Reliability and Validity of Biostatical Analysis used for Pharmacy Research Questionnaire in Saudi Arabia

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ABSTRACT

Objectives: To declare reliability and validity of Biostatical Analysis used for Pharmacy Research Survey in Saudi Arabia. **Methods:** It is a cross-section survey developed by the authors and the research team. It's based on the updated literature, 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 λ6) and McDonald's ω, 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 31 questions. The completed responders (185) (mean ± SD) was 3.236 ± 0.326 and McDonald's ω, Cronbach alpha and Gutmann's λ6 were 0.980, 0.980 and 0.990, respectively with CI 95% (0.975-0.983) and inter-item coloration was 0.607, while the item-total coloration >0.53 and McDonald's ω, Cronbach alpha and Gutmann's λ6 value if deleted was >0.97. 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 was >0.57, the related components were four of all 31 questions in four components as suggested. They were not confirmed by confirmatory with statistically significant ($p<0.001$) of the factor model, by factor analysis, by scree plot and pathway analysis and fit not with the original survey changed to 3 factor loading. The confirmatory factor index was (0.761), Tucker-Lewis Index (TLI) was (0.737), Goodness of fit index (GFI) was (0.844) and expected cross validation index (ECVI) (9.029). The collinearity of 23 questions was autocorrelation (2.609e-5) with not statistically significant ($p=0.951$). The majority of 23 question had Enjuone value close to number 1, while 11 questions had condition index more than 30. All of the 23 questions had The Variance inflation factor (VIF) less than 10 except four questions and had tolerance more than 0.1 except four questions. **Conclusion:** The reliability and validity related to the corrected survey of biostatistics analysts used in pharmaceutical research in the Kingdom of Saudi Arabia were high. The pharmacy practice was properly used in further future research in Saudi Arabia.

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

INTRODUCTION

Reliability and validity are a common concept used in the pharmacy research field. The reliability was 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] that's you need tools to assure to give the same results once repeated the test. The reliability consisted of various types that are including test-retest reliability or, parallel from reliability and inter-rater reliability, or internal consistency reliability. The internal reliability needs various biostatistical analysis to implement that including Cronbach alpha and Machdolan W. The validity was defined as "the degree to which the researcher has measured what he has set out to measure".[1] The validation had several types with common which were content and construct validity. The content validity easy to use, while contract validity needs biostatistical analysis with principal component and factorial analysis. The validity had several advantages that's including unified the goal of the project; it is part of quality management processes, to keep the question of the survey within one field and target. The construct validity needs special education and training to implement through software biostatistical programs.

In the past years, the pharmacy strategic plan involved the pharmacy research and validated the role of the pharmacists with a clinical and economic impact in the pharmacy practice.[1-5] Besides, pharmacy indicators of follow-up and a successful pharmacy strategic plan were implemented,[1] including patients and pharmacist satisfaction. As a result, various publications related to the pharmacist with outcome in practice revealed. Also, multiple cross-sections study through a self-survey about patient satisfaction with pharmacy services and pharmacist job satisfaction also revealed.[6] Both surveys extracted from previous literature with a new design appropriate for pharmacy practice in the Kingdom of Saudi Arabia. Even though both studies were very edifying, but reliability and validity are highly suggested for both surveys. Some studies in the biostatistical knowledge of the healthcare

professional including pharmacist; they had been done with a very brief discussion about reliability and validity or eve not existed.[7-11] Another study done in pharmacy research knowledge of biostatistics with reliability checked and without detail information about the reliability or validity of the study.[12] The authors were not familiar with an investigation about the reliability or validity of the biostatistics analysis knowledge in Saudi Arabia. The aim of the current study is to declare the reliability and validity of the biostatistics analysis of a pharmacy research survey in the Kingdom of Saudi Arabia.

METHODS

Survey Development

It is a cross-section survey developed by the authors and hit the research team. It's based on the updated literature and national and international accreditation standards organizations.[13-16] The survey contained two parts: the first section about demographic data for responders including genders, nationality with dichotomous data and age with ordinal data. The rest of the data uses as ordinal information, including the responder's qualifications, responders background, education, the board of pharmaceutical certificate and the current job and experience. The other section of demographic information was hospital data with ordinal data and included 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 domain. 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 distributes electronically or manually to target responders 20-30 as a pilot. Sometimes they interview patients to assure all the questions clear and understood by the responders. All comments brought for discussion. The correction of the survey had been done based on the agreement of most research members.[17] 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).[18]

Internal Consistency Reliability

Item-Item Correlation

The method used to measure each question to another one, with high coloration results in more than 0.7 that is high internal consistency reliability survey.[18,19]

Item-Total Correlation

The method to measure the total questions correlates with each question alone. The high results more than 0.7, the high correlate internal consistency reliability of the survey.[18,19]

Split Half Reliability (Gutmann's λ6)

The method used through the SPSS and JASP program with the scale option and reliability section. All questions to scale or ordinal data need to be measured. The test used a split-half option. The SPSS or JASP will split the question into two half and measures the coloration of the two groups. The high results more 0.9 about coloration means higher reliability with internal consistency.[17,20,21]

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 a scale or ordinal data included in the analysis. The scale more than 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.[17,22,23]

Face Content Validity

The principle authors planned the survey and 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.[17,19]

Construct Validity

Exploratory Factorial Analysis

The method was used for the construct validity of the survey. The factor 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.[15,21]

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.[15,21]

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.[24]

Statically Analysis

Various biostatical analysis was done in the current study like the McDonald's ω, Cronbach alpha and Gutmann's λ6 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 used during the study. 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 the 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%), respec-

Table 1: Scale Reliability Statistics.

								95.0% Confidence Interval									
	mean	sd	McDonald's ω	Cronbach's α	Gutmann's λ6	Greatest lower bound	Average inter-item correlation	Lower	Upper								
scale	3.236	0.326	0.980	0.980	0.990	0.989	0.607	0.975	0.983								
	Note. Of the observations, 185 were used, 25 were excluded pairwise and 210 were provided.																
	3.315	0.418	0.979	0.979	1.000	0.993	0.592	0.966	0.988								
	Note. Of the observations, 28 were used, 2 were excluded pairwise and 30 were provided																
Item Reliability Statistics																	
		186 responders			If item dropped			29 responders			If item dropped						
		mean	sd	item-rest correlation	McDonald's ω	Cronbach's α	Gutmann's λ6	mean	sd	item-rest correlation	McDonald's ω	Cronbach's α	Gutmann's λ6				
Q1	Description analysis	3.187	1.147	0.887	0.979	0.978	0.990	3.367	1.217	0.916	0.978	0.977	1.000				
Q2	Mean	3.733	1.288	0.789	0.979	0.979	0.990	3.900	1.269	0.759	0.978	0.978	1.000				
Q3	Mode	3.555	1.274	0.785	0.979	0.979	0.990	3.800	1.215	0.781	0.978	0.978	1.000				
Q4	Median	3.66	1.303	0.744	0.98	0.979	0.990	3.867	1.252	0.757	0.979	0.978	1.000				
Q5	Standard Deviation (SD)	3.679	1.307	0.775	0.979	0.979	0.990	3.967	1.273	0.720	0.979	0.978	1.000				
Q6	Standard Error of Mean (SEM)	3.433	1.197	0.812	0.979	0.979	0.990	3.733	1.172	0.768	0.978	0.978	1.000				
Q7	The nominal, ordinal, continuous variable	3.231	1.233	0.789	0.979	0.979	0.990	3.172	1.338	0.796	0.978	0.978	1.000				
Q8	P value	3.702	1.174	0.749	0.979	0.979	0.990	3.800	1.157	0.829	0.978	0.978	1.000				
Q9	Confidence Interval (CI)	3.617	1.145	0.761	0.979	0.979	0.990	3.667	1.155	0.811	0.978	0.978	1.000				
Q10	Paired T test	3.248	1.184	0.873	0.979	0.978	0.990	3.300	1.208	0.913	0.978	0.977	1.000				
Q11	Unpaird T test	3.202	1.174	0.871	0.979	0.978	0.990	3.233	1.165	0.901	0.978	0.977	1.000				
Q12	Chi Square	3.201	1.18	0.833	0.979	0.979	0.990	3.167	1.206	0.882	0.978	0.977	1.000				
Q13	One way ANOVA	3.211	1.206	0.879	0.979	0.978	0.990	3.233	1.194	0.880	0.978	0.977	1.000				
Q14	Two way ANOVA	3.134	1.201	0.868	0.979	0.978	0.990	3.233	1.165	0.877	0.978	0.977	1.000				
Q15	Regression analysis	3.105	1.134	0.885	0.979	0.978	0.990	3.233	1.194	0.887	0.978	0.977	1.000				
Q16	Z Score	2.889	1.094	0.751	0.979	0.979	0.990	3.000	1.035	0.564	0.979	0.979	1.000				

Q17	Correlation Coefficient	3.329	1.226	0.817	0.979	0.979	0.990	3.667	1.213	0.696	0.979	0.978	1.000
Q18	Odds ratios	3.449	1.139	0.729	0.98	0.979	0.990	3.367	1.159	0.712	0.979	0.978	1.000
Q19	Wilcoxon Rank Sum	2.908	1.13	0.845	0.979	0.979	0.990	3.033	1.189	0.859	0.978	0.977	1.000
Q20	Fisher s Exact	2.971	1.154	0.826	0.979	0.979	0.990	2.833	1.085	0.772	0.978	0.978	1.000
Q21	Mann-Whitney	2.957	1.164	0.835	0.979	0.979	0.990	2.933	1.172	0.850	0.978	0.977	1.000
Q22	Kruskal-Wallis ANOVA	2.923	1.118	0.821	0.979	0.979	0.990	2.897	1.145	0.791	0.978	0.978	1.000
Q23	Yates correction for Chi Square	2.87	1.048	0.751	0.979	0.979	0.990	2.867	1.074	0.752	0.978	0.978	1.000
Q24	McNemar Test	2.7	1.022	0.743	0.979	0.979	0.990	2.533	1.008	0.665	0.979	0.978	1.000
Q25	Tukey s HDS	2.652	0.997	0.7	0.98	0.979	0.990	2.600	1.102	0.675	0.979	0.978	1.000
Q26	Type of Error	3.587	1.096	0.694	0.98	0.979	0.990	3.633	1.129	0.516	0.979	0.979	1.000
Q27	Microsoft Excell	3.819	1.083	0.536	0.98	0.980	0.991	4.067	0.980	0.511	0.979	0.979	1.000
Q28	Microsoft Access	3.284	1.108	0.542	0.98	0.980	0.990	3.567	1.104	0.450	0.980	0.979	1.000
Q29	SPSS	3.087	1.082	0.744	0.98	0.979	0.990	3.100	1.155	0.846	0.978	0.977	1.000
Q30	SAS	2.742	0.981	0.687	0.98	0.979	0.990	2.700	0.988	0.712	0.979	0.978	1.000
Q31	Survey Monkey Analysis	3.256	1.181	0.59	0.98	0.980	0.991	3.300	1.088	0.768	0.978	0.978	1.000

tively. Most of the pharmacists 16 (8%) had not certified of pharmaceutical specialties 193 (92%).

Reliability

The three tests had been done of reliability of 31 questions for the initial (29) responders the (mean ± SD) was 3.315 ± 0.418 and McDonald's ω, Cronbach alpha and Gutmann's λ6 were 0.979, 0.979 and 1.000, respectively with CI 95% (0.966-0.988), while inter-item coloration was 0.592. After the completed number of responders (185), mean ± SD was 3.236 ± 0.326 and McDonald's ω, Cronbach alpha and Gutmann's λ6 were 0.980, 0.980 and 0.990, respectively with CI 95% (0.975-0.983) and inter-item coloration was 0.607. Among the 30 responders, all questions item-total coloration >0.40 and McDonald's ω, Cronbach alpha and Gutmann's λ6 value if deleted was >0.97, while with responders' number (185), the item-total coloration >0.53 and McDonald's ω, Cronbach alpha and Gutmann's λ6 value if deleted was >0.97 (Table 1). The Split-Half reliability of 185 valid cases and 31 items; the Cornbrash's Alpha of part 1 was 0.973, while part 2 was 0.952, the correlation between forms were 0.883. The Spearman-Brown Coefficient of unequal length was 0.938 and Guttman Split-Half Coefficient was 0.925 (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 (Table 3). The commonalities extraction for all questions was >0.57, the related components were four of all 31 questions in components 4 as suggested as declared with scree plot (Figure 1). They were not established by confirmatory with statistically significant (p<0.001) of the factor model, by factor and pathway analysis and fit not with the original survey and changed to 3 factor loading. (Figure 2). The square, multiple correlations of the questions

Table 2: Split half reliability.

Case Processing Summary			
		N	%
Cases	Valid	185	88.1
	Excluded[a]	25	11.9
	Total	210	100.0
a. Listwise deletion based on all variables in the procedure.			
Reliability Statistics			
Cronbach's Alpha	Part 1	Value	.973
		N of Items	16[a]
	Part 2	Value	.952
		N of Items	15[b]
	Total N of Items		31
Correlation Between Forms			.883
Spearman-Brown Coefficient	Equal Length		.938
	Unequal Length		.938
Guttman Split-Half Coefficient			.925
a. The items are: Description analysis, Mean, Mode, Median, Standard Deviation (SD), Standard Error of Mean (SEM), The nominal, ordinal, continuous variable, P value, Confidence Interval (CI), Paired T test, Unpaird T test, Chi Square, One way ANOVA, Two way ANOVA, Regression analysis, Z Score.			
b. The items are: Correlation Coefficient, Odds ratios, Wilcoxon Rank Sum, Fisher s Exact, Mann-Whitney, Kruskal-Wallis ANOVA, Yates correction for Chi Square, McNemar Test, Tukey s HDS, Type of Error, Microsoft Excell, Microsoft Access, SPSS, SAS, Survey Monkey Analysis.			

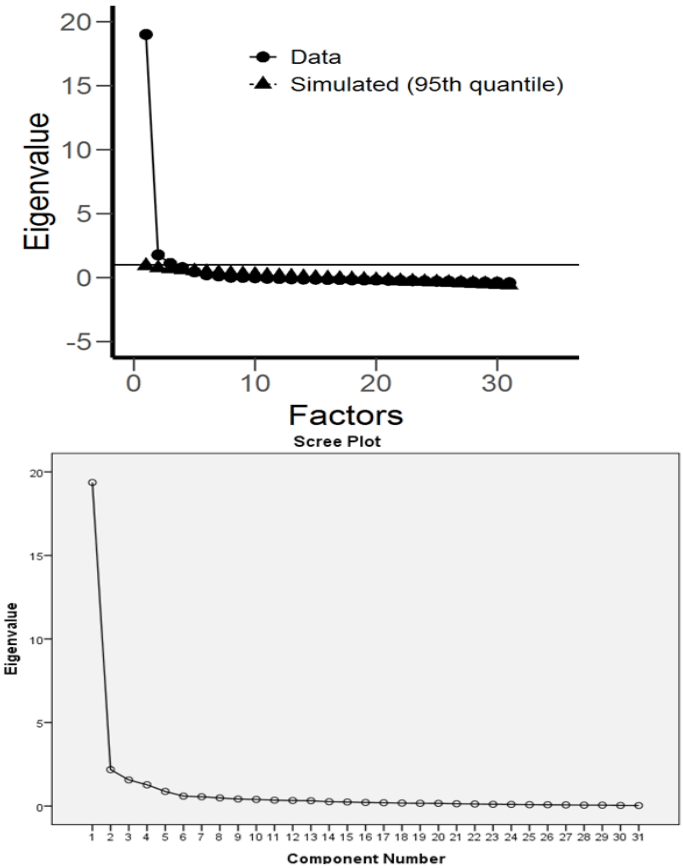

Figure1: Exploratory Factor Analysis Scree Plot

R2 were from (0.450 to 0.911), while factor loading was all the questions >0.69 and it was a range (0.692-1.197) with p <0.001 after removing the 8 questions confirmed with 3 factor loading. In the pathway analysis, each latent factor and observed coloration with >0.7 with p <0.001 as discovered in pathway analysis. The confirmatory factor index was 0.761, Tucker-Lewis Index (TLI) was 0.737, Goodness of fit index (GFI) was 0.844 and Expected cross validation index (ECVI) 9.029. Other results Bentler-Bonett Non-normed Fit Index (NNFI) was 0.737, Bentler-Bonett Normed Fit Index (NFI) was 0.733, Parsimony Normed Fit Index (PNFI) was 0.666, Bollen's Relative Fit Index (RFI) was 0.706, Bollen's Incremental Fit Index (IFI) 0.762, Relative Noncentrality Index (RNI) was 0.761, Root mean square error of approximation (RMSEA) was 0.176 and Standardized root mean square residual (SRMR) was 0.407 (Table 4 and 5).

Collinearity

The correlation coefficients of 23 questions was R2 were (0.943) and RMSE was (0.376) with statistically significant (p<0.001), while the autocorrelation was (2.609e -5) with not statically significant (p=0.951). The majority of 23 question had Enjuone value had close to number 1, while 11 questions had condition index more than 30. All 23 of the questions had the Variance inflation factor (VIF) less than 10 except four questions and had tolerance more than 0.1 except for questions (Table 6).

DISCUSSION

Biostatistical analysis is a crucial part of pharmacy research. The biostatistics sciences were an essential part of the study of Pharm D graduate in the Kingdom of Saudi Arabia. All research pharmacists should have a basic knowledge of biostatistics to prevent any mistakes in the results of the research. As a result, the authors and his colleagues did a study to assess the level of knowledge of basic biostatistics among the pharmacists.

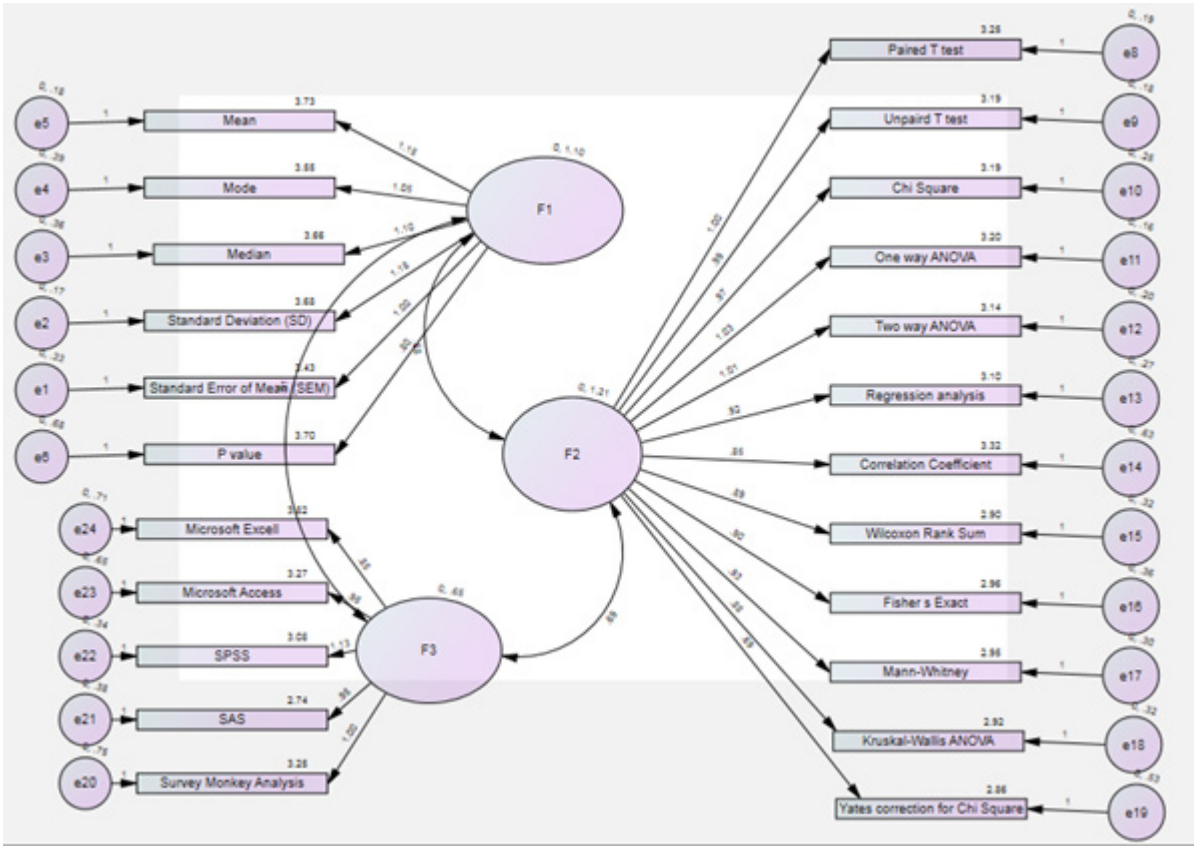

Figure2: confirmatory analysis pathway diagram

Table 3: Exploratory Factor Analysis Validity.

	Exploratory Factor Analysis (EFA)				
	Kaiser-Meyer-Olkin Measure of Sampling Adequacy. KMO and Bartlett's Test			**.966**	
	Bartlett's Test of Sphericity	**Approx. Chi-Square**	**df**	**5222.122**	
			Sig.	**210**	
				< .001	
	Items	**Communalities**	**Rotated Component Matrix[a]**		
		Extraction	**Factor 1**	**Factor 2**	**Factor 3**
Q1	Description analysis	.810	.	0.661	0.44
Q2	Mean	.875	.	0.635	0.447
Q3	Mode	.809	.	0.564	0.437
Q4	Median	.842	.	0.598	.
Q5	Standard Deviation (SD)	.899	0.443	0.745	.
Q6	Standard Error of Mean (SEM)	.824	.	.	0.822
Q7	The nominal, ordinal, continuous variable	.707	.	.	0.745
Q8	*P* value	.764	0.408	.	0.65
Q9	Confidence Interval (CI)	.793	0.731	0.499	.
Q10	Paired T test	.850	0.713	0.5	.
Q11	Unpaird T test	.858	0.649	0.566	.
Q12	Chi Square	.830	0.708	0.513	.
Q13	One way ANOVA	.872	.	.	0.728
Q14	Two way ANOVA	.846	.	.	0.793
Q15	Regression analysis	.826	0.713	.	.
Q16	Z Score	.624	0.43	0.763	.
Q17	Correlation Coefficient	.799	0.806	.	.
Q18	Odds ratios	.772	0.831	.	.
Q19	Wilcoxon Rank Sum	.866	0.473	0.566	.
Q20	Fisher s Exact	.828	0.441	0.765	.
Q21	Mann-Whitney	.826	0.452	0.732	.
Q22	Kruskal-Wallis ANOVA	.849	0.445	0.713	.
Q23	Yates correction for Chi Square	.723	0.458	0.616	0.461
Q24	McNemar Test	.813	0.55	0.588	0.402
Q25	Tukey s HDS	.805	0.556	.	0.401
Q26	Type of Error	.750	.	0.426	0.798
Q27	Microsoft Excel	.578	.	.	0.469
Q28	Microsoft Access	.703	0.542	.	0.435
Q29	SPSS	.688	0.597	.	0.475
Q30	SAS	.683	0.674	.	.
Q31	Survey Monkey Analysis	.669	0.403	.	0.457

Table 4: The Confirmatory Factor Analysis analysis test.

	Confirmatory Factor Analysis (CFA)					
	Chi-square test					
		Baseline model	5899.246	253	***P***	
		Factor model	1577.464	230	< .001	
	Items	**Squared Multiple Correlations**	**Factor loading (F)**	**95% Confidence Interval**		
		R^2		Lower	Upper	*p*
Q1	Mean	0.894	F1 1.197	1.090	1.304	< .001
Q2	Mode	0.746	1.103	0.994	1.213	< .001
Q3	Median	0.784	1.157	1.054	1.259	< .001
Q4	Standard Deviation (SD)	0.911	1.237	1.151	1.323	< .001
Q5	Standard Error of Mean (SEM)	0.762	1.040	0.935	1.145	< .001
Q6	P value	0.450	0.774	0.622	0.926	< .001
Q7	Paired T test	0.849	F2 1.078	0.995	1.161	< .001
Q8	Unpaird T test	0.849	1.067	0.981	1.153	< .001
Q9	Chi Square	0.811	1.050	0.958	1.143	< .001
Q10	One way ANOVA	0.876	1.116	1.037	1.195	< .001
Q11	Two way ANOVA	0.848	1.085	0.998	1.172	< .001
Q12	Regression analysis	0.798	1.010	0.917	1.103	< .001
Q13	Correlation Coefficient	0.569	0.927	0.809	1.045	< .001
Q14	Wilcoxon Rank Sum	0.771	1.002	0.896	1.108	< .001
Q15	Fisher s Exact	0.740	0.984	0.876	1.092	< .001
Q16	Mann-Whitney	0.794	1.036	0.934	1.138	< .001
Q17	Kruskal-Wallis ANOVA	0.764	0.968	0.866	1.070	< .001
Q18	Yates correction for Chi Square	0.545	0.770	0.642	0.897	< .001
Q19	Microsoft Excel	0.412	F3 0.692	0.553	0.831	< .001
Q20	Microsoft Access	0.556	0.826	0.701	0.950	< .001
Q21	SPSS	0.664	0.877	0.779	0.975	< .001
Q22	SAS	0.567	0.741	0.628	0.853	< .001
Q23	Survey Monkey Analysis	0.488	0.812	0.679	0.946	< .001

The study was cross-sectional with a survey that had been distributed to the pharmacist in the Kingdom of Saudi Arabia. The authors did a brief validation of the survey. In the current study, the authors try to evaluate the reliability and validity of the survey. The findings showed a very high reliability of internal consisted of three biostatistical tests either in the pilot responders or completed responders pharmacist and higher than previous medicine residents study.[8] Besides, the question of the survey had a perfect correlation with each other or among the total questions. The validation of the study had been done through factoring Analysis with expiatory or confirmatory Analysis. The findings of EFA show statically significant of using sample size and suggested four components over 31 questions. The confirmatory Analysis hasn't confined the results of 4 components. It changed to 3 factor loading with statistical significance through a regression model, scree plot and pathway analysis after removing the eight questions. The confirmatory analysts reach up to 0.7 to 0.8 with 23 questions in the survey. The current findings showed that the majority of the questions were collinearity not excised with an emphasis on autocorrelations. If the sample sizes increase, the collinearity might disappear. A unique study was first done in the Middle or Gulf area and all Saudi Arabia. The researcher can esteem the survey and allocate with a good number of sample size.

CONCLUSION

The knowledge of biostatistical analysis was used in pharmacy research with the corrected survey had high reliability and validation scale level. Further study with a corrected survey in the future with an adequate sample size is suggested in the Kingdom of Saudi Arabia.

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None.

CONFLICT OF INTEREST

None.

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 In-

Table 5: The validity analysis test.

Index	Value	normal value
Comparative Fit Index (CFI)	0.761	>0.9
Tucker-Lewis Index (TLI)	0.737	>0.9
Bentler-Bonett Non-normed Fit Index (NNFI)	0.737	>0.9
Bentler-Bonett Normed Fit Index (NFI)	0.733	>0.9
Parsimony Normed Fit Index (PNFI)	0.666	>0.9
Bollen's Relative Fit Index (RFI)	0.706	>0.9
Bollen's Incremental Fit Index (IFI)	0.762	>0.9
Relative Noncentrality Index (RNI)	0.761	>0.9
Root mean square error of approximation (RMSEA)	0.176 CI 90% (0.167-0.184) P<0.001	> or = 0.08
Standardized root mean square residual (SRMR)	0.407	> 0.04
Hoelter's critical N (α = .05)	33.084	
Hoelter's critical N (α = .01)	35.064	
Goodness of fit index (GFI)	0.844	>0.9
McDonald fit index (MFI)	0.029	
Expected cross validation index (ECVI)	9.029	

Table 6: The Collinearity analysis test.

	Collinearity							95% CI			
	Eigenvalue	Condition Index	Unstandardized	Standard Error	Standardized	t	p	lower	upper	Tolerance	VIF
Q1	22.056	1.000	0.012	0.067	0.047	0.180	0.857	-0.119	0.143	0.104	9.580
Q2	0.224	9.933	0.018	0.056	0.074	0.332	0.741	-0.091	0.128	0.147	6.814
Q3	0.163	11.635	0.006	0.055	0.023	0.100	0.920	-0.103	0.114	0.142	7.021
Q4	0.098	14.966	-0.038	0.065	-0.155	-0.583	0.561	-0.167	0.091	0.103	9.702
Q5	0.064	18.625	0.072	0.059	0.269	1.222	0.223	-0.044	0.189	0.149	6.691
Q6	0.055	20.024	0.075	0.035	0.272	2.133	0.034	0.006	0.145	0.415	2.412
Q7	0.047	21.665	-0.289	0.088	-1.057	-3.301	0.001	-0.462	-0.116	0.070	14.306
Q8	0.039	23.784	0.110	0.090	0.397	1.219	0.225	-0.068	0.287	0.068	14.618
Q9	0.038	24.118	0.091	0.060	0.332	1.513	0.132	-0.028	0.210	0.149	6.694
Q10	0.032	26.270	-0.080	0.090	-0.298	-0.889	0.375	-0.257	0.097	0.065	15.467
Q11	0.028	28.084	0.107	0.082	0.393	1.310	0.192	-0.054	0.268	0.080	12.449
Q12	0.025	29.841	-0.043	0.057	-0.151	-0.753	0.453	-0.155	0.069	0.179	5.581
Q13	0.020	32.817	0.069	0.052	0.263	1.320	0.189	-0.034	0.171	0.182	5.495
Q14	0.020	33.176	0.001	0.075	0.004	0.016	0.987	-0.148	0.150	0.100	9.958
Q15	0.016	36.950	-0.043	0.065	-0.154	-0.668	0.505	-0.171	0.084	0.136	7.364
Q16	0.016	37.510	0.018	0.069	0.067	0.266	0.790	-0.118	0.155	0.114	8.790
Q17	0.014	39.127	0.017	0.066	0.058	0.254	0.800	-0.113	0.147	0.137	7.287
Q18	0.011	44.518	0.058	0.049	0.189	1.178	0.240	-0.039	0.155	0.281	3.554

Q19	0.009	48.718	0.108	0.035	0.363	3.096	0.002	0.039	0.176	0.457	2.188
Q20	0.009	50.525	0.038	0.039	0.131	0.980	0.329	-0.038	0.114	0.403	2.480
Q21	0.007	56.983	-0.095	0.045	-0.321	-2.126	0.035	-0.184	-0.007	0.317	3.151
Q22	0.005	69.562	0.026	0.047	0.079	0.549	0.584	-0.067	0.119	0.344	2.909
Q23	0.004	72.552	0.064	0.033	0.234	1.945	0.054	-9.805e -4	0.130	0.500	2.001
R	R^2	Adjusted R^2	RMSE	R^2 Change	F Change	df1	df2	p			
0.958	0.953	0.908	0.376	0.908	71.456	32	167	< .001			
ANOVA									**Collinearity** Threshold		
Model	Sum of Squares	df	Mean Square	F	p		Variance inflation factor (VIF)		>10		
Regression	233.294	23	7.425	10.143	< .001		Tolerance		> 0.1		
Residual	23.706	168	0.135	0.141			Condition index (CI)		> 30		
Total	257.000	191					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**								
	2.609e -5 0.0 45	1.994	0.951								

dex; **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.

REFERENCES

1. Alomi YA, Alghamdi SJ, Alattyh RA, *et al.* The evaluation of pharmacy strategic plan in past 2013-2016 and forecasting of new vision 2030 at ministry of health in Saudi Arabia. J Pharm Pract Community Med. 2018;4(2):93-101.
2. Alomi YA, Aldosori N, Alhadab M, *et al.* The outcomes of clinical pharmacist consultation visits at ministry of health hospitals in Saudi Arabia: Medication safety and pharmacy research. J Pharm Pract Community Med. 2017;3(3):168-75.
3. Alomi1 YA, Fallatah AO, Al-Shubaar N, *et al.* The clinical outcomes of pharmacist interventions in total parenteral nutrition services in Riyadh City, Saudi Arabia. Int J Pharm Heal Sci. 2019;2(2):135-40.
4. Alomi YA, Aldosori N, Alhadab M, *et al.* The value of clinical pharmacist consultation visits at ministry of health hospitals in Saudi Arabia: Intravenous admixture services and pharmacy total quality management. J Pharm Pract Community Med. 2017;3(3):161-7.
5. Alomi YA, Aldosori N, Alhadab M, *et al.* Impact of clinical pharmacist consultation visits at ministry of health hospitals in Saudi Arabia: clinical pharmacy services and pharmacy workforce. J Pharm Pract Community Med. 2017;3(3):154-60.
6. Alomi YA, Kurdy L, Aljarad Z, *et al.* Patient satisfaction of pharmaceutical care of primary care centers at ministry of health in Saudi Arabia. J Pharm Pract Community Med. 2016;2(3):79-87.
7. Ferrill MJ, Norton LL, Blalock SJ. Determining the statistical knowledge of pharmacy practitioners: A survey and review of the literature. Am J Pharm Educ. 1999;63(4):371-6.
8. Windish DM, Huot SJ, Green ML. Medicine residents' understanding of the biostatistics and results in the medical literature. J Am Med Assoc. 2007;298(9):1010-22.
9. Al-Zahrani SH, Al-Khail BAA. Resident physician's knowledge and attitudes toward biostatistics and research methods concepts. Saudi Med J. 2015;36(10):1236-40.
10. Polychronopoulou A, Eliades T, Taoufik K, *et al.* Knowledge of European orthodontic postgraduate students on biostatistics. Eur J Orthod. 2011;33(4):434-40.
11. Shetty AC, AlRasheed NM, Albwardi SA. Dental professionals' attitude towards biostatistics. Journal of Dentistry and Oral Hygiene. 2015;7(7):113-8.
12. Alomi YA, Altebainawi A, Alabdullatif A. Biostatistical analysis knowledge of Pharmacy Research in Kingdom of Saudi Arabia. In: ISPOR Europe. Copenhagen, Denmark. 2019;22(S3):S779. Available from: https://www.ispor.org/heor-resources/presentations-database/presentation/euro2019-3118/93718.
13. Boynton PM, Greenhalgh T. Hands-on guide to questionnaire research: Selecting, designing and developing your questionnaire. Br Med J. 2004;328(7451):1312-5.
14. Artino AR, LaRochelle JS, Dezee KJ, *et al.* Developing questionnaires for educational research: AMEE Guide No. 87. Med Teach. 2014;36(6):463-74.
15. Mackenzie SB, Podsakoff PM, Podsakoff NP, *et al.* Construct measurement and validation procedures in MIS and behavioral research: Integrating new and existing techniques. MIS Q. 2011;35(2):293-334.
16. Siny T, Colin FR, Abdullah ST. Avoiding failed spinal anesthesia: "Advik technique" A very rare unusual site of ventilator breathing circuit leakage: Beware. Saudi J Anesth. 2017;11(5):80-9.
17. Jain S, Dubey S. Designing and validation of questionnaire. Int Dent Med J Adv Res. 2016;2(1):1-3.
18. Kimberlin CL, Winterstein AG. Validity and reliability of measurement instruments used in research. Am J Heal Pharm. 2008;65(23):2276-84.
19. Kumar R. Research Methodology a step-by-step guide for beginners. 3rd edition. SAGE Publications Ltd. 2011.
20. Nath S. Best split-half and maximum reliability. IOSR J Res Method Educ. 2013;3(1):1-8.
21. Hervás A, Guàrdia OJ, Peró CM, *et al.* A structural equation model for analysis of factors associated with the choice of engineering degrees in a technical university. Abstr Appl Anal. 2013.
22. Viladrich C, Angulo-Brunet A, Doval E. A journey around alpha and omega to estimate internal consistency reliability. An Psicol. 2017;33(3):755-82.
23. Deng L, Chan W. Testing the difference between reliability coefficients alpha and omega. Educ Psychol Meas. 2017;77(2):185-203.
24. Dormann CF, Elith J, Bacher S, *et al.* Collinearity: A review of methods to deal with it and a simulation study evaluating their performance. Ecography. 2013;36(1):27-46.