	Condition Index	Unstandardized	Standard Error	Standardized	t	p	lower	upper	Tolerance	VIF
Q1	19.585	1	0.127	0.045	0.403	2.803	0.006	0.038	0.217	0.327	3.06
Q2	0.064	17.527	0.101	0.057	0.327	1.765	0.079	-0.012	0.214	0.21	4.764
Q3	0.058	18.365	-0.058	0.062	-0.19	-0.936	0.35	-0.179	0.064	0.177	5.645
Q4	0.043	21.406	0.027	0.057	0.091	0.477	0.634	-0.085	0.14	0.2	4.988
Q5	0.032	24.857	-0.026	0.057	-0.092	-0.457	0.648	-0.138	0.086	0.178	5.608
Q6	0.031	25.115	-0.056	0.055	-0.2	-1.022	0.308	-0.165	0.052	0.192	5.196
Q7	0.025	28.06	-0.087	0.055	-0.322	-1.581	0.116	-0.195	0.022	0.175	5.724
Q9	0.025	28.228	0.02	0.062	0.069	0.331	0.741	-0.101	0.142	0.169	5.908
Q10	0.021	30.444	-0.023	0.051	-0.082	-0.459	0.647	-0.124	0.077	0.225	4.446
Q11	0.017	33.75	0.09	0.058	0.298	1.541	0.125	-0.025	0.205	0.195	5.138
Q12	0.016	35.416	-0.031	0.07	-0.108	-0.449	0.654	-0.17	0.107	0.125	7.995
Q13	0.014	36.96	0.002	0.066	0.007	0.03	0.976	-0.129	0.133	0.14	7.163
Q14	0.012	39.817	0.071	0.051	0.238	1.382	0.169	-0.03	0.172	0.243	4.122
Q15	0.011	42.818	0.053	0.063	0.186	0.846	0.399	-0.071	0.176	0.151	6.63
Q16	0.01	44.175	-0.097	0.073	-0.328	-1.33	0.185	-0.241	0.047	0.12	8.317
Q17	0.009	46.595	0.044	0.057	0.146	0.777	0.438	-0.068	0.157	0.205	4.875
Q20	0.008	49.811	0.03	0.056	0.107	0.546	0.586	-0.08	0.141	0.186	5.364
Q22	0.008	50.386	0.008	0.051	0.029	0.157	0.875	-0.092	0.108	0.217	4.61
Q24	0.007	52.71	-0.015	0.072	-0.051	-0.208	0.835	-0.157	0.127	0.121	8.272
Q25	0.005	60.737	0.107	0.064	0.376	1.671	0.097	-0.019	0.234	0.141	7.093
R	R²	Adjusted R²	RMSE	R² Change	F Change	df1	df2	p			
0.953	0.908	0.898	0.37	0.908	82.844	20	167	< .001			
ANOVA									Collinearity Threshold		
Model	Sum of Squares	df	Mean Square	F	p			Variance inflation factor (VIF)	>10		
Regression	228.018	20	11.401	83.34	< .001			Tolerance	< 0.1		
Residual	22.982	168	0.137					Condition index (CI)	> 30		
Total	251	188						The eigenvalue (coloration matrix); if it is close to 0 collinearity is high, if it is close to 1 there is no collinearity in the data			
Durbin-Watson											
Autocorrelation	Statistic	p									
0.010	1.970	0.816									

21 question had Enjuone value close to number 1, while 12 questions only had condition index more than 30. All of the 16 questions had the Variance inflation factor (VIF) less than 10 and had tolerance more than 0.1 (Table 5).

DISCUSSION

The knowledge of pharmacy research is vital in pharmacy practice in the Kingdom of Saudi Arabia. Several key performance indicators set up for the plan, including the research with an emphasis on knowledge, practice and perception. One previous study by the author and his colleagues about pharmacist knowledge of research through the cross-sectional survey. The survey was validated by the revision of expert pharmacists, pilot study and reliability of the bio-statistical analysis of Cronbach alpha. In the study, the author wishes to declare much detail of the reliability and validity of the survey questions. In the findings showed with first responders was done through three biostatistics test of McDonald's ω , Cronbach alpha and Gutmann's. All of the tests showed excellent reliability similar to previous study and better than other that's might be to differences in the sample size or internal consistency for each study and it can be repeated at any time or place in the Kingdom of Saudi Arabia with the same outcome.^{11,14,15} The first responders until research completed the number of responders with the same reliability. There was a good collaboration with each question with total and each question was critical and valid if the question deleted. Two methods was done to check the validation of the survey with exploratory factor analysis to check the construct of the survey and validate each group of questions and related latent factors - beside another to authorize the exploratory factoring with confirmatory factoring analysis. The method of exploratory recommends one component, one factor loading with 21 questions with statistically significant similar to the previous study.¹⁴ The colorations of each question to all question was high and confirmed by seconds method of confirmatory analysis with loading one component as same as the original survey with high correlation with statistical significance. Besides, the confirmation was obvious through pathway analysis and the scree plot. As a result, the internal validity was high and contracture of the survey. The survey was tested with collinearity because the presence of multicollinearity may affect the negative of the survey through lateral collinearity. The finding showed the majority question without collinearity and other questions the possibility of collinearity that's related might sample size needs to increase. Besides, the auto-correlation not statistically significant that will become weak the possibility of collinearity in the survey. The reliability and validity of knowledge pharmacy research surveys first done in the Kingdom of Saudi Arabia and the Middle East country. The surgery found high reliability, validity and the pharmacist can employ in practice with a good number of samples.

CONCLUSION

The pharmacy research knowledge survey in Saudi Arabia had high reliability with internal consistency through various biostatistical tests. Besides, the validation of the survey was high through the factorial analysis method. The researcher can use the survey with the same goal and enough sample size.

ACKNOWLEDGEMENT

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ABBREVIATIONS

KSA: Kingdom of Saudi Arabia; **CFI:** Comparative Fit Index; **TLI:** Tucker-Lewis Index; **NNFI:** Bentler-Bonett Non-normed Fit Index; **NFI:** Bentler-Bonett Normed Fit Index; **PNFI:** Parsimony Normed Fit Index; **RFI:** Bollen's Relative Fit Index; **IFI:** Bollen's Incremental Fit Index; **RNI:** Relative Noncentrality Index; **RMSEA:** Root Mean Square Error of Approximation; **SRMR:** Standardized Root Mean Square Residual; **GFI:** Goodness of Fit Index; **MFI:** McDonald Fit Index; **ECVI:** Expected Cross Validation index; **SPSS:** Statistical Package of Social Sciences; **JASP:** Jeffrey's Amazing Statistics Program; **ANOVA:** Analysis of Variance; **SPSS-Amos:** Statistical Package of Social Sciences-Analysis of Moment Structures.

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