

Psychometric Assessment of the PPDG: Utilizing Cronbach's Alpha as a Means of Reliability

Lisa R. Marr-Lyon, Ph.D., M.Ed.¹; Gireesh V. Gupchup, Ph.D., F.A.Ph.A.²; and Joe R. Anderson, Pharm. D.¹

¹University of New Mexico College of Pharmacy, Albuquerque, NM; and ²Southern Illinois University Edwardsville School of Pharmacy, Edwardsville, IL

Key words: pharmacy practice, enhancing measurement understanding, directive guidance

Abstract

Introduction: Since the development of the 10 item Purdue Pharmacist Directive Guidance (PPDG) Scale several studies of the psychometric properties of the PPDG have been conducted. Although Cronbach's alpha was calculated as a means of internal consistency reliability, a demonstration of the mean centering of the individual items from the instrument were not explored. *Objectives:* This study focused on investigating the mean stabilization of items within the PPDG as they pertain to Cronbach's reliability coefficient calculation.

Methods: Using item analysis procedures in SPSS, the mean stability of items within the general factor of directive guidance and subscales of instruction and feedback and goal setting were examined for the PPDG.

Results:

Mean stability scores for entire PPDG scale and the subscales of instruction and feedback and goal setting were strong. Also, corrected item-total correlations and Cronbach's alphas following item deletion were good for the overall PPDG scale and the subscales.

Conclusions: The results provide evidence to enhance understanding of the psychometric stability of the PPDG scale and its subscales.

Introduction

Operational definitions of reliability analyses stem from the base conceptualization of results that are consistent, stable, conventional and precise (1,2,3,4). The standard error of measurement, or range of error in an individual's score, is of paramount importance when examining individuals' scores on assessment instruments. Four common types of reliability when testing for psychometric properties of instruments include: test-retest, alternate forms, inter-scorer/inter-rater reliability and split-half procedures (3,5). More precisely defined, test-retest reliability is attained by correlating scores from instrument administrations at two points in time. (1,6). Using parallel forms of an instrument and measuring a characteristic or trait multiple times alternate forms reliability is assessed. (2,5). The similarity, or correlation, between scores from the parallel instruments is the reliability statistic. Inter-scorer/inter-rater reliability methods encompass professional judgment between scorers of instruments or clinical conditions (1). The kappa coefficient is used to define the strength of association among rater scores (2,5). Finally, split-half reliability procedures include administering a test at one point in time, splitting items (often odd and even numbered questions) in half, and correlating the two components. As such, the effects of time are removed from administration procedures and a coefficient of internal consistency is attained (1,2).

In previous works, researchers explored the psychometric properties of the Purdue Pharmacist Directive Guidance Scale (PPDG) (7,8,9). Anderson, Marr-Lyon and Gupchup used

principal axis factor analysis whereby two rotation techniques were used for construct validation purposes—varimax and promax rotations. A robust factor structure emerged from the principal axis with promax rotation technique. Using a promax rotation, the reliabilities of the instrument were rotated resulting in two sub-scales of: instruction and feedback and goal setting (7). In tandem, the authors also published a commentary encapsulating the split-half and parallel forms of the instrument. Statistical analyses were conducted using R and SPSS computer programs. Using R, Revelle's Beta was .84; using SPSS, the pearman-Brown coefficient of .86 and Gutman's Lambda of .86 were calculated. To further validate strong psychometric findings, the authors also examined the general saturation of the instrument using R software package (8). In 2012, the authors published psychometric findings whereby a Schmid-Leiman transformation was attained. In other words, a general saturation factor of directive guidance and two subscales of instruction and feedback and goal setting emerged. McDonald's Omega and Cronbach's alpha were robust (9).

These previous psychometric findings, specifically factor analysis procedures, were conducted to examine construct validity of the instrument, and various methods of assessing reliability of the instrument were utilized. Although Cronbach's alpha was calculated as a means of internal consistency reliability, a demonstration of the mean centering of the individual items from the instrument were not explored or presented. Therefore, a primary purpose of this recent investigation is to examine, more thoroughly,

Cronbach's alpha for the overall measure of directive guidance as well as the sub-scales of instruction and feedback and goal setting. Cronbach's alpha, as is noted in the psychometric literature, can be conceptualized as the mean of all possible split-halves (10,11,12). With that in mind, we investigated the mean stabilization of items within the PPDG as they pertain to Cronbach's reliability coefficient calculation.

Methods

A detailed description of the data collection procedures are described elsewhere (7). Briefly, patients enrolled in the study were identified through chart review procedures. Data collection occurred at community pharmacies in both rural and metropolitan areas of New Mexico. Criteria for inclusion in the study were that individuals: 1) had either Type 1 or Type 2 diabetes, 2) were prescribed diabetic medications and/or in possession of diabetic supplies, 3) were over the age of 18, 4) could read and write English, and 5) provide written-informed consent. Ninety-nine individuals, forty percent male, comprised the final participant pool. Ethnic breakdown of the sample was primarily of Hispanic and Anglo descent with forty-six percent identifying as Hispanic, 47% as Anglo and 7.2 % as either American Indian, African American or 'other' ethnicities. Approval for the study was granted from the University of New Mexico Human Research Review Committee (HRRC).

The PPDG is a ten-item measure that enhances the understanding of pharmaceutical care delivery in pharmacy practice by assessing the general factor of directive guidance (13). In essence, on a Likert-type scale of 0-4, patients rate the level of perceived instruction and feedback and goal setting received from their pharmacist during the past 3 months. Specifically, the Likert-type scale assess patients' perceptions as follows: 0=never, 1=rarely, 2=sometimes, 3=often 4=very often. The 10 item scores are summed with a higher score indicating greater reported directive guidance; a maximum score of 40 can be attained. The sub-scales can also be computed separately from the overall directive guidance measure.

Using SPSS, version 18, (<http://spssmanual.com/index.html>) reliability analyses were conducted for Cronbach's alpha. Specifically item analysis procedures were conducted in order to attain the mean stabilization score for each item within the PPDG. Secondly, corrected item-total correlations were attained for the individual PPDG questions. Third, Cronbach's alpha was calculated for the scale pending item deletion of the general factor of directive guidance and sub-scales of instruction and feedback and goal setting.

Results

The results are presented in Tables 1, 2, and 3. For the overall scale of directive guidance, the mean score responses following item deletion are stable with averages ranging from 17.10 to 18.61. Corrected item-total correlations are strong with values from .73 to .87. Cronbach's alpha values following item deletion are greater than .94 indicating strong internal consistency for the overall measure pending item deletion. The overall Cronbach's score of .95 for the directive guidance measure is a robust mean split-half comparison, grand mean=1.97, $F=31.26$, $p<.001$ (Table 1). Mean stability scores for the subscale of instruction, items one through six of the measure, are strong with values ranging from 11.57 to 12.15. Corrected item-total correlations are respectable with values greater than or equal to .78. Cronbach's alphas following item deletion for the Instruction sub-scale are greater than .90. An over-all sub-scale alpha of .95, grand mean=2.36, $F=9.17$, $p<.001$ is a strong mean split-half calculation (Table 2). Questions seven through ten of the measure comprise the Feedback and Goal-setting sub-scale. Mean stability scores are respectable with values ranging from 4.05 to 4.55. Corrected item-total correlations are strong with values greater than .75. Cronbach's alpha values, pending item deletion, are respectable with values greater than .87. An overall feedback and goal-setting internal consistency of .92, grand mean=1.42, $F=9.90$, $p<.001$ is a robust mean split-half coefficient, (Table 3).

Discussion/Conclusion

Known as the mean of all possible split-halves, Cronbach's alpha is a strong measure of internal consistency reliability (1,10,11,14,). More recent reliability procedures such as Revelle's Beta (1979) and McDonald's omega (1999) capture facets of internal consistency reliability (general factor saturation); and we have demonstrated the utility of these coefficients as they pertain to the psychometric testing of the PPDG instrument (7,8,9). The purpose of this paper was to demonstrate the vitality of mean stability of the PPDG using item analysis procedures in SPSS. A critique of split-half reliability procedures is that when a test is 'split-in-half' fewer participant responses are available to stabilize around a mean (1,15,16).

Researchers conducting the current investigation revealed consistent mean values within the sub-scales of Instruction and Feedback and Goal Setting and the general factor of Directive Guidance. In general, the greater the number of items on a measure, the greater the reliability; the larger number of items can compensate for greater variability in items responses. To that end, the mean stability demonstrated from item responses on a measure with ten or less questions is viewed as robust (1,2,12). As such, the practical importance of Cronbach's alpha as a measure of

internal consistency reliability for the PPDG is enhanced. A larger participant sample would increase the power of validating results from previous studies examining the psychometric properties of the instrument. In tandem, use of the scale among other diverse populations would broaden the scope of psychometric testing and enhance cultural comparisons of the general factor of directive guidance.

References

1. Groth-Marnat G. *Handbook of psychological assessment*. New York, NY: John Wiley & Sons, Inc. , 1990.
2. Pedhauzer EJ, Schmelkin L. *Measurement, design & analysis: an integrated approach*. New Jersey: Lawrence Erlbaum Associates, 1991.
3. Revelle W. Hierarchical cluster analysis and the internal structure of tests. *Multivar Beh Res*, 1979, 14, 57-74.
4. Zinbarg RE, Revelle W, Yovel I, Li W. Cronbach's alpha, Revelle's Beta, and McDonald's Omega: their relations with each other and two alternative conceptualizations of reliability. *Psy*, 2005: 70(1), 123-133.
5. DeVellis RF. *Scale development theory and applications*. Thousand Oakes: Sage Publications, 2003.
6. Shavelson RJ. *Statistical reasoning for the social sciences*, 2nd edition. Needham Heights, MA: Allyn and Bacon, 1988.
7. Anderson JR, Marr-Lyon LR, Gupchup GV. Psychometric properties of the Purdue Pharmacist Directive Guidance (PPDG) Scale in a sample of diabetes patients in the Southwestern United States. *Psychol Rep* 2010, 107: 61-67.
8. Marr-Lyon LR, Anderson JR, Gupchup, GV. Split-half and parallel reliabilities of the Purdue Pharmacist Directive Guidance Scale. *Psychol Rep* 2010, 107, 276.
9. Marr-Lyon, LR, Gupchup GV, Anderson JR. An evaluation of the psychometric properties of the Purdue Pharmacist Directive Guidance Scale using SPSS and R software packages. *Res Soc Ad Pharm*, 8 (2012), 166-171.
10. [Personality-project.org/r/book/Chapter 7.pdf](http://personality-project.org/r/book/Chapter%207.pdf)
11. www.sagepub.com/.../4869_Kline_Kline_Chapter_5_Classical_Test
12. Nunnally JC, Bernstein J. *Psychometric Theory*. New York, NY: McGraw-Hill, 1994.
13. Gupchup GV, Wolfgang AP, Thomas J III. Development of a scale to measure directive guidance by pharmacists. *Ann Pharmacother* 1996, 30: 1369-1375.
14. Zinbarg RE, Revelle W, Yovel I, Wen L. Cronbach's alpha, Revelle's beta, and McDonald's Omega: their relations with each other and two alternative conceptualizations of reliability. *Psychometrika* 2005; 1: 123-133.
15. Grimm LG, Yarnold PR. *Reading and understanding multivariate statistics*. Washington, DC: American Psychological Association, 1997.
16. Domino G, Domino ML. *Psychological Testing: An Introduction*. New York, NY: Guilford Press, 1979.

Table 1.
Internal Consistency Reliability Properties for Questions 1-10 of the Purdue Pharmacist Directive Guidance Scale (Item-Total Statistics)

	Scale Mean if Item Deleted	Corrected Item-total Correlation	Cronbach's Alpha if Item Deleted
Instruction			
1. Your pharmacist told you what to expect from your medications.	17.24	.83	.94
2. Your pharmacist gave you some information on how to take your medication.	17.10	.80	.95
3. Your pharmacist said things that made it easier to understand how to take your medication.	17.22	.86	.95
4. Your pharmacist made it clear what is expected of you with regard to your medication.	17.34	.87	.95
5. Your pharmacist taught you how to take your medication.	17.67	.80	.95
6. Your pharmacist gave you some information to help you understand your diabetes better.	17.69	.81	.95
Feedback and Goal Setting			
7. Your pharmacist assisted you in setting a goal for yourself with respect to taking your medication correctly.	18.09	.79	.95
8. Your pharmacist checked back with you to see whether you followed advice you were given.	18.61	.73	.95
9. Your pharmacist gave you feedback on how you were doing without saying it was good or bad.	18.53	.74	.95
10. Your pharmacist told you who you should contact in case you need assistance with your medication.	18.10	.76	.95

(F=31.26, p<0.001)

Note: Responses to each item were obtained on a Likert-type scale assess as follows:

0=never, 1=rarely, 2=sometimes, 3=often 4=very often

Table 2.
Internal Consistency Reliability Properties for Questions 1-6 (Instruction Subscale)
of the Purdue Pharmacist Directive Guidance Scale (Item-Total Statistics)

	Scale Mean if Item Deleted	Corrected Item-total Correlation	Cronbach's Alpha if Item Deleted
Instruction			
1. Your pharmacist told you what to expect from your medications.	11.69	.88	.94
2. Your pharmacist gave you some information on how to take your medication.	11.57	.86	.95
3. Your pharmacist said things that made it easier to understand how to take your medication.	11.68	.90	.94
4. Your pharmacist made it clear what is expected of you with regard to your medication.	11.79	.93	.94
5. Your pharmacist taught you how to take your medication.	12.12	.81	.95
6. Your pharmacist gave you some information to help you understand your diabetes better.	12.15	.78	.96

(F=9.17, p<0.001)

Note: Responses to each item were obtained on a Likert-type scale assess as follows:
 0=never, 1=rarely, 2=sometimes, 3=often 4=very often

Table 3.
Internal Consistency Reliability Properties for Questions 7-10 (Feedback and Goal setting Subscale)
of the Purdue Pharmacist Directive Guidance Scale (Item-Total Statistics)

	Scale Mean if Item Deleted	Corrected Item-total Correlation	Cronbach's Alpha if Item Deleted
Feedback and Goal Setting			
7. Your pharmacist assisted you in setting a goal for yourself with respect to taking your medication correctly.	4.05	.76	.91
8. Your pharmacist checked back with you to see whether you followed advice you were given.	4.55	.88	.88
9. Your pharmacist gave you feedback on how you were doing without saying it was good or bad.	4.48	.87	.88
10. Your pharmacist told you who you should contact in case you need assistance with your medication.	4.05	.77	.91

(F=9.90, p<0.001)

Note: Responses to each item were obtained on a Likert-type scale assess as follows:
 0=never, 1=rarely, 2=sometimes, 3=often 4=very often