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Psychometric validation of the Chinese version of the Illness Perception Questionnaire-Revised for patients with hypertension

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Abstract

Title. Psychometric validation of the Chinese version of the Illness Perception Questionnaire-Revised for patients with hypertension.

Aim. This paper is a report of a study to evaluate the psychometric properties of the Chinese version of the Illness Perception Questionnaire-Revised using the technique of confirmatory factor analysis.

Background. The Illness Perception Questionnaire-Revised is the most commonly used instrument for assessing patients' views of illness, and there is good evidence for the psychometric properties of the English version. However, there is inconsistency in the literature about how scores of the Illness Perception Questionnaire-Revised should be used.

Method. A cross-sectional survey was conducted in three teaching hospitals in central Taiwan. The Chinese Illness Perception Questionnaire-Revised was administered to a purposive sample of 358 patients with hypertension in 2005–2006.

Results. Confirmatory factor analysis provided evidence of satisfactory factorial validity, convergent validity and discriminant validity of the Chinese Illness Perception Questionnaire-Revised. Internal consistency was supported by adequate Cronbach's alphas (ranging 0·67–0·87) and composite reliability (0·57–0·88). The factor structures of the identity and cause subscales were found to be an acceptable fit to the data. The findings of model evaluations supported the seven-factor structure, after removal of six poorly fitting items. Second-order analysis indicated two factors (control and negative illness representation) representing latent constructs underlying the factors of personal control, treatment control, consequence, timeline-cyclic and emotional representation.

Conclusion. The Chinese Illness Perception Questionnaire-Revised is a reliable and valid instrument for the measurement of illness perceptions in patients with hypertension.

Keywords: Chinese version, confirmatory factor analysis, hypertension, Illness Perception Questionnaire-Revised, instrument validation, nursing

Introduction

Hypertension is the third leading cause of death, causing one in every eight deaths worldwide (World Health Organization 2003). Although the therapeutic effectiveness of the treatment and prevention of hypertension has greatly improved in recent decades, the control rate of hypertension is < 30% (Chobanian *et al.* 2003). Many factors are responsible for this low control rate, but patient non-adherence remains one of the most important reasons (Neutel & Smith 2003). Without adherence, therapeutic effectiveness is impossible to achieve.

Illness perception is an important factor in understanding how patients manage their illness and their behavioural outcomes (Hagger & Orbell 2003). Illness perceptions have been shown to influence adherence to treatment advice for desirable therapeutic outcomes in cross-sectional (Horne & Weinman 2002, Ross *et al.* 2004) and longitudinal (Coutu *et al.* 2003, Searle *et al.* 2007) studies, and were better predictors of health outcomes than disease variables (Groarke *et al.* 2005). Failure to achieve adherence and desirable outcomes indicates failure to produce changes in perceptions about an illness through communication processes (Leventhal *et al.* 1998).

Many instruments have been developed to assess patients' views of illness (Scisney-Matlock & Watkins 1999, Coutu *et al.* 2003, Jessop & Rutter 2003, Broadbent *et al.* 2006). Among these, the Illness Perception Questionnaire-Revised (IPQ-R) is the most commonly used, and its factor structures have been supported by exploratory factor analysis (Moss-Morris *et al.* 2002, Figueiras & Alves 2007). However, very few researchers have examined how existing data really fit the underlying constructs, which a scale is intended to reflect (Hagger & Orbell 2005).

The IPQ-R has been translated into Chinese and is available on the web (http://www.uib.no/ipq/pdf/IPQ-R-Chinese.pdf). Its psychometric properties, however, have not yet been shown. Patients' views of their illness are greatly affected by the social and cultural systems in which they live. Thus, verification of the validity and reliability of the IPQ-R in different clinical and cultural contexts may provide empirical evidence for its generalizability and utility in future cross-cultural studies.

Background

The IPQ-R is a theoretically driven questionnaire, and its basis is the self-regulation model (SRM). The underlying assumption of the SRM is that people respond to an illness according to their individual illness perceptions (Leventhal *et al.* 1998). When facing a health threat, individuals construct their own cognitive and emotional illness representations (IR), which correspond with the need for processes to manage the threat cognitively and emotionally to achieve danger control and fear control. Individuals act as problem-solvers in self-regulating their coping behaviours and generating action plans to deal with the health threat according to their illness perceptions.

The original IPQ was first developed by Weinman *et al.* (1996) to assess theoretical concepts of illness perception. Moss-Morris *et al.* (2002) further improved the psychometric properties by including four new subscales and revising the items of the IPQ. The revised version of the IPQ (IPQ-R) has three components: IR (individual beliefs about illness), identity (the symptoms or labels through which patients connect themselves with the illness) and causes (attribution of the illness). The IR component consists of seven subscales. Two subscales, timeline (acute/chronic) and timeline-cyclical, describe the chronicity and variations of the disease. The consequence subscale evaluates patients' perceptions of the potential impact of the illness on their physical, social and psychological well-being. The cure control subscale is divided into personal and treatment control to assess separately patients' beliefs about the best way to control their condition and the effectiveness of the treatment. Two new subscales, illness coherence (the extent of patients' understanding of their illness) and emotional representations (emotional reactions to the illness), were added to explore the rest of the response to health threats described in the SRM (Weinman *et al.* 1996, Moss-Morris *et al.* 2002).

The cause component of the IPQ-R is designed to assess patient attribution of health threat. In Western culture, patients tend to attribute their illness to intrapersonal etiological agents such as stress, diet, smoking or lack of exercise; however, Chinese patients usually attribute their illness to a disharmony that arises from imbalances between internal and external forces in their individual and contextual conditions (Landrin & Klonoff 1994, Chen & Swartzman 2001). External causes include violation of religious moral or taboos, such as *pa tzu* (the specific time of one's birth or fate), *feng shui* (geomancy or predicting a person's luck in a given year), temperature, weather or a clean environment. Internal causes are blood blockage, immunity and emotions (Chang 2000, Chen & Swartzman 2001). To capture these concepts in assessing causality, two subscales named culture and balance were added to the causal component of the Chinese IPQ-R.

The third component of the IPQ-R is identity. Identity is the major reason why patients seek medical help (Leventhal *et al.* 1998). Although hypertension is asymptomatic (Ross *et al.* 2004), some researchers have found that most patients believe that hypertension is an episodic symptomatic illness, which greatly differs from the medical understanding of its asymptomatic nature (Wilson *et al.* 2002). Some patients may experience symptoms before and after a diagnosis of hypertension (Kjellgren *et al.* 1998). Meyer *et al.* (1985) also found that patients develop a representation of hypertension, which monitors their symptoms to tell them when their blood pressure (BP) is elevated. Although their BP estimation might not be accurate, patients tend to self-regulate their treatment behaviours accordingly. Despite its subjectivity, the symptom experience not only results in high use of healthcare services (Wagner & Strogatz 1984), but also affects individual adherence to therapeutic regimens (Meyer *et al.* 1985, Jessop & Rutter 2003).

Some IPQ-R studies have provided evidence of its acceptable internal consistency, test–retest reliability, discriminant validity, predictive validity, known group validity and structural validity in patients with chronic illnesses (Moss-Morris *et al.* 2002) and healthy people (Figueiras & Alves 2007). Hagger and Orbell (2005) employed confirmatory factor analysis (CFA) to validate a similar factor structure of the IPQ-R in patients with abnormal cervical smears. Other researchers have reported acceptable internal consistency of IR in patients with asthma (Ohm & Aaronson 2006) and diabetes (Searle *et al.* 2007) and in patients having hemodialysis (Covic *et al.* 2004).

Some observations about applications of the IPQ-R occur in the literature. First, some researchers have reported high intercorrelations among subscales (Hagger & Orbell 2003), such as personal control and treatment control/illness coherence (r = 0·56–0·61; Moss-Morris *et al.* 2002, Covic *et al.* 2004, Ohm & Aaronson 2006, Frostholm *et al.* 2007) and emotional representation and consequence (r = 0·52–0·82; Hagger & Orbell 2005, Fowler & Baas 2006, Frostholm *et al.* 2007). The patterns of high intercorrelations may have two explanations: the existence of oblique factors that measure different dimensions of constructs, or the existence of a second-order factor (a higher latent construct that explains covariance among first-order factors; Rubio *et al.* 2001). Second, inconsistent uses of test scores were found. Some researchers have used subscale scores (Moss-Morris *et al.* 2002, Ross *et al.* 2004), while others have found that a composite score, such as negative IR (timeline, consequence and emotional representation) and positive IR (personal control and treatment control) seemed to explain more of the variance in medical and/or behavioural outcomes than single factors (Ohm & Aaronson 2006, Frostholm *et al.* 2007). How a scale score should be used is dependent on the underlying constructs of the instrument (Brown 2006), but no researchers have provided empirical evidence of this with respect to the IPQ-R.

These issues can be evaluated by examining the dimensionality of the factorial structure using the CFA technique. The CFA is a robust analytical technique that permits evaluation of the factorial structure by specifying factor models *a priori* and testing the goodness of fit of competing models, including higher-order models. Several goodness-of-fit tests of the model may be used to compare competing models statistically (Brown 2006).

The study

Aim

The aim of the study was to evaluate the psychometric properties of the Chinese IPQ-R.

Design

The study was a descriptive, cross-sectional design and the data were collected from March 2005 to May 2006.

Participants

A convenience sample of 358 patients with hypertension from three teaching hospitals in central Taiwan was recruited. Patients who met the following criteria were invited to participate in the study: (1) aged 18 years or older; (2) a diagnosis of essential hypertension; and (3) able to understand questions of the questionnaire. The exclusion criteria were those with: (1) any critical or acute episodes and complications or (2) a diagnosis of secondary hypertension.

The minimum sample size needed to obtain meaningful parameter estimates with CFA is about 200. With an appropriate number of indicators per factor, a large sample size is not necessary (Marsh *et al.* 1998). The sample size in the present study was 358, and the Critical *N* indices of all models exceeded 200, indicating that the sample size was adequate for the study (Bagozzi & Yi 1988).

Instruments

The IR components of the IPQ-R are shown in Table 1, and consist of 38 items on seven subscales: timeline, timeline-cyclical, consequences, personal control, treatment control, illness coherence and emotional representations. All items were scored on a 5-point scale ranging from 1 = 'strongly disagree' to 5 = 'strongly agree'. The item score was calculated by the scoring syntax suggested by Moss–Morris *et al.*, available at http://www.uib.no/ipq/index.html. A higher score indicates more serious consequences, negative

Table 1 Factor correlations of the Chinese Illness Perception Questionnaire-Revised subscales

Factor	1	2	3	4	5	6	7	8	9	10	11	12
1. Identity	0·56											
Illness representation												
2. Timeline	0·08	0·68										
3. Timeline-cyclical	0·39***	0·02	0·76									
4. Consequence	0·48***	0·12*	0·55***	0·68								
5. Personal control	−0·07	0·15*	−0·03	−0·06	0·64							
6. Treatment control	−0·08	0·24***	−0·09	−0·13*	0·51***	0·60						
7. Illness coherence	0·07	0·16**	−0·31***	−0·30***	0·43***	0·26***	0·68					
8. Emotional representation	0·40***	0·12*	0·60***	0·73***	−0·01	−0·04	−0·30***	0·80				
Cause												
9. Psychological cause	0·51***	0·10	0·40***	0·56***	−0·01	−0·13*	−0·12*	0·52***	0·64			
10. Balance	0·27***	0·07	0·48***	0·41***	0·15*	0·05	−0·23***	0·35***	0·60***	0·61		
11. Cultural cause	0·17**	−0·10	0·22***	0·28***	−0·33***	−0·21***	−0·26***	0·25***	0·28***	0·24***	0·75	
12. Risk factor	0·19***	0·08	0·12*	0·12	0·05	0·02	−0·02	0·03	0·32***	0·34***	0·04	0·76

The square roots of averaged variance extracted estimates are on the diagonal and correlation coefficients are on the off-diagonal.
$^{*}P < 0{\cdot}05$; $^{**}P < 0{\cdot}01$; $^{***}P < 0{\cdot}001$.

emotional representations, chronic and cyclic nature of illness, better illness coherence, personal control and treatment control.

The identity component was measured by three subscales: symptom score (numbers of symptoms the patients identified as being hypertension-related), symptom occasion (symptom experience before and after a hypertension diagnosis) and high blood pressure (HBP) prediction (symptoms that patients use to predict their high BP). The Symptom score was obtained by asking a patient to rate 32 symptoms using a Yes/No response format. Only those symptoms identified by a patient as hypertension-related were counted in the score. Symptom occasion was measured by asking patients to indicate, on the ordinal scale of No, Uncertain, or Yes, if they had experienced symptoms before and after the hypertension diagnosis. HBP prediction was determined by asking patients if they could predict HBP through symptom experience. The total number of symptoms patients used to predict their HBP was also counted. To analyse the items of Symptom occasion and HBP prediction in the CFA, we parcelled the items by summing those that measured a similar construct (Brown 2006).

The causal component of the IPQ-R had four subscales – psychological attribution, risk factors, immunity and accident or chance – giving a total of 18 items. In this study, two of the original items related to 'accidents' and 'germs' were deleted because of irrelevance to the aetiology of hypertension. We generated two additional subscales assessing cultural attribution and balance attribution. The items *feng shui,* bad luck and *pa tzu* (fate) were included in the cultural attribution, and the items weather, sleeplessness, hotness or blood blockage were designed to assess attributions to balance causality. In total, 21 items encompassing four causal subscales (psychological, risk factor, cultural attribution and balance) were expected to assess patient attribution of their illness. Each item was rated on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Higher scores indicate a stronger belief in attribution of the illness. A basic information sheet was developed to collect information about gender, age, history of hypertension and blood pressure status.

Data collection

The study was conducted in two phases. In the first phase, language equivalence between the Chinese and English versions of the IPQ-R and the content validity of the Chinese version were examined. The semantic equivalence of the two versions was examined by two bilingual persons. Some terms used in the items were modified for cultural suitability. Another bilingual expert did the back-translation. The items were accepted if they reached 90% semantic equivalence between the two versions. Five experts in nursing education, cardiovascular medicine, instrument development, or health education evaluated the content validity.

In the second phase, both the reliability and validity of the Chinese IPQ-R were examined. Patients were recruited from the cardiovascular clinics of three teaching hospitals.

Face-to-face interviews following a standard procedure for data collection were conducted in outpatient clinics by the researcher (SLC) and a trained research assistant.

Ethical considerations

Permission to access the study site was granted from the participating hospitals and approval was obtained from the Institutional Review Board of the hospital. Standard procedures for human rights protection such as explanation of patient rights, study purposes, patient confidentiality and obtaining informed consent were carefully followed before data collection.

Data analysis

The data were analysed using SPSS version 11·0 for Windows and LISREL 8·54. Pearson's product-moment correlation was performed to examine relationships among the subscales of the Chinese IPQ-R. The factor structures of the Chinese IPQ-R items were examined in the following sequence: single-factor model, one-factor model, seven-factor orthogonal and oblique models and second-order model. In the single-factor model, goodness-of-fit of the data to each single-factor was examined for unidimensionality. If the one-factor model was validated, a unidimensional construct of the measured items was supported. If the orthogonal model was sustained, distinct constructs among the factors were confirmed. If the data were found to be a best fit to the oblique model, the possibility of a second-order model was suggested. The hierarchical factorial structure of the Chinese IPQ-R scales was examined with a second-order CFA. Using CFA in this manner, the goodness of fit and sample-specific variance could be observed (Anderson & Gerbing 1988).

The fit statistics used were as follows. Absolute fit indices such as chi-square, χ^2/d.f. (with acceptable values between 1 and 3) and Goodness of Fit Index (GFI, with values ≥0·90 indicating a good fit) are used to evaluate full model fit. The Comparative Fit Index (CFI) was used to evaluate the adequacy of the models. A value of ≥0·95 indicates a good fit. The Non-Normed Fit Index (NNFI) with values of 0·90–0·94 indicating adequate fit and values of ≥0·95 indicating excellent fit, were used to assess incremental fit. The root mean square error of the approximation (RMSEA) was calculated to take into account the error of approximation of the model fit. An RMSEA value of ≤0·05 indicates good fit and values of 0·05–0·08 indicate acceptable fit. An root mean square residual (RMR) value of < 0·05 indicates good fit (Bagozzi & Yi 1988, Kline 2005, Brown 2006).

Internal consistency was evaluated by calculating Cronbach α-coefficients. Composite reliability (CR) was used to measure the reliability of latent constructs. CR values of ≥0·60 indicated that satisfactory internal consistency reliabilities existed in the latent constructs (Bagozzi & Yi 1988).

Convergent validity was supported if patterns of correlations among a set of indicator-factor loadings were high and statistically significant (Anderson & Gerbing 1988). Two methods were used to examine the discriminant validity of the constructs. One was examination of the confidence interval (CI) of correlation coefficient between two factors (Anderson & Gerbing 1988). If the values of the CI do not include 1, the discriminant validity of the constructs is supported. The other method was to compare the square of the correlation estimation between two factors with the average variance extracted (Fornell & Larcker 1981). Kline (2005) also suggested that, if the values of factor correlations are < 0·85, then discriminant validity is supported.

Results

The sample consisted of 202 men (56·4%) and 156 women (43·6%), with a mean age of 65·36 years (SD = 12·4). The mean length of hypertension history was 10·46 years (SD = 8·4), with a mean systolic blood pressure (SBP) of 138·75 mmHg (SD = 15·3) and a mean diastolic of 80·06 mmHg (SD = 11·9).

Factor correlations

In examining the intercorrelations among the latent factors of the Chinese IPQ-R (Table 1), the identity component was positively related to the negative IR and all subscales of cause. Statistically significant and positive correlations among causal attributions and negative IR were also found. The strongest factor correlations were found among negative IR (timeline-cyclical, consequence and emotional representation; r = 0·55–0·73) and positive IR (illness coherence, personal control and treatment control; r = 0·43–0·51), indicating the possible existence of higher-order factors.

Factor structure of the Chinese IPQ-R

Confirmatory factor analysis results for single latent factors of the Chinese IPQ-R are presented in Table 2. The fit indices showed good fit to the data, and each observed variable was connected to only one construct. Unidimensionality of each subscale latent factor was supported.

Table 3 summarizes the relative fits of the different competing models of the IR and the cause to the data. In

Table 2 Fitness indices of the single latent factors of the Chinese Illness Perception Questionnaire-Revised

Factor	Item	GFI	RMR	CR	Cronbach α
Identity	3	1·00	0·00	0·57	–
Illness representation					
1. Timeline	5	0·96	0·03	0·81	0·81
2. Timeline-cyclical	4	0·98	0·02	0·85	0·84
3. Consequence	5	0·97	0·04	0·81	0·80
4. Personal control	5	0·99	0·02	0·80	0·79
5. Treatment control	4	0·98	0·02	0·69	0·67
6. Illness coherence	5	0·95	0·04	0·81	0·81
7. Emotional representation	4	0·99	0·01	0·88	0·87
PC + TC	9			0·79	0·78
Con + Cyc + ER	13			0·94	0·82
Cause					
1. Psychological cause	7	0·96	0·05	0·82	0·82
2. Balance	5	0·99	0·03	0·73	0·75
3. Risk factor	3	1·00	0·00	0·80	0·78
4. Cultural cause	3	1·00	0·00	0·80	0·79

PC, personal control; TC, treatment control; PC + TC, a composite scale of personal control and treatment control; Cyc, timeline-cyclical; Con, consequence; ER, emotional representation Con + Cyc + ER, a composite scale of consequence, timeline-cyclical and emotional representation. GFI, Goodness of Fit Index; RMR, root mean square residual; CR, composite reliability.

the initial analysis for the IR component, the seven first-order oblique model showed the best fit to the data [Akaike's Information Criterion (AIC) = 1664·43, GFI = 0·82, NNFI = 0·93 and RMSEA = 0·060]. However, several items of the IR were found to fit the data poorly. Model modification was guided by examining values of the modification indices (MI), expected parameter change (EPC) and standardized residuals (SR). The revised model was not composed of a nested solution and so AIC instead of differences in chi-square values was used to compare models. Models with the lowest AIC values indicated the best fit to the data (Brown 2006).

Item 18, 'My hypertension will improve in time', was dropped because the factor loading was not statistically significant. After removing the item, the fit indices were as follows: AIC = 1559·85, GFI = 0·83, NNFI = 0·94 and RMSEA = 0·059. Four items were deleted because of weak factor loadings ($\lambda < 0{\cdot}40$) in all four CFA. Items were removed one item at a time in the following order: item 8, 'My hypertension does not have much effect on my life', item 36 'My hypertension does not worry me', item 17 'My actions will have no affect on the outcome of my hypertension' and item 19 'There is very little that can be done to improve my hypertension'. The fit statistics of the revised model were as follows: AIC = 1184·88, GFI = 0·85, NNFI = 0·95 and RMSEA = 0·056.

In addition, the findings of the Lagrange analysis showed that the largest values of MI (116·73), EPC (0·26) and SR (10·80) existed between the error covariance of items 33 (I get depressed…) and 34 (…I get upset). Introduction of a correlated error can bring about substantial improvement in the model fit, but spurious conclusions about relationships between measures may occur and the validity of the results may be threatened (Brown 2006). An error correlation reflects that some of the covariance in the indicators is not explained by the latent factor but by the systematic method variance. Without clear theoretical or methodological reasons, correlated measurement errors in the model are not recommended. Correlated error terms may also suggest item redundancy (Kline 2005, Brown 2006). Thus, item 34 was dropped because of its higher values of MI. Finally, a 32-item seven first-order oblique model was produced and resulted in an excellent fit to the data (AIC = 996·19, GFI = 0·87, NNFI = 0·95 and RMSEA = 0·049).

Table 3 Fit statistics for different models of illness representations and causes

Model	χ^2 (d.f.)	χ^2/d.f.	AIC	NNFI	CFI	GFI	RMSEA
Illness representation							
One first-order factor	4823·56/495	9·74	4656·62	0·71	0·73	0·55	0·160
Seven first-order factors (orthogonal)	1374·57/464	2·96	1502·57	0·90	0·91	0·81	0·074
Seven first-order factors (oblique)	826·19/443	1·86	996·19	0·95	0·96	0·87	0·049
Seven first-order two second-order factors	845·47/453	1·87	995·47	0·95	0·96	0·87	0·049
Cause							
One first-order factor	1222·81/135	9·05	1294·81	0·72	0·76	0·72	0·150
Four first-order factors (orthogonal)	500·56/135	3·71	572·56	0·90	0·91	0·87	0·087
Four first-order factors (oblique)	339·40/129	2·63	423·40	0·94	0·95	0·90	0·068

Orthogonal – the factors are constrained to be uncorrelated; Oblique – the factors are allowed to be correlated.
CFI, Comparative Fit Index; GFI, Goodness of Fit Index; AIC, Akaike's Information Criterion; NNFI, Non-Normed Fit Index; RMSEA, root mean square error of the approximation.

Based on the pattern of correlations and previous empirical findings, the seven first-order factors were re-specified into second-order models. A moderate correlation value of 0·5 was used as a cut point for respecification. However, the factor loading of timeline was quite low (λ = 0·23) and nonsignificant. A two second-order factor was observed to offer the best fit to the data (Figure 1). Both the seven first-order oblique factors and the seven first-order two second-order factors showed comparable and acceptable fits. The chi-square value of the two second-order factors was slightly larger than the seven first-order factors and the difference in chi-square reached a statistically significant level (χ^2_{diff} = 19·28, d.f. = 10, $P < 0{\cdot}05$). However, the target coefficient (T = 0·98) was close to value of 1, which indicates that the first-order factor can be explained by the second-order factor (Marsh & Hocevar 1985). As the second-order model also offered an excellent fit, the model was the most parsimonious of all the models evaluated.

For the causal component, three items (item 2 'heredity', item 6 'poor medical care in my past' and item 13 'aging') were deleted due to their low factor loadings (λ < 0·5) and AIC improved from 539·89 to 423·40. In model comparisons, the four first-order oblique factors showed the best fit to the data (Table 3). For the identity component, a three-item model was found to offer excellent fit to the data.

Reliability

The results for reliability of the Chinese IPQ-R are presented in Table 2. Cronbach's alpha coefficient for all factors ranged from 0·67 to 0·87. All CR values exceeded the recommended values of 0·60 and only the value for identity was <0·60 (CR = 0·57).

Convergent validity

Factor loadings for all of the items were above 0·50 (0·51–0·86 for IR, 0·51–0·59 for identity and 0·51–0·87 for cause). The t-values for loading estimates ranged from 6·79 to 17·38 and were statistically significant ($t > 1{\cdot}96$), indicating that the items were able to represent their underlying constructs. These items were loaded only on a predestined latent factor and no cross-loadings were found between factors, indicating that the items measure the similar construct. Convergent validity was thus supported (Kline 2005).

Discriminant validity

Discriminant validity was supported by the following findings. Table 1 showed that correlation coefficients among

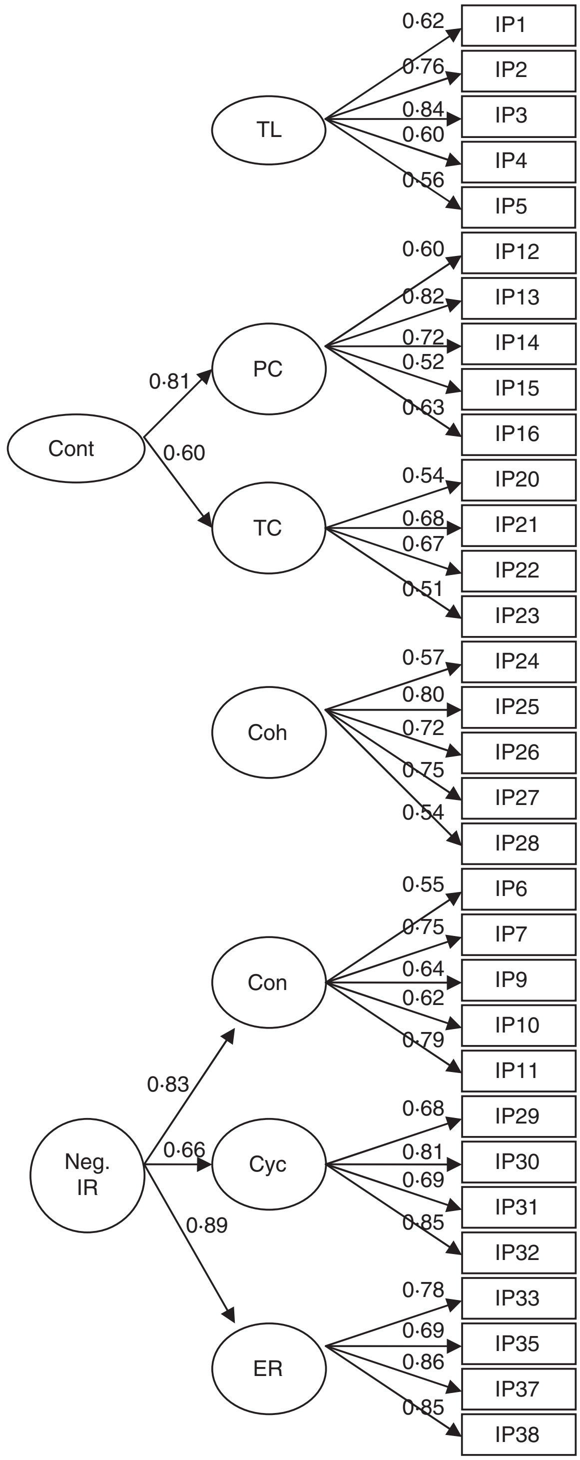

Figure 1 Higher order model of illness representations. *First-order factors: TL, timeline; PC, personal control; TC, treatment control; Coh, illness coherence; Cyc, timeline-cyclical; Con, consequence; ER, emotional representation. Second-order factors: Neg. IR, negative illness representations; Cont: control. χ^2 = 845·47, d.f. = 453, Comparative Fit Index (CFI) = 0·96, Goodness of Fit Index (GFI) = 0·87, root mean square error of the approximation (RMSEA) = 0·049.

the factors were not greater than 0·85. Also, the square roots of average variance extracted estimates were greater than the correlations coefficients on the off-diagonal in the matrix. The findings for all the confidence interval analyses between each of the two factors excluded the value of 1, indicating that each pair of constructs is empirically distinct (Fornell & Larcker 1981; Anderson & Gerbing 1988).

Discussion

The study had some limitations. The sample in this study was comprised of older patients, who were recruited from cardiovascular clinics of teaching hospitals in central Taiwan and who were attended by cardiovascular physicians; they thus had well-controlled blood pressure levels. It might not be possible to generalize our findings beyond this population. The model specification was fine-tuned *post hoc* based on the modification indices. Our results are tentative and can be used as a starting point for comprehensively validating the IPQ-R. Replication of the study and cross-validation of the findings with new samples are necessary for generalization. As illness representation may change over time in different disease stages, further longitudinal studies exploring the nature of the factors in patients with diverse stages of disease severity may provide fruitful information for refinement and further validation of the instrument.

Our results confirm and extend previous findings of the factor structure and psychometric properties of the Chinese IPQ-R (Moss-Morris *et al.* 2002, Hagger & Orbell 2005, Figueiras & Alves 2007). The instrument demonstrated satisfactory factorial validity, convergent validity, discriminant validity and reliability. Factor validity existed in the factors of identity, timeline-cyclical, illness coherence, risk factor and psychological and cultural attributions. After deleting non-fitting items, structural validity for timeline, consequence, treatment control, personal control, balance attribution and emotional representation was also supported.

Consistent with previous empirical findings (Moss-Morris *et al.* 2002, Hagger & Orbell 2005, Figueiras & Alves 2007, Frostholm *et al.* 2007), strong intercorrelations among positive and negative beliefs of the IR were found. It is reasonable to combine highly correlated factors to form a single measure for reasons of parsimony and reductions in error (Brown 2006). The CFA results show that both of the seven first-order oblique factors and the seven first-order two second-order factors were adequate fits to the data. Although the result of the chi-square difference test favoured the first-order model, the finding of target coefficient analysis showed that the second-order model was more parsimonious and provided a better fit. As the second-order factor is nested under the first-order factor, the chi-square change always favours the first-order factor (Brown 2006). Theoretically, the higher order model is also consistent with the three theoretical concepts comprised in the original IPQ plus a new factor of illness coherence (Weinman *et al.* 1996). In sum, the findings provide support for the use of the two composite scores of control and negative IR in addition to the seven subscale scores of the IPQ-R.

The factor structure of the IR was supported after deletion of six poorly fitting items. Most of the deleted items were negatively worded. Reverse-worded items are usually added to a scale to prevent acquiescence bias (DeVellis 2003, Brown 2006). Conversely, negatively worded items may become a source of method bias, especially when the questionnaire is long and the study sample is older (DeVellis 2003). Respondents may become confused about the meanings the items are intended to measure. Further study is needed to examine the existence and extent of the method effect that results from negative wordings.

Contrary to previous findings (Moss-Morris *et al.* 2002, Hagger & Orbell 2005), timeline was positively statistically significantly associated with control factors and also showed poor fit in the second-order factor. This finding may have resulted from disease- and culture-specific variations. Croyle (1990) found that, when encountering high blood pressure, people tend to minimize the health threat by endorsing their hypertension as an acute or cyclical condition. After perceiving controllability or becoming knowledgeable, patients may be more willing to accept the chronicity of the condition. As time passes, patients may also become more aware of the impact of an illness and consequently develop more negative beliefs of IR. In addition, previous researchers have reported that patients may perceive that questions about timeline are assessing attributes other than the duration of the illness, such as its stability (Scharloo *et al.* 1998, Frostholm *et al.* 2007) and impact on their life (Herda *et al.* 1994). In Chinese culture, patients usually adapt to health threats by employing strategies such as 'seeking bliss' and 'listening to heaven' (Chen 1996). They may interpret the questions such as 'I expect to have this illness for the rest of my life' and 'My illness is likely to be permanent rather than temporary' as unwanted fatalism; the item 'This illness will pass quickly' conveys an expectation rather than a measure of the duration of the illness. Therefore, timeline attribute need to be further explored.

The CFA results also provide evidence of the reliability and validity of identity. This finding supports use of the identity scale in assessing patients' subjective experience with symptom presentation, which may contribute to further understanding of its clinical utility in predicting health behaviours. Identity is

What is already known about this topic

- The Illness Perception Questionnaire-Revised is the most commonly used instrument for assessing illness perceptions, and is based on the theoretical assumptions of the self-regulation model.
- There is good evidence for the psychometric properties of the English version of the instrument.
- There is inconsistency in the literature about how scores on the instrument should be used.

What this paper adds

- The reliability, factorial validity and divergent and convergent validities of the Chinese version of the Illness Perception Questionnaire-Revised are acceptable.
- Confirmatory factor analysis supports the Illness Perception Questionnaire-Revised as a multidimensional measure.
- Scores on the seven subscales can be used individually or the subscale items for control and negative illness perceptions can be combined into composite scores for parsimony.

influential in determining individual illness perceptions and coping strategies for health threats (Leventhal *et al.* 1998). Although findings regarding symptom representation of hypertension in the literature are inconsistent, some patients do experience symptoms and adjust their health behaviours accordingly (Meyer *et al.* 1985, Kyngas & Lahdenpera 1999, Rose *et al.* 2000). Similar to previous findings, identity was positively correlated in our study with negative IR (Ohm & Aaronson 2006) and causality (Moss-Morris *et al.* 2002). The results indicate that patients who experience more symptoms tend to view their illness as being unpredictable and as having serious consequences for their life, and they have more emotional responses toward the illness, as well as a higher tendency to seek attribution for their symptoms.

For the causal component, after deletion of three non-fitting items, CFA results showed that 18 items of four first-order oblique factors fitted the data the best, which partially differed from the original causal structures (Moss-Morris *et al.* 2002). The non-fitting items were those classified as risk factors in the original IPQ-R, including heredity, poor medical care in the past and aging. All of the causal scores were strongly positively correlated with a negative IR, and partially negatively correlated with treatment control and illness coherence, implying strong needs for illness attribution when a health threat is perceived as negative or unexpected. Individual beliefs about the causal attribution of illness or symptoms have great effects on an individual's emotional response to an illness (Cameron *et al.* 2005), health behaviours such as delays in seeking care (Horne *et al.* 2000) and subsequent preventive health behaviour (Weinman *et al.* 2000). Validation of the psychometric properties of the scale may help healthcare professionals to understand better lay views of causality and develop further interventions.

Conclusion

The findings of the study support the Chinese IPQ-R as being a reliable and valid tool for measuring patient illness beliefs. The results have implications for appropriate uses of the test scores and further refinement of the IPQ-R. Clinically, the utility of the tool was also improved by adding culture-specific items to assess illness attribution and disease-specific items to explore the identity of patients with hypertension. The instrument may be used in clinical practice to understand the illness perceptions of hypertensive patients. Evaluation of the effects of identity and causal attribution of adherence of patients with hypertension may contribute to new knowledge. We also found illness perception to be a universal concept for patients' adaptation to health threats. Further studies comparing the psychometric properties of the IPQ-R cross-culturally may advance generalizability of the tool in diverse socio-cultural contexts.

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Author contributions

S-LC and J-CT were responsible for the study conception and design. S-LC and W-LL performed the data collection. S-LC performed the data analysis. S-LC and J-CT were responsible for the drafting of the manuscript. S-LC and J-CT made critical revisions to the paper for important intellectual content. S-LC and J-CT provided statistical expertise. J-CT and W-LL provided administrative, technical or material support. J-CT supervised the study.

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