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Evaluation of Patient Satisfaction of Pharmaceutical Services by Variable Selection Using Factor Analysis

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ABSTRACT

Objective: Pharmacists' professional roles to include provision of information and pharmaceutical care services have obtained in a focus on collaborative pharmacist-patient professional relationships. We analyzed correlation of various social factors with what is about the contribution of the pharmacist as patient educator in pharmacy. The need for pharmacist services is discussed, as communicate effectively with patients that are quality of the scientific evidence to support their efficacy and reduce toxicity. Pharmacist appropriate interaction with patients taking the wrong medication can largely solve. The use of statistical methods in many areas of applied healthcare research has grown considerably in recent years.

Methods: In this paper, have been used a multivariate analysis with latent variables for the estimation of the evaluation of patient satisfaction of pharmaceutical services using correlation of social factors. Also, in this paper for the factor analysis (FA) approach, have been used the principal component analysis (PCA) jointly to compute the coefficients of variables and dimension reduction. Results: The results have shown the four components were significant and with our results were agreement.

Conclusion: Exploratory factor analysis was used to examine the covariance structure of the data reported by approximately 500 members. Further research is needed to develop and test instruments based on theoretical frameworks, to test satisfaction go to pharmacies and to choose a model for data determined in satisfaction over time.

INTRODUCTION

Pharmacist as a member of the health care team has been in contact directly with health people [1]. It is now widely accepted that the quality of pharmacist–patient communication is fundamental for effective health care [2,3]. A key part of this development has been the concept of the extended role, which emphasizes the contribution that pharmacists can make in four key areas: the management of prescribed medicines; the management of chronic conditions; the management of common ailments; and the promotion and support of healthy lifestyles [4,5]. Pharmacists' roles have evolved historically from a focus on medication dispensing and compounding to provision of patient information, education, and care services [6-8]. The question that arises is whether the right interpersonal communication between the pharmacist and the patient really exist? Does the pharmacist have the good performance from view of public? How can be demonstrated right understanding of the pharmacist's role as the main body to prevent the misuse of drugs and medication information? What social factors involved in understanding the role of the pharmacist? The study purpose was to investigate views patients of selected in the evaluation pharmacist-patient professional relationship in responding to these questions. Researchers have declared pharmacist-patient communication not only important for improving appropriate medication use, but also for achieving desired patient outcomes [9,10]. In some of the studies, The medication reviews included factors such as patient interviews by a pharmacist to evaluate medication use and adherence [11-15], patient use of health and human services, [11], a quality of life survey [7,12,16], and any patient reported problems with medications [12,17,18]. Our analysis is declared in the context of a shift in pharmacists' roles from product to patient orientation as well as enhanced pharmacists' roles via drug utilization review for all medical aid patients. In the future, training programs should be appropriate to the functional skills of pharmacists to develop interpersonal competence. Usually, selection of the important variables for medical research is one of the most important model selection problems in statistical applications. To this end, a variety of variable selection approaches have been suggested [19]. We proposed the multistep generalized unbiased interaction detection and estimation with adaptive forward selection algorithm. Scientists has been shown that for regression problem, this method outperform some well-known variable selection algorithm like least absolute shrinkage and selection operator (LASSO). [20], studied variable selection for the semi-parametric regression model of longitudinal data when some covariates are measured with errors. They have proposed a bias- corrected variable selection procedure based on the combination of the quadratic inference function and shrinkage estimation [21]. Latent variable selection, in linear and nonlinear models has been used [22,23]. Also, a set of new methods to select variables in the correlated data are proposed [24]. Robustness and efficiency are jointly two methods as optimal property for variable selection method [25]. Also, a review of some older methods of latent variable selection problem for multivariate generalized linear models can be found [26]. However, one of the most well-known multivariate methods in the measurement of latent variables is the factor analyses which have become more popular in recent years, especially in the high-dimensional case. The most promising aspect of this approach is that it can simultaneously do variable selection and model fitting which is due consideration of stochastic errors in the variable selection process. Different types of penalties have been introduced in the context of variable selection [27-31]. On the other hand, sometimes data belongs to some unobserved categories or they are heterogeneous. Finite mixture models can be useful in such situations. Finite mixture of regression models have been studied by authors like Khalili and Chen [32]. Recently Eskandari and Ormoz [33] have been studied the variable selection in a finite mixture of semi-parametric regression models and finite mixture of generalized semi-parametric models. In those works, a one dimensional nonparametric function has been used in the model and it has been multiplied by a multivariate covariate. In this paper, we will consider a multivariate factor analysis for data reduction. We used unobserved random variables P_j as a nonparametric function of our model. In the previous works, local linear smoothers have been used, while here we will consider multivariate factor analysis.

METHODS

Factor analysis in multivariate data sciences, investigates help to whether particular covariates explain any of the heterogeneity of treatment effects between studies. Meta-analysis is sometimes used to relate the results of the trials to published averages of patient characteristics within trials, for example average age or proportion of women to men. Such analyses are often difficult to interpret [34,35]. A common situation is that there are few trials in a meta-analysis but many possible patient characteristics that might explain heterogeneity. Multiple analyses using each of these characteristics may be done. Some analyses may be undertaken simply because of observed patterns in the results of the trials, which suggest that a certain covariate may be important. In this situation, we use the factor analysis. Factor analysis is a statistical method used to describe variability among observed, correlated variables in terms of a potentially lower number of unobserved variables called factors.

Theory of Factor Analysis

Suppose we have a set of P observable random variables, $q_1, q_2, ..., q_p$ with means $\mu_1, \mu_2, ..., \mu_p$.

Suppose for some unknown constants l_{ij} and k unobserved random variables P_j, where $i \in 1,...,P$ and $j \in 1,...,k$, where $k \prec P$, we have $q_i - \mu_i = l_{i1}P_1 + ... + l_k P_k + \varepsilon_i$. Here, ε_i is independently distributed error terms with zero mean and finite variance, which may not be the same for all i Let $Var(\varepsilon_i) = \psi_i$, so that we have $Cov(\varepsilon) = Diag(\psi_1, ..., \psi_p) = \Psi$ and $E(\varepsilon) = 0$. In matrix terms, we have $Q - \mu = LP + \varepsilon$. If we have n observations, then we will have the dimensions $Q_{p\times n}, L_{p\times k}$, and $P_{k\times n}$. Each column of x and P denote values for one particular observation, and matrix L does not vary across observations. Also we will impose the following assumptions on P. P and ε are independent. $E(P) = 0,\ Cov(P) = I$ (Make sure that the factors are uncorrelated). Any solution of the above set of equations following the constraints for P is defined as the factors, and L as the loading matrix.

Suppose, $Cov(Q - \mu) = \Sigma$. Then note that from the conditions just imposed on P, we have $Cov(Q - \mu) = Cov(LP + \varepsilon)$, or $\Sigma = LCov(P)L' + Cov(\varepsilon)$ or $\Sigma = LL' + \Psi$.

Note that for any orthogonal matrix L, if we set $L = LP$ and $P = Q'P$, the criteria for being factors and factor loadings still hold. Hence a set of factors and factor loadings is identical only up to orthogonal transformation.

In other words, it is possible that variations in three or four observed variables mainly reflect the variations in fewer unobserved variables. Factor analysis searches for such joint variations in response to unobserved latent variables. The observed variables are modeled as linear combinations of the potential factors, plus "error" terms. The information gained about the interdependencies between observed variables can be used later to reduce the set of variables in a dataset. Computationally this technique is equivalent to low rank approximation of the matrix of observed variables. Factor analysis originated in psychometrics, and is used in behavioral sciences, social sciences, marketing, product management, operations research, and other applied sciences that deal with large quantities of data. Such multiple or post hoc analyses lead to a high probability of false positive conclusions. It is necessary to limit the number of covariates proposed for investigation again to protect against false positive conclusions [35]. There are several advantages in our research, including the minimum system error, correlation between measurable factors and auxiliary factors effects on response explanatory variable. These are through a regression logistic model and using Meta regression will be investigated. In this theory is shown the best model has the maximum power test that in result a researcher can use with rely on it for evaluation research proposed hypothesis. The development of the increasing appreciation of the benefits of using statistical methods in healthcare research, also in particular in relation to evaluation such methods to both statisticians and healthcare researchers will undoubtedly increase over the next years [36]. Medical statisticians will in the future be expected to have a more detailed knowledge of the fundamental principles of Factor Analysis inference, whilst applied healthcare researchers will frequently analyses their own data using other approaches, mirroring the current situation as regards classical statistics. According to the studies for multinomial case, we applied a Factor Analysis method in a term of a potentially lower number of unobserved variables.

Suppose a similar study is performed in m different centers each involving a comparison among age, gender, marital status and education which four outcomes labeled questionnaire. The questionnaires were distributed in five zones and five pharmacies and in each region, hundred volunteers participated. So, the response variable is a multinomial one for four factors of age, gender, marital status and education.

A Real Example: Active Population of Islamic Republic of Iran Between years 2012-2014

We presented an analysis on the active population of Islamic Republic of Iran. The data set used includes information for 500 patients who were referred to the pharmacy in the city in years 2012 to 2014. Evaluation form to collect information in 5 different areas was distributed between patients at random by our pharmacists. In this study, simple random sampling (SRS) and statistical analysis was performed using the Factor Analysis models, and the estimation of parameters different social factors of between people via Cumulative Percent approach it was shown. Our statistical population was composed of all members of society who were selected from between them 500 patients. Measurement tool in the evaluation form were consists of four questions about personal details and 14 personality tests the 500 people who were referred to the pharmacy in the city. Before completing the evaluation form to anyone on the overall objective of the study was described. Also, consent was obtained from each individual to participate in the research project. In this evaluation, 254 women and 246 men were studied. Social factors such as age, gender, marital status and level of education were coded. The social factors divided to four groups: age (=) gender (=), marital status (=) and level of education (=). Thus, we encountered to multinomial population. Part of the questions were relevant to amount of the understanding of the role of the pharmacist that to deals the knowledge and satisfaction rate of the public of the pharmacists in the form of how use of prescription drugs. These questions included q1, q4, q9, q13. Some other questions was related to satisfaction rate of the public of informing medical and pharmacy services in the form of O.T.C. drugs in different pharmacy. These questions included q2, q3, q6, q7. And finally, another part of the questions deals to rate self-medication by people. These questions included q5, q8, q11, q12 and q14. In each of the three main questions, social factors are also investigated. A total of 14 questions to assess public awareness and appreciation of pharmacists and pharmaceutical delivery system were determined. The questionnaire the data as a random sample of 500 cases of patients aged 16 years and greater than was collected by 5 pharmacists. The data set from 5 different areas that we have considered them as the centers of study.

RESULTS

Data Analysis

We aim to establish causal relationships between variables representing social factors. We want to interpret and analyses the data in terms of the encoded causal relations. The chosen effectiveness parameters in our analysis were the coefficients q1, q4, q9 and q13. The results have shown that the response to the survey about amount of the understanding of the role of the pharmacist that to deals the knowledge and satisfaction rate of the public of the pharmacists in the form of how uses of prescription drugs are relevant. In question q1, effectiveness factors was included F1=0.14 and F2=0.71. These numbers represent the amount of inform the public of the pharmacist role is. In comparing the first and second factors we described the public know the role of the pharmacist. In question q4, effectiveness factors was included F1= -0.69 and F2= -0.93. These factors showed that in spite of know of role of pharmacist, public haven't desire to ask his medical questions from pharmacist. In question q9, effectiveness factors was included F1= -0.14 and F2=0.73. These factors indicate that public about comment pharmacists about the use of medication, are relatively satisfied. In question q9, effectiveness factors was included F1=0.74 and F2= -0.09.

These factors suggest that public about pharmacists recommendation about the use of medication, are relative attention. Part of other parameters effectiveness were related to satisfaction rate of the public of informing medical and pharmacy services in the form of O.T.C. drugs in different pharmacy. These questions were included q2, q3, q6, q7. In question q2, effectiveness factor was included F2=0.90. In question q3, effectiveness factors was included F1= -0.64 and F2= -0.19. These questions show that the public of receiving their drugs especially O.T.C at the pharmacy are satisfied. Questions 6 and 7 to deals of knowing people from O.T.C. drugs or non-prescription drugs. In question q6, effectiveness factors was included F1=0.73 and F2= -0.05. In question q7, effectiveness factors was included F1=0.48 and F2=-0.39. Another part of the questions deals to rate self-medication by people. These questions were included q5, q8, q11, q12 and q14. In question q5, effectiveness factor was included F2=0.54. In question q8, effectiveness factors were included F1=0.11 and F2=0.56. In question q11, effectiveness factor was included F2=0.63. In question q12, effectiveness factor was included F2=0.61. In question q14, effectiveness factor was included F2=0.38. The rate of effectiveness on society concerning use of self-medication was achieved about 60%. For example, in the study population who had at least partial knowledge of the role of the pharmacist in the selection process, there are prescription medications 72.2% respondents are that in addition to the knowledge to asking of the pharmacist and unwillingness of use non-prescription drugs also pharmacists comment are totally believe. Pharmacists' role in the selection of drugs, more effective and influential in their recovery processes. Another example in the population of study is related to individuals that at least partially of the delivery status of nonprescription drugs in the pharmacy have knowledge and satisfaction. 34.1% of respondents obtained their drugs from pharmacies and as well supply of non-prescription drugs with their satisfaction. Final example in the population of study is related to the respondents' tendency to use arbitrary drugs. 70% of respondents despite knowledge of important role of pharmacist in medicinal counseling tend to consume have on arbitrary. According to the above findings can be pointed to weaknesses in popular culture. In fact, creating a culture in preparation and proper use of drugs is one of the most important pillars of preventing misuse use of drugs that in this research is studied. The estimate of probabilities in the multinomial distribution of q8, q10 and q11 are presented in **Table 3.**

Table 1. Cumulative function and Eigen values.

Component	P1	P2	P3	P4
Eigen Value	2.07	1.75	1.42	1.38
Cumulative percent	31.3%	26.4%	21.5%	20.8%
According to the table above Eigenvalue and Cumulative percent (P1) component is higher than other component. The first component (P1) is function of q8, q10 and q11. Ratio of variance for first component is 31.3%. The second component (P2) is function of q5, q6 and q7. Also, ratio of variance for the second component is 26.4%. Ratio of variance for third component is 21.5% and also for fourth component is 20.8%.				

We also computed the estimate of probabilities for multinomial distribution of q5, q6 and q7. Results presented in **Table 5.** In the principal components approach, should choose highest eigenvalues. In this study, they are four components. The first component (P1) is function of q8, q10 and q11. Ratio of variance for first component is 31.3%. The second component (P2) is function of q5, q6 and q7. Also, ratio of variance for the second component is 26.4%. The other results are shown in **Table 1.** Also, the maximum correlation is between first component and q11. Therefore, in the **Table 2.** we have presented likelihood ratio test for each cell in q11**.**

Table 2. Likelihood ratio tests.

N of Valid Cases (q11)	Statistics	Value	d. f.	Asymp. Sig.
221	Likelihood Ratio	6.706	6	0.3490
190	Likelihood Ratio	6.896	6	0.331
106	Likelihood Ratio	4.824	6	0.5670
According to the table Likelihood ratio test for each cell in q11 is shown. The maximum correlation is between first component and q11.				

Table 3. q8*q10*q11 cross-tabulation.

Q11	Q8	Q10		
		1	2	3
1	1	14%	15.4%	6.3%
	2	7.7%	10.4%	5.4%
	3	16.7%	19%	4.5%
2	1	6.8%	7.4%	4.2%
	2	6.3%	8.4%	4.2%
	3	22.6%	24.7%	8.9%
3	1	3.8%	9.4%	2.8%
	2	10.4%	18.9%	3.8%
	3	15.1%	27.4%	5.7%
In the table above the estimate of probabilities in the multinomial distribution of q8, q10 and q11 is shown. Displaying a distribution of cases by their values on three variables is known in the table.				

Table 4. q5*q6*q7 cross-tabulation.

Q7	Q5	Q6		
		1	2	3
1	1	3.9%	3%	23.7%
	2	3.9%	1.8%	33%
	3	3%	2.7%	25.1%
2	1	0.01%	0.1%	22.6%
	2	0.1%	3.8%	34%
	3	0.1%	0.1%	36.9%
3	1	0.1%	0.1%	28%
	2	4%	4%	24%
	3	0.1%	0.1%	40%

It shows that Cross-Tabulation of questions (q5-q6 and q7). In the table above the estimate of probabilities in the multinomial distribution of q5, q6 and q7 is shown.

Table 5. q5*q6*q7 cross-tabulation.

Q7	Q5	Q6		
		1	2	3
1	1	3.9%	3%	23.7%
	2	3.9%	1.8%	33%
	3	3%	2.7%	25.1%
2	1	0.01%	0.1%	22.6%
	2	0.1%	3.8%	34%
	3	0.1%	0.1%	36.9%
3	1	0.1%	0.1%	28%
	2	4%	4%	24%
	3	0.1%	0.1%	40%

It shows that Cross-Tabulation of questions (q5-q6 and q7). In the table above the estimate of probabilities in the multinomial distribution of q5, q6 and q7 is shown.

Table 6. Interaction distributed based on q1 and q4 Interaction distributed based on q5, q6 and q7 Interaction distributed based on q8, q10 and q11.

1	What is the role of the pharmacist in your life?	q1
2	Do you want your prescription drug information ask to pharmacist?	q4
3	Are you taking prescribed medications without a prescription?	q5
4	Do you know the word the word O.T.C. drugs?	q6
5	Do you know some medicines are purchased at pharmacies without a prescription?	q7
6	Do you want doctor to prescribe your favorite drugs?	q8
7	How much do you believe the use of herbal medicines?	q10
8	Do you prefer purchase supplements without a prescription form pharmacies?	q11

In the table Interaction distributed based on q1 and q4 also q5, q6 and q7 and also q8, q10 and q11 is appeared. The description of each component are also been explained.

DISCUSSION

Pharmacists are usually an easily available source of primary care because of the widespread distribution of pharmacies [37]. By accessing a pharmacist as an expert adviser the patient can be prepared for a health care about the use of health care supplies including drugs that do not require a prescription. The pharmacist also has the expertise in professional network to refer a patient to doctor if there is a need for diagnosis and treatment with medicines that do require a prescription or other treatments. In this article, using the principal component approach and cumulative presents for variances of factors, factor analysis was developed to the model, which is one of the most flexible methods in multivariate analysis [38]. In this research, exploratory factor analysis was used to examine the covariance structure of the data reported by approximately 500 members during 2012-2014. Further research is needed to investigate the relationship between factor analytic results and survey structure, as well as to assess the relationship between factor scores and key exposure variables.

REFERENCES

1. Yuki I. Role of the Clinical Pharmacist in Pharmaceutical Care. Japanese J Pharm Health Care Sci. 2005;31:113-120.
2. Dickson D. Barriers to communication: Interaction for practice in community nursing, Basingstoke, MacMillan. 1998.

3. Hargie O and Morrow N. How to communicate effectively with patients: NPA 97 pharmacy business and practice, London, At link 1997.

4. Beales J and Austin Z. The pursuit of legitimacy and professionalism: the evolution of pharmacy in Ontario (Canada). Pharm Historian. 2006;1:222-227.

5. Mara K. Communication and conflict resolution in emergency medicine. Emerg Med Clin North America. 1999;17:451-459.

6. Lipton HL, et al. Pharmacists as Agents of Change for Rational Drug Therapy. Int J Technol Assess Health Care. 1995;11:485-508.

7. Cipolle RJ, et al. Pharmaceutical Care Practice: The Clinician's Guide (2ndedn), New York, NY: McGraw-Hill Companies, Inc. 2004.

8. Hanlon JT, et al. Can clinical pharmacy services have a positive impact on drug-related problems and health outcomes in community-based older adults? Am J Geriat Pharmacother. 2004;1:3-13.

9. De Young M. Research on the effects of pharmacist-patient communication in institutions and ambulatory care sites. Am J Health Syst Pharm. 1996;53:1277-1291.

10. Bupendra Sh and Betty Ch. Conceptualizing and measuring pharmacist patient communication: a review of published studies. Res Soc Admin Pharm. 2006;2:153-185.

11. Krska J, et al. Pharmacist-led medication review in patients over 65: a randomized, controlled trial in primary care. Age Ageing. 2001;30:205-211.

12. Jameson JP and VanNoord GR. Pharmacotherapy consultation on polypharmacy patients in ambulatory care. Ann Pharmacotherapy. 2001;35:835-840.

13. Cooper NJ, et al. Comprehensive decision analytical modeling in economic evaluation: A Bayesian approach. Health Economic. 2004;13:203-226.

14. Christensen D, et al. A Pharmacy management intervention for optimizing drug therapy for nursing home patients. Am J Geriatric Pharmacotherapy. 2004;4:248-256.

15. Doucette WR, et al. Comprehensive medication therapy management: identifying and resolving drug-related issues in a community pharmacy. Clin Ther. 2005;27:1104-1111.

16. Hanlon JT, et al. A randomized, controlled trial of a clinical pharmacist intervention to improve inappropriate prescribing in elderly outpatients with polypharmacy. Am J Med 1996;100:428-437.

17. Farrell VM, et al. Clinic for identifying and addressing polypharmacy. Am J Health Syst Pharm. 2003;60:1830-1835.

18. Furniss L, et al. Effects of a pharmacist's medication review in nursing homes. Br J Psychiatry. 2000;176:563-567.

19. Chang Y. Variable Selection via Regression Trees in the Presence of Irrelevant Variables. Commun Stat-Simul C. 2012;42:1702-1726.

20. Tian R and Xue Li. Variable selection for semiparametric erosion variables regression model with longitudinal data. Sci Res. 2013;3:52-59.

21. Eklund M and Zwanzig S. SimSel: a new simulation method for variable selection. J Statist Comput Simulat. 2012;82:515-527.

22. Wu LC, et al. Variable selection in joint location and scale models of the skew-normal distribution. J Stat Comput Sim. 2012;83:1266-1278.

23. Zeng L and Xie J. Group variable selection for data with dependent structures. J Stat Comput Sim. 2012;82:95-106.

24. Bradic J, et al. Penalized composite quasi-likelihood for ultrahigh dimensional variable selection. J R Statist Soc B 2011;73:225-349.

25. Li R and Liang H. Variable selection in semipararmetric regression modeling. Ann Statist. 2008;36: 261-286.

26. George EI. The variable selection problem. J Amer Statist Assoc. 2000;95:1204-1208.

27. Tibshirani R. Regression shrinkage and selection via the lasso. J Royal Statist Soc Series B. 1996;58:267-288.

28. Fan J and Li R. Variable selection via nonconcave penalized likelihood and its oracle properties.J Amer Statist Assoc. 2001;96:1348-1360.

29. Fan J and Li R. Variable selection for cox,s proportional hazards model and frailly model. Ann Statist. 2002;30:74-99.

30. Fan J and Li R. New estimation and model selection procedures for semiparametric modeling in longitudinal data analysis. J Amer Statist Assoc. 2004;99:710-723.

31. Fan J and Peng H. Nonconcave penalized likelihood with a diverging number of parameters.Amer Statist. 2014;22:928-961.

32. Khalili A and Chen J. Variable selection in finite mixture of regression models. J Amer Statist Assoc. 2007;102:1025-1028.

33. Eskandari F and Ormoz E. Variable selection in finite mixture of semi-parametric regression models.Commun in Stat-Theory and Methods. 2016;45:695-711.

34. Greenwood CMT, et al. Statistical issues in a metaregression analysis of randomized trials: impact on the dietary sodium intake and blood pressure relationship. Biometrics 1999;55:630-636.

35. Daniels MJ and Hughes MD. Meta-analysis for the evaluation of potential surrogate Markers. Stat Med. 1997;16:1965-1982.

36. Spiegelhalter DJ, et al. Bayesian Approaches to Clinical Trials and Health-care Evaluation (2ndedn), Chichester, John Wiley and Sons Limited, UK. 2004.

37. Van Grootheest K, et al. Pharmacists' role in reporting adverse drug reactions in an international perspective. Pharmacoepidemiol Drug Saf. 2004;13: 457-464.

38. Breslow N. Biostatistics and Bayes. Stat Sci. 1990;5:269-284.