

Examining the Factor Structure of the Revised Illness Perception Questionnaires (IPQ-R) among Underserved Type II Diabetic Patients

Xueying (Carol) Li, MS, Health Integrity LLC, Baltimore, MD

Amy McQueen, PhD, Washington University School of Medicine, St. Louis, MO

Anjali D. Deshpande, PhD, Washington University School of Medicine, St. Louis, MO

ABSTRACT

Illness representations are patients' beliefs and expectations about an illness or somatic symptom. The most frequently used measure of illness representations is the Revised Illness Perception Questionnaire (IPQ-R) and it has been widely utilized to study perceptions of various chronic conditions, find predictors associated with perceptions of an illness, and to change misperceptions through intervention.

Since this instrument was developed using European-origin populations and much of the research using the IPQ-R has been conducted in European Countries^{3,4,9,14,24}. Some of the items in the IPQ-R might need to be adapted for different populations as the items' explanations or conceptualizations and effectiveness may vary^{1,15}. Our research was the first study to examine the factor structure of the IPQ-R for Type II diabetes in a US sample of underserved, mostly African American, patients diagnosed with Type II diabetes. Confirmatory Factor Analysis (CFA) was conducted through the use of SAS® PROC CALIS to assess model fit for the seven hypothesized subscales, then good fitting subscales were examined in a single model. CFA did not confirm the hypothesized factor structure, but after dropping eight poor performing items, a five-factor correlated model (illness coherence, timeline cyclical, personal control, treatment control, and consequences) fit the data well.

INTRODUCTION

Illness representations are central to Leventhal's self-regulation theory²⁰ which comprise five domains: identity (disease symptoms and names), timeline (disease duration-acute or chronic), consequences (expected outcomes such as severity, disability, impact on life functions), cure/control (whether the disease is perceived as preventable, curable or controllable), and cause (internal or external). Leventhal's self-regulation model proposes that individuals form representations of illness or health threats in response to concrete and abstract sources of information available to them^{21,27}. These sources of information can include personal experience, contact with friends and family, contact with health professionals, and exposure to the media or social environment²⁰. Understanding illness representations is particularly valuable because it identifies targets for interventions designed to restructure disease-related beliefs, which then would lead to more favorable health behaviors and disease outcomes.

The most frequently used measure of illness representations, the Illness Perception Questionnaire (IPQ), was developed to quantitatively assess five content domains of cognitive illness representations²⁰. This instrument was subsequently revised (IPQ-R) to include two additional dimensions: illness coherence and emotional representations. Illness coherence describes the person's understanding of the illness. Emotional representation reflects the extent to which the person's illness affects their mood, such as feelings of depression or anxiety.

Type II diabetes is one of the major causes of premature illness and death in the US. According to the National Diabetes Fact Sheet (2011), diabetes affects 25.8 million people, or 8.3% of the US population. Given their impact on health behaviors and health outcomes, it is crucial to assess the cognitive and emotional representations of Type II Diabetes among diagnosed individuals. Common misperceptions then can be targeted for intervention.

Although the IPQ-R is commonly used to assess the relationship between illness perceptions and outcomes, this instrument was developed using European-origin populations and much of the research using the IPQ-R has been conducted in European countries^{3,4,9,14,24}; therefore, some of the items in the IPQ-R might need to be adapted for different populations as the items' explanations or conceptualizations and effectiveness may vary^{1,15}. Few studies in the US have used the IPQ-R for diabetes^{6,13,25}. Although these US samples have involved participants from minority populations, none of the studies conducted factor analytic evaluations of hypothesized scales.

Across diseases, studies have reported differences in the best fitting factor structure of the IPQ-R, which may be due to the different analysis methods used. The most frequently used methods for evaluating the instrument's measurement properties are confirmatory factor analysis (CFA), exploratory factor analysis (EFA), and principle component analysis (PCA). EFA methods are used when hypotheses of the factor structure cannot be supported a priori. CFA is considered the superior method to test the construct validity of IPQ-R because it allows the investigator to test hypothesized factorial structures of each construct and their inter-relations, as well as consider several indices of good model fit¹⁷. However, very few evaluations of the IPQ-R have used CFA.

Our research objective was to examine the factor structure of the IPQ-R for Type II diabetes in a US sample of underserved, mostly African American, patients diagnosed with Type II diabetes. Although we hypothesized the

same factor structure as the original IPQ-R validation paper by Moss-Morris et al.²³, we allowed for modifications to our CFA models as needed to establish good fit to our sample's data. Such measurement evaluation is important and encouraged, even by the IPQ-R developers, because of expected differences across illnesses and research settings²³. Reliable and valid instruments are necessary to appropriately characterize and compare differences in illness perceptions between groups of individuals, and assess changes over time in response to intervention

METHOD

Participants' age, gender, race/ethnicity, education level, income, and insurance status were collected with standard self-report measures⁷. The Diabetes IPQ-R is comprised of three parts: A) The identity scale which assesses beliefs about whether 20 symptoms are related to diabetes (1=yes/0=no); B) The causal beliefs scale which assesses respondent's beliefs about 20 potential causes of diabetes (1=strongly disagree, 2=disagree, 3=neither disagree nor agree, 4=agree, 5=strongly agree); and C) The 7 illness representations dimensions rated on the same Likert-type response scale (1=strongly disagree, 2=disagree, 3=neither disagree nor agree, 4=agree, 5=strongly agree): consequences (6 items), timeline acute/chronic (6 items), timeline cyclical (4 items), illness coherence (5 items), personal control (6 items), treatment control (5 items) and emotional representation (6 items). Each of the seven multi-item scales contained at least one reverse-worded item that was reverse-scored prior to all analyses.

DATA PREPARATION

The 38 items from the seven domains were renamed v1 through v38 for simplicity prior to building a CFA model and the seven reverse-worded items were reverse-scored using an ARRAY.

```
data ipq_r;
set original;
array coh dia_coher_1-dia_coher_5 dia_cyc_1-dia_cyc_4 dia_persctrl_1-dia_persctrl_6
      dia_trtctrl_1-dia_trtctrl_5 dia_conseq_1-dia_conseq_6 dia_emot_1-dia_emot_6
      dia_acuchr_1-dia_acuchr_6;
array var v1-v38;
do over coh;
var=coh;
array group v1-v38;
if group=6 then group=.;
end;
array reverse v5 v13 v15 v16 v20 v23 v31;
do over reverse;
if reverse=1 then reverse=5;
else if reverse=2 then reverse=4;
else if reverse=3 then reverse=3;
else if reverse=4 then reverse=2;
else if reverse=5 then reverse=1;
end;
run;
```

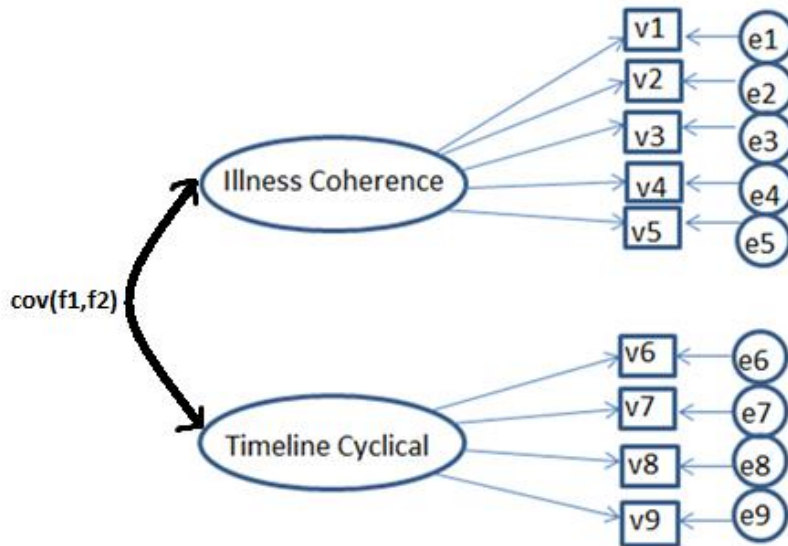
DATA ANALYSIS

Confirmatory Factor Analysis (CFA)

CFA was used to investigate the factor structure of each of the seven subscales, and all CFA models were fitted using SAS/STAT® version 9.3. Preliminary analyses assessed univariate normality using skewness and kurtosis values for each item. Multivariate normality was also assessed by including the KURTOSIS option in the SAS® PROC CALIS procedure to compute Mardia's coefficient¹⁹. Items in each subscale were indicated to load only on their hypothesized factor. Post-hoc modifications to improve model fit were considered when there was practical or theoretical support, such as the inclusion of error covariances and removal of poor-performing items or subscales. Subscales were tested individually, then individual subscales with good fit were tested in a multi-factor model. All factors were allowed to correlate. Multiple fit indices including comparative fit index (CFI) and Root Mean Square Error of Approximation (RMSEA) and its associated 90% confidence interval were used to assess overall model fit.

CFI values between 0.90-0.95 or above suggest adequate to good fit^{16,17} and RMSEA values <0.6 suggest good model fit¹⁷.

Figure 1. Example of the CFA model structure for the domain of Illness Coherence and Timeline Cyclical



The following is the code for the CFA model of the first two domains: Illness coherence & Timeline cyclical, where v1 through v9 represent the 5 items in the domain of illness coherence and 4 items in the domain of timeline cyclical. cov(f1,f2) indicates the covariance between these two latent factors. The option method=fiml specifies the full information maximum likelihood (FIML) estimation method in order to use all variables information.

```
proc calis cov res mod s data=ipq_r final_data method=fiml;
lineqs
v1=lv1f1 f1+e1,
v2=lv2f1 f1+e2,
v3=lv3f1 f1+e3,
v4=lv4f1 f1+e4,
v5=lv5f1 f1+e5,
v6=lv6f2 f2+e6,
v7=lv7f2 f2+e7,
v8=lv8f2 f2+e8,
v9=lv9f2 f2+e9;
std
f1=1,
e1-e9=vare1-vare9;
cov
f1 f2=cf1f2;
var
v1-v9;
run;
```

RESULTS

Participant Characteristics

We administered a cross-sectional, mailed survey to 965 adults and 677 returned a completed survey (70% response rate). Among the respondents, 243 had type II diabetes and comprised the subsample for this analysis. Diabetic patients were aged 52 to 75 years old with an average age of 60 years ($SD=5.4$), and 65% were female. The sample was mostly Black (79%) and had an annual income below \$25,000 (87%). Most respondents had Medicaid or Medicare (77%), and others had no insurance (17%) or other types of insurance (5%). About half (57%) had a high school education or less. In this sample of persons with diabetes, 42% were current smokers, 45% were currently using insulin, 37% had ever been hospitalized for their diabetes, and 63% reported fair or poor self-rated health. The average body mass index was 33.8 (standard deviation=8.7).

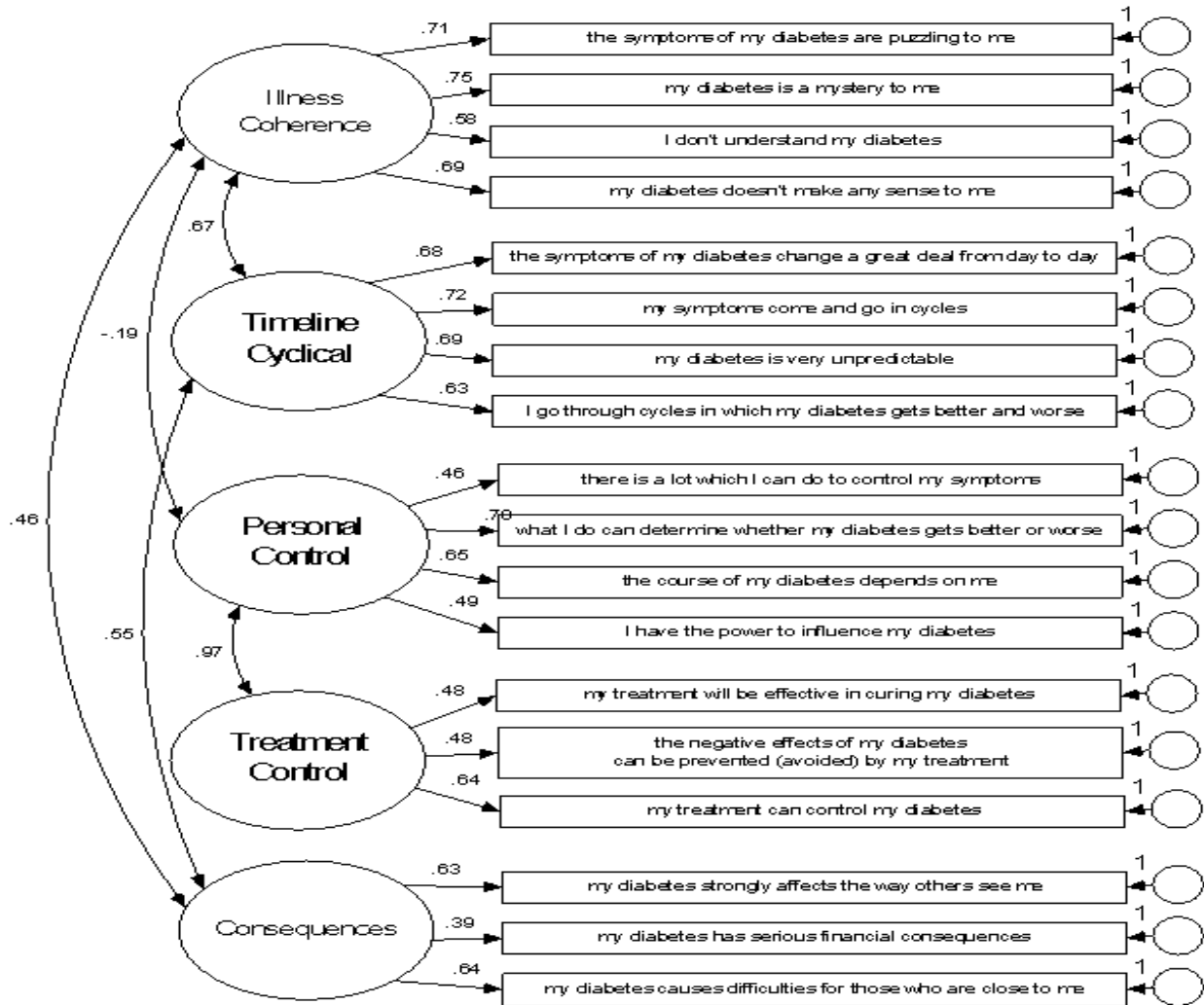
Confirmatory Factor Analysis (CFA)

We tested each hypothesized subscale of the Diabetes IPQ-R separately (Table 1 in appendix). Model fit was good for the hypothesized coherence and timeline cyclical subscales. Model fit was improved after removing reverse-worded and poor loading items for the personal control (2 items removed), treatment control (2 items), and consequences (2 items) subscales. For the emotional representations subscale, the hypothesized model did not explain the data adequately, but adding a residual covariance to the model for two similar items improved model fit: “I get depressed when I think about my diabetes” and “when I think about my diabetes I get upset”. However, although the error covariance contributed substantially to the model misspecification, the magnitude of the association was low ($r = .14$). For the subscale of timeline acute/chronic, three items reflected beliefs that diabetes was an acute disease and three items reflected beliefs that diabetes was a chronic disease. We attempted to correlate the similar items within a single factor structure, but model fit was poor. We also examined two correlated latent factors, which were highly negatively correlated so model fit was better, but not good.

After determining the best structure for each subscale independently, we next built up a correlated factors model. We started with the best-fitting single factor model, illness coherence and successively added other single factors to the model and assessed model fit (Table 1). In the combined model, one reverse-worded, low-loading item (“I have a clear picture or understanding of my diabetes”) from the illness coherence subscale was dropped. The emotional consequences subscale fit the data well independently, but could not be added to the correlated factors model (as a single factor or combined with another factor) without significant decrement in model fit. We were also unable to include additional Timeline chronic/acute subscales in the model without a significant decrease in model fit. Thus, we concluded that the best correlated factors model consisted of five latent factors representing the illness coherence, timeline cyclical, personal control, treatment control, and consequences subscales (Figure 2). These five factors differed from the hypothesized solutions because we eliminated all six of the reverse-worded items from the five included subscales, and dropped two additional low-loading items (‘my diabetes is a serious condition’, ‘my diabetes has major consequences on my life’). All the factor loadings for the final set of items were reasonably strong ($>.30$) and significant ($p < .001$). Of concern is the magnitude of the association between personal control and treatment control subscales ($r=0.96$) and between emotional representation and consequences subscales ($r=0.85$) (Table 1). High correlations between these factors suggest that they may not reflect independent domains. Second order factors for these pairs did not improve model fit, nor did collapsing two factors into one.

Consistent with prior studies using mean scores for IPQ-R subscales, we created manifest scores for the seven factors based on our findings and provide descriptive statistics for those subscales in Table 2 in appendix. Cronbach’s alpha provides an estimate of internal consistency. Mean scores for each subscale are moderate given the five-point response scale. The strongest beliefs were related to control of diabetes and its chronicity. Similarly, in another IPQ study of Type II diabetes² personal control and treatment control also had relatively higher mean scores than other dimensions, and the scores of several items indicating chronicity were high. Half of the correlations between subscales were significant and positive in this study, except for the inverse association between chronic and acute timeline beliefs.

Figure 2. Final structure of the five correlated factor model providing good fit to our data



LIMITATION

Several limitations need to be considered when evaluating our results. Our study involved a self-administered, self-report questionnaire. The interpretation of data from self-report surveys is possibly limited by concerns of response bias¹⁴. Response bias refers to the tendency of participants to respond in a particular way to items, independent of intended content, yielding systematic variance that is irrelevant to the content under study¹². To avoid response biases, it has been suggested that scale items should be both positive and reverse-worded¹². However, because our sample involved underserved patients with low education, the reverse-worded items may have caused more confusion for these participants. Thus, future studies may use cognitive interviewing techniques (e.g., thinking out loud) to directly assess whether participants had any difficulties understanding and responding to certain items^{5,22}. Our cross-sectional study cannot assess the reliability of IPQ-R factors over time. Participants were recruited from a single university clinic whose patient population consists of a large proportion of African Americans of low socioeconomic status. Future studies may recruit a more diverse patient population in the US.

CONCLUSION

Our study adds to current evaluations of the psychometric properties of the commonly used and adapted IPQ-R instrument by providing a thorough examination of the factor structure of the IPQ-R for Type II diabetes in a sample of underserved patients using CFA. Consistent with several previous studies, the model fit for the seven-factor structure proposed by Moss-Morris et al.²³ was found to be a poor fit to our data^{2,4,5,8,11,18,27}. However, we achieved good fit for a five-factor model after dropping eight items, which could serve as a starting point for further analysis and future use of this measure. Most of the items excluded from our model were reverse-worded or low-loading items that have been reported as poor items in other studies, too^{2,5,8,24}. Future studies should avoid the use of reverse-worded items and further evaluate strategies for increasing the conceptual independence of domains such as emotional representation

and consequences, and personal and treatment control, as well as beliefs about the acute vs. chronic timeline or duration of diabetes.

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CONTACT INFORMATION

Your comments and questions are valued and encouraged. Contact the author at:

Name: Xueying(Carol) Li
Enterprise: Health Integrity,LLC
Address: 7102 Ambassador Rd. Suite 100
City, State ZIP: Baltimore, MD,21244
Work Phone: 410.277.5144
E-mail: lic@healthintegrity.org

Name: Amy McQueen
Enterprise: Washington University School of Medicine
Address: 660 South Euclid Avenue, Campus Box 8005
City, State ZIP: St. Louis, MO ,63110
Work Phone: 314.286.2016
E-mail: amcqueen@dom.wustl.edu

Name: Anjali D. Deshpande
Enterprise: Washington University School of Medicine
Address: 660 South Euclid Avenue, Campus Box 8005
City, State ZIP: St. Louis, MO ,63110
Work Phone: 314.286.0148
E-mail: adeshpan@dom.wustl.edu

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APPENDIX

Table 1. Results of confirmatory factor analysis of domains of the diabetes IPQ-R

Construct	# Items	# Factors	χ^2	df	P	CFI	RMSEA	CI	AIC	Notes
Single Factors										
M1 Lack of illness coherence	5	1	6.06	5	0.300	0.996	0.030	(<.001,0.096)	3536.59	As hypothesized
M2 Timeline cyclical	4	1	2.21	2	0.331	1.000	0.021	(<.001,0.131)	2874.37	As hypothesized
M3 Personal control	4	1	0.10	2	0.956	1	<.001	(<.001, <.001)	2735.38	Removed 2 reverse-worded items
M4 Treatment control	3	1								Removed 2 reverse-worded items
M5 Consequences	3	1								Removed 1 reverse-worded item; 2 with loading <.30
M6 Negative emotional representations	6	1	12.93	8	0.065	0.985	0.050	(<.001,0.098)	4226.24	Error Corr (depressed, upset)=0.14***
M7 Timeline chronic/acute	6	2	18.27	8	<0.0001	0.970	0.072	(0.028,0.117)	4320.41	Factor Corr = -0.61***
Multiple Correlated Factors										
M1 + M2	9	2	42.96	25	0.068	0.978	0.021	(<.001,0.057)	6339.40	Corr (F1,F2)=0.55***
M1 + M2 + M3	13	3	138.08	62	<0.0001	0.904	0.071	(0.055,0.087)	9016.78	
Drop item ^a	12	3	70.06	51	0.040	0.973	0.039	(0.009,0.060)	8301.83	Removed 1 reverse-worded items from F1
M1 + M2 + M3 + M4	15	4	115.37	83	0.0002	0.956	0.040	(0.020,0.056)	11111.85	Corr (F3,F4)=0.96***
M1 + M2 + M3 + M4 + M5	18	5	216.06	125	<0.0001	0.912	0.055	(0.042,0.067)	12552.61	
M1 + M2 + M3 + M4 + M5 + M6	24	6	458.00	236	<0.0001	0.874	0.062	(0.053,0.071)	16643.38	Corr (F5, F6)=.85***

Legend. M=Model, Corr=Correlation, F=Factor

^a Dropped illness coherence item: I have a clear picture or understanding of my diabetes

Table 2: Final scales for IPQ-R domains among underserved patients with type 2 diabetes (N=243)

	Items	Alpha	Mean	SD	Bivariate correlations of mean scores							
					1	2	3	4	5	6	7	
1 Lack of illness coherence	4	0.77	2.63	.92								
2 Timeline cyclical	4	0.77	2.92	.94	0.52***							
3 Personal control	4	0.64	3.89	.75	-0.12	0.12						
4 Treatment control	3	0.55	3.63	.80	-0.03	0.11	0.56***					
5 Consequences	3	0.53	2.59	.87	0.32***	0.42***	0.09	0.09				
6 Negative emotional representations	6	0.81	2.74	.88	0.42***	0.48***	0.01	0.04	0.57***			
7 Timeline chronic	3	0.82	3.41	1.10	0.12	0.25***	0.18**	0.04	0.20**	0.27***		
8 Timeline acute	3	0.55	2.48	.80	0.12	0.06	0.19**	0.17**	-0.01	-0.04	-0.39***	

SD= standard deviation; *p<0.05, **p<0.01, ***p<0.001