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Variations of a Commonly Used Medication Adherence Assessment Scale: Do Changes in Scale Change Structure Results?

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Abstract

Background: Medication nonadherence is a major barrier to both patients and health care professionals when trying to manage medical conditions. An appropriate self-report adherence tool would be helpful in determining a patient's medication adherence. **Objectives:** To observe variations in scale scores based on modifications to an Original Adherence Scale, with the hypothesis that making modifications to the Original Adherence Scale will create variations in the percentage of adherent patients. **Methods:** This cross-sectional study utilized mailed surveys to people identified in a prescription claims administrative dataset who had a pharmacy claim for at least 2 antihypertensive medications. One thousand people were equally divided and randomly placed in 1 of 4 groups: Original Adherence Scale Group, Time Reference Scale Group, 4-Point Likert-Type Scale Group, Multiple Medication Scales Group. Each scale underwent assessment of internal reliability using Cronbach's α. Changes made to the Original 4-item scale included altering the time reference period from 3 months to 7 days, changing response options from Yes/No to a Likert-type scale, and incorporating multiple scales so that the respondent may report on up to 4 different options. **Results:** There were 437 surveys completed appropriately, yielding a 46.4% response rate. The overall scale scores indicating perfect adherence was 51.8% for the 4-Point Likert-Type Scale Group, 66.5% for the Multiple Medication Scales Group, 68.8% for the Original Adherence Scale Group, and 78.9% for the Time Reference Scale Group. **Conclusion:** When there are more selection options, a change in time reference, or more medications reported, the amount of adherent patients varied.

Keywords

adherence, clinical decision making, communication, diabetes, disease management, compliance

Introduction

Medication nonadherence is a major barrier to both patients and health care professionals in managing medical conditions. Nonadherence is the extent to which a patient does not follow the advice of health care professionals.[1] Adherence can neither be easily predicted nor assumed, as it is a very individualized parameter unique to each patient. Nonadherence can lead to an increased number and length of hospitalizations, as well as higher total costs of care.[2]

Medication adherence is measured through several different ways. Self-report is an important method that is commonly used. Self-report can include directly asking the patient to recount their medication-taking behavior or be conducted as questionnaires and surveys. As such, the development of the instrument or scale must be based on sound psychometric principles and informed by research in survey methodology. Survey research can take a quantitative approach that allows researchers to quantify their subjects in terms of predetermined characteristics, with the aim of identifying frequencies of events, or to describe the association between variables.

Questions, often referred to as items, must be derived from the research question of a study. Items should have strong face validity, be sensible and readable, as well as inclusive of the concept being measured. Likewise, the response options must be appropriate for the concept being measured. There are several attributes of a question and its response options that, depending on how they are operationalized, may lead a respondent to answer in various ways. For example, if asking a respondent how many times in a specified period they missed a medication, one would expect that responses might vary depending on the time frame that the respondent is asked to think about. If the question uses a 1-week time frame, there may be fewer responses admitting to missing doses than if there were a 3-month referenced time frame, allowing for more time of the questionable event. Reducing the time frame

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enhances the validity of reporting the past, as long as the time frame is adequate to observe the event.[3] A shorter time allows a respondent to more readily recall an event as opposed to having to remember a behavior over a great length of time.

Response options are important in that they inform the research goal, while matching the intention of the question. If measuring whether an event occurred or not, a Yes/No dichotomous response option is appropriate. However, if there is the probability that the event may have occurred more than once in the specified reference period or if it is important to know the frequency or magnitude of the event occurring during that time frame, it may be more appropriate to use a scale with multiple, ordered response options, such as the Likert-type scale. When measuring a behavior such as medication adherence, it may be more applicable to gain a sense of the frequency of missing doses rather than a dichotomized Yes/No response indicating missing at least 1 dose in a predetermined period. Forced-choice questions, such as Agree or Disagree dichotomous responses, may create an acquiescence response set.[4] With this, respondents have the tendency to agree irrespective of the content of the item survey questions.[4] A potential complication with using dichotomous Agree/Disagree response options for studies of medication-taking behavior is that a respondent is forced into a nonadherent category based on missing 1 dose during a referenced period, which would also place the respondent in the same category as someone who missed multiple doses during the same period. Both respondents would be considered "nonadherent." The use of a Likert-type scale may be more appropriate in the situation where the frequency of missed doses is important to obtain.

Another attribute of many self-report adherence measures is the fact that the surveyor forces a respondent to think of all their medications that they take on a regular basis and determine the adherence for all therapies combined. The percentage of adults in the United States who takes 3 or more prescriptions per day was 20.6% between 2009 and 2012.[5] The relevance of having the respondent think through all of their individual medication regimens when determining whether they missed at least 1 dose of any one of the regimens may be difficult. Research has demonstrated that an exercise such as this may lead to the respondent discounting missing one therapy because of their varied beliefs and attitudes of the importance of one therapy versus another. In a study of patients who recently experienced an episode of acute coronary syndrome, nonadherence to 4 classes of medications commonly prescribed varied by drug class.[6] One way to reduce the potential for error in responses is to ask the patient about each medication in their overall regimen.

Although there is not a current "gold standard" for self-reported measure of medication adherence, one of the most commonly used self-reported assessments is a 4-item scale originally published by Morisky et al.[7] The Original 4-item scale uses a dichotomous response of Yes or No for each of the 4 items in the scale. Specific attributes of this scale include the following. First, the scale uses a 3-month time reference period in which the respondent is asked to recall missing a dose of medication during that time. Second, the responses to the 4 questions are dichotomized as Yes/No. Third, the respondent must think of all the medications they take to decide whether they missed a dose or took too much of their medication. In addition, the 4-item scale may suffer from low validity and sensitivity.[8]

The goal of this study was to determine whether changes to several attributes of the Original 4-item scale would create variation in the number of patients who would be classified as adherent or nonadherent. Changes made to the Original 4-item scale included altering the time reference period from 3 months to 7 days, changing response options from Yes/No to a Likert-type scale, and incorporating multiple scales so that the respondent may report on up to 4 different medications in their medication regimen. The hypothesis was that making modifications to the Original 4-item scale would lead to variations in the percentage of adherent patients.

Methodology

Study Design

This cross-sectional study used a survey mailed to people prescribed at least 1 antihypertensive medication for chronic use.

The prescription drug plan of the university performed the data-pull for the study. The first step was to identify 1000 patients who met the inclusion criteria. The first 1000 patients starting with claims for antihypertensive medications submitted in January 2009 were identified in the data-pull. The researchers then randomly assigned each patient to 1 of the 4 study groups. An address was obtained for each potential study subject. Once identified, potential study subjects were recruited using a mailed survey packet.

Patients were informed of the nature of the study in a brief introduction letter. The initial page contained detailed information about the project and language related to informed consent. Patients willing to participate in the study completed the questionnaire and returned it in a preaddressed, pre-stamped envelope. A reminder postcard was sent 1 week after the initial survey was sent. A second mailing of the study survey occurred to all nonrespondents 3 weeks after the initial mailing. The investigators kept track of responses and removed respondent names and addresses from the mailing list to avoid sending packets to subjects who already completed the survey. The investigators also identified all survey packets returned to the

sender, in response of erroneous addresses, or in the case of telephone calls or emails received from potential subjects alerting the investigators they did not wish to participate. The Institutional Human Subjects Committee (IRB) of the affiliated medical school approved the study.

The questionnaire consisted of several sections. The first section consisted of the 4-item scale in its various versions depending on which group the patient was assigned to. The Original Adherence Scale questions are the following:

> In the past 3 months, have you at times been careless about taking your medicine?
> During the last 3 months, have you every forgotten to take your medicine?
> During the last 3 months, have you every stopped taking your medicine because you felt better?
> During the last 3 months, have you ever stopped taking your medicine because you felt worse?

Responses to each question are Yes/No. Changes were made to specific aspects of the 4-item scale for this study.

The first change was in the reference time period that the questionnaire uses. The original scale uses a 3-month reference period. The alteration was to reduce the time to a 7-day reference period. This is the Time Reference Scale Group. The second change was to increase the number of response options from Yes/No to a 4-point Likert-type scale ranging from "All the time" to "Never" as response options. The original scale derived a score by assigning a value of "1" to the "Yes" response and "0" to the "No" response. The Likert-type scale assigned score values as follows: "all of the time" = 1, "most of the time" = 2, "some of the time" = 3, and "none of the time" = 4. The higher the sum, the more adherent the patient appears. This group is called the 4-Point Likert-Type Scale Group.

The last change was in the specific medications the patient is asked to think about when answering the scaled questions. The Original Adherence Scale simply asks about medicines. It does not distinguish between specific medications. The revised version asked the respondent to consider up to 4 specific antihypertensive medications and to respond for each of the antihypertensive medications they were taking. This group's survey consisted of 4 identical 4-item scales that used the dichotomized response option of Yes/No for each question in the scale. This is the Multiple Medication Scales Group. For each patient, they could complete up to 4 adherence scales for their antihypertensive medications. Each individual 4-item scale was scored by summing the responses. A "No" response was assigned a value of 0, while a "Yes" response was assigned a value of 1. An overall 4-scale adherence score was then calculated by taking the mean of the completed individual 4-item scales that each respondent completed. The range of overall 4-scale adherence scores was from 0 to 4, with 0 equaling perfect adherence. In summary, charges were the following:

> *Group 1* (Original Adherence Scale) was the original scale, with 4 items that utilized a 3-month time reference, was not focused on specific medicines, and used a Yes/No response option for all questions.
> *Group 2* (Time Reference Scale) had 4 items, using a 7-day time reference, was not focused on specific medicines, and used Yes/No response options.
> *Group 3* (4-Point Likert-Type Scale) had 4 items, used a 3-month time reference, focused on all medications, and used a 4-point Likert-type scale with 1 = all the time, 2= most of the time, 3 = some of the time, and 4 = never.
> *Group 4* (Multiple Medication Scales) had 4 items, used a 3-month time reference, focused the patient on specific medications by having 4 sets of adherence scales that were specific for each of up to 4 antihypertensive medications the patient was currently taking, and used Yes/No response options.

Study Population

Subjects were recruited from those enrolled in the university's employee/dependent and retiree prescription drug plan. All subjects were aged 18 years or older and had at least 2 pharmacy claims for medication used for the treatment of hypertension in the 6-month period prior to the survey. Patients taking antihypertensive medications were chosen for several reasons. First, for consistency in patient type, a single, albeit large classification of medications, was chosen. Second, as a group, cardiovascular medications, and particularly antihypertensive medication, is one of the most commonly prescribed classes of medication, which lead to the largest potential subject sample for this study. Third, in the language of the survey, it helped focus the respondent to think of a particular medication or group of medicines they take when completing the survey. It was understood that antihypertensive medications might be used to treat conditions other than hypertension. We included in the instructions to the patient that the medication used should be for the treatment of high blood pressure or heart-related conditions. We acknowledged that the diagnosis for the use of these medications was not available in the database in which we identified potential subjects.

Statistical Analysis

Descriptive statistics included calculating the mean with standard deviation for continuous variables and frequency with percentage for categorical variables. The same statistics were used to detail the individual 4-item scale item

Table 1. Demographics.

Measure	Female (%)	Age (Mean ± SD)
Original Adherence Scale	70	62.5 (8.9)
Time Reference Scale	68	65.8 (11.6)
4-Point Likert-Type Scale	67	66.6 (13.6)
Multiple Medication Scales	49	67.0 (12.1)

and scale scores for each of the 4 groups. Internal consistency for each of the 4-item scale versions was conducted using Cronbach's α. An α of greater than 0.7 was considered high enough to be considered psychometrically acceptable.[9]

Results

Response Rates

Of the 1000 surveys mailed, 59 surveys were returned as undeliverable. Of the remaining 941 surveys, 437 were returned, for an overall response rate of 46.4%. Response rates varied by survey: 46.4% for the Original Adherence Scale Group; 50.2% for the Time Reference Scale Group; 48.3% for the 4-Point Likert-Type Scale Group; and 39.0% for the Multiple Medication Scales Group.

Demographics

Most of the groups contained more female subjects (67% to 70%), except the Multiple Medication Scales Group where there was only 49% (see Table 1). The mean age for all 4 groups ranged from 62 and 67 years.

Scale Scores

The mean scale sum, frequency, and percentage for all 4 surveys are detailed in Table 2. For the Original Adherence Scale, Time Reference Scale, and Multiple Medication Scales groups, perfect adherence was score of 0. With this, subjects stated "No" to all of the adherence questions. For the 4-Point Likert-Type Scale, "Never" was coded with a score of 4. Therefore, a score of 16 indicated perfect adherence, or never practicing the listed behaviors. The overall scale scores indicating perfect adherence ranged from 51.8% for the 4-Point Likert-Type Scale Group, 66.5% for the Multiple Medication Scales Group, 68.8% for the Original Adherence Scale Group, and 78.9% for the Time Reference Scale Group. Further analysis of the individual scales of the Multiple Medication Scales scores shows that the first and third scales were similar in the percentage indicating perfect adherence, while the second scale completed had a lower percentage of perfect adherence scores, and the last scale completed, all respondents reported perfect adherence.

Table 2. Summary of Mean Scale Sum, Frequency, and Percentage of Responses for Each Survey.

Scale Score	Percent of Patients With Scale Score	
Original Adherence Scale		
0	68.8	Perfect adherence
1	23.2	
2	4.5	
3	1.8	
4	1.8	
Time Reference Scale		
0	78.9	Perfect adherence
1	13.6	
2	5.9	
3	1.7	
4	0	
Likert-Type Scale Adherence (sum of responses)		
11	2.6	
12	5.3	
13	4.4	
14	7.0	
15	28.9	
16	51.8	Perfect adherence
Multiple Medication Scales (mean of up to 4 scale scores)		
0	66.3	Perfect adherence
0.25	1.1	
0.5	5.4	
0.67	3.3	
1.0	19.6	
1.5	1.1	
2.0	3.3	

Analysis of Individual Scale Questions

Analysis of the individual scale questions is presented in Table 3. This analysis was conducted to identify which of the individual scale items was endorsed most often and to compare the variation in pattern of responses of individual items between scales. The individual scale item with the highest endorsement of nonadherence was the "Forgetfulness" item. It varied from 3% (Multiple Medication Scales) to 37.7% (Likert-type scale) of responses. The Original Adherence Scale had values similar to the Multiple Medication Scales. The Time Reference Scale (7 day) item had 16.1% of respondents indicating forgetfulness as a reason in comparison to the Original or the Likert-type response groups, as well as most of the Multiple Medication Scales groups.

The question about "Carelessness" being a reason for nonadherence varied from 0% (Multiple Medication Scales) to 15.8% of responses for the Likert-type scale. Stopping medication because subjects "Felt Better" was rarely endorsed, with variation from 0% to 6.1% of responses, apart from the Likert-type scale. Over 18% of respondents

Table 3. Percentage of Endorsement of Nonadherent Response to Each Question on Each Scale.

Individual Scale Question	Original Adherence (%)	4-Point Likert-Type (%) (Response Choice of 3 or Less)	Time Reference to 7 Day (%)	Multiple Medication Individual Scales (%)
Carelessness	9.8	15.8	12.7	1.8, 2.2, 7.1, 0
Forgetfulness	29.5	37.7	16.1	25.0, 27.3, 14.3, 0
Felt better	2.7	6.1	0.8	1.1, 5.5, 3.6, 0
Felt worse	2.7	18.4	0.8	1.1, 1.8, 3.6, 0

in the Likert-Type Scale Group indicated that they stopped taking medicine when they "Felt Worse." This was much higher than the percentage of endorsements for the feeling worse question of the other scales. Overall, when the individual items of each scale were examined across the groups, the Likert-Type Scale Group had the highest endorsement of any item indicating nonadherence.

Internal Reliability: Cronbach's α

Using Cronbach's α, the internal reliability was calculated for each of the 4 survey scales. The Original Adherence Scale had an α of 0.63, the Time Reference (7-day reference period) Scale was 0.52, and the Likert-Type Scale score was 0.55. Last, Cronbach's α scores were calculated for each of the Multiple Medication surveys. The Cronbach's α was 0.21 for the first survey, 0.08 for the second survey, and 0.51 for the third survey. The fourth survey had 0 variance items, with all respondents reporting perfect adherence.

Discussion

It was confirmed that modifications to the Original Adherence Scale provided variation in percentage of respondents that were categorized as being adherent to their antihypertensive medications. This has potential implications for the research that has been conducted using this 4-item scale, in that it has undergone modification by researchers since it was originally published in 1986.

Specific Changes

Response Options. When there are more response options using the Likert-type scale, the percentage of patients classified as adherent decreased. Giving a greater range of response options that describe the frequency of taking medication, beyond a dichotomous "Yes/No" response, may have allowed the respondent more freedom to describe their true medication-taking behavior. Missing a dose now and again may be classified as still being adherent in the minds of many patients; so that when answering a Yes/No response, some subjects may be electing the response indicating being adherent. When the respondent is given a greater range of options to choose from, they may be more likely to find a response option that they perceive to match their behavior. Survey methodology research has demonstrated that the reliability and validity of a question increases when the number of response alternatives increases. The optimum number of response options was found to be between 4 and 7. With fewer than 4 alternatives, the reliability and validity decrease, and from 7 alternatives onward psychometric properties of the scale scarcely increase further.[10,11] Another reason to support using multiple response options is that the item responsiveness improves when using a Multi-Item Scale.[12]

Time Reference. It was found that the percentage of patients categorized as adherent was higher in the Time Reference Scale Group, which used a 7-day time reference period, compared with the percentage of patients considered adherent in the Original Adherence Scale Group, which used a 3-month reference period. In other words, patients reported fewer nonadherent episodes during the 7-day period as opposed to the 3-month period. This is possibly due to the fact that a patient may miss more doses over a longer period of time. Using a greater time reference period of the Original Adherence Scale provides a longer time period in which to capture nonadherent events while still being a time frame in which the patient can recall the event(s) with some accuracy and confidence.

Multiple Medication Assessment. A number of interesting findings came from the analysis of this group. First, 66.3% of respondents had an overall scale score that indicated perfect adherence. This percentage of respondents indicating perfect adherence is similar to the 68.8% with a perfect adherence score on the Original Adherence Scale. Therefore, using the multiple scale approach yielded a similar finding as the Original Adherence Scale. Another interesting observation was that the first and third scales had similar scores, while the second scale completed had a lower percentage of perfect adherence scores. This may have occurred because when presented with multiple options, people initially think of the adherent medication, while the second medication documented is often the one that they may take less often. Fascinatingly, this group had the lowest response rate of all 4 groups. This may be due to the

greater respondent burden that was required to complete up to 4 scales with 16 questions, while the other 3 surveys consisted of only 4 questions. Respondent burden is well recognized as a factor associated with response rates and completeness of surveys, as well as being associated with respondent bias such as satisficing.[13,14] Last, it was observed that the fourth scale had the fewest number of respondents and all respondents had perfect adherence. Respondents may have saved the best for last (so to speak) or were experiencing fatigue as they worked through the previous scales. Another possible explanation is that respondents were doing what is known as satisficing, where answering any answer is better than leaving it blank, coupled with acquiescent bias, where by this point the respondent wanted to appear as adherent as possible.[4] Further research, perhaps using cognitive interviewing, may be able to discern the reasons for the variation across the 4 different scales.

Internal Consistency. The Cronbach's α scores were all below the acceptable level of 0.7, meaning that this particular scale may not have the stability to obtain true assessments of adherent behavior. This is a similar finding to other studies.[15]

Overall Discussion

When examining the distribution of responses for each scale, change provided additional information, which potentially supports the use of the Likert-type scale, rather than the dichotomized Yes/No format. The 4-Point Likert-Type Scale Group had the greatest variation in endorsement of responses that would indicate nonadherence to medication. Using a shorter time reference period led to fewer patients being classified as nonadherent compared with the Original Adherence Scale. The Multiple Medication Scale approach provided a similar proportion of patients classified as nonadherent as the Original Adherence Scale Group. Variation can also be seen with Cronbach's α. The different numbers showed that adherence varies when changes are made to a questionnaire.

Study Limitations

Researchers acknowledge potential limitations in this study. The data collected in this study cannot be generalized to other populations and conditions. This investigation only targeted individuals over the age of 18 enrolled in a specific university's employee/dependent and retiree prescription drug plan taking antihypertensive medication. We did not analyze the effects of differences in subject characteristics on the variation in responses due to the fact that we had limited data on the subjects. Additionally, educational information on the patients was not collected. Literacy and education are 2 variables that could have influenced the results. If patients were not able to comprehend the directions or surveys, results could have been produced with error. However, the purpose of this study was not to measure literacy or education. The purpose of this study was to observe whether changes in several aspects of a commonly used adherence survey would create differences in the adherence score.

Conclusion

Changes in various aspects of a self-reported medication adherence scale lead to variations in the number and percentage of patients categorized as adherent. Making changes to an original scale may lead to scale scores and results that vary from those of the original scale. Researchers and clinicians must realize this fact when incorporating existing scales into research or clinical uses.

Declaration of Conflicting Interests

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References

1. Campbell RJ Jr. Adherence to medication. *N Engl J Med*. 2005;353:1972-1974. doi:10.1056/NEJM200511033531819
2. Touchette DR, Shapiro NL. Medication compliance, adherence, and persistence: current status of behavioral and educational interventions to improve outcomes. *J Manage Care Pharm*. 2008;14(6 suppl D):S2-S10.
3. Converse JM, Presser S. *Survey Questions: Handcrafting the Standardized Questionnaire*. Beverly Hills, CA: Sage; 1986.
4. Streiner DL, Norman GR. *Health Measurement Scales: A Practical Guide to Their Development and Use*. 2nd ed. Oxford, NY: Oxford University Press; 1995.
5. US National Center for Health Statistics. *Health, United States, 2015: With Special Feature on Racial and Ethnic Health Disparities*. Hyattsville, MD: US National Center for Health Statistics; 2016.
6. Sud A, Kline-Rogers EM, Eagle KA, et al. Adherence to medications by patients after acute coronary syndromes. *Ann Pharmacother*. 2005;39:1792-1797. doi:10.1345/aph.1G249
7. Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of a self-reported measure of medication adherence. *Med Care*. 1986;24:67-74. doi:10.1097/00005650-198601000-00007
8. Nunnally JC, Bernstein IH. *Psychometric Theory*. 3rd ed. New York, NY: McGraw-Hill; 1994.
9. Lozano LM, García-Cueto E, Muñiz J. Effect of the number of response categories on the reliability and validity of rating scales. *Methodology*. 2008;4:73-79. doi:10.1027/1614-2241.4.2.73

10. Comrey AL. Factor-analytic methods of scale development in personality and clinical psychology. *J Consult Clin Psychol*. 1988;56:754-761. doi:10.1037/0022-006X.56.5.754
11. Kirshner B, Guyatt G. A methodological framework for assessing health indices. *J Chronic Dis*. 1985;38:27-36. doi:10.1016/0021-9681(85)90005-0
12. Galesic M, Bosnjak M. Effects of questionnaire length on participation and indicators of response quality in a web survey. *Public Opin Q*. 2009;73:349-360. doi:10.1093/poq/nfp031
13. Bradburn N. Respondent burden. Paper presented at: Second Biennial Conference on Health Survey Research Methods; May 4-6, 1977; Williamsburg, VA.
14. Nunnally JC. *Psychometric Theory*. 2nd ed. New York, NY: McGraw-Hill; 1978.
15. Svarstad BL, Chewning BA, Sleath BL, Claesson C. The Brief Medication Questionnaire: a tool for screening patient adherence and barriers to adherence. *Patient Educ Couns*. 1999;37:113-124. doi:10.1016/S0738-3991(98)00107-4