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Modeling Adherence to Therapeutic Regimens in Patients with Hypertension

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Purpose. This study was done to identify and test a model of the psychosocial variables that influence adherence to therapeutic regimens in patients with hypertension.

Method. A convenience sample of 219 patients with hypertension who were enrolled in an outpatient clinic of a cardiovascular center in Korea participated in the study. They completed self-administered questionnaires anonymously. The questionnaire was based on the Social Action Theory model and a literature review. The explanatory model was constructed and tested using structural equation modeling in order to examine the effects within the model.

Results. The results of this study showed that perceived self-efficacy was the strongest factor influencing patient adherence in this sample. Adherence to therapeutic regimens in patients with hypertension was influenced by self-efficacy, patient-provider relationship, social support, and depression.

Conclusions. Adherence to therapeutic regimens in patients with hypertension was most strongly influenced by self-efficacy. These findings suggest that nursing interventions to promote patient adherence should focus on the promotion of self-efficacy including improvement in patient-provider relationship and social support, and reduction in depression.

Key Words : Patient adherence, Self-efficacy, Hypertension

INTRODUCTION

Hypertension, which affects 15-20% of Koreans, is an important modifiable risk factor for cardiovascular disease (Park, Kim, Kim, Kang, & Jee, 2001). Cerebrovascular and heart diseases are the second and third leading causes of death, respectively, in Korea (Korean National Statistics Office, 2002), and impose large financial and social burdens. Mortality rates for cardiovascular diseases are continuously increasing due to the widespread prevalence of high blood pressure. In particular, the continued high prevalence of hypertension and the low rate of patient adherence to therapeutic regimens make this disease a cause for great concern (Park et al., 2001). Therefore, adherence to therapeutic regimens in patients with hypertension is a major public health challenge for health-care professionals in Korea.

Patient adherence to therapeutic regimens is a critical factor for the continued health and well-being of patients with hypertension. Adherence implies that patients have collaborative involvement with a health-care provider in developing and adjusting their plans, which may include pharmacologic agents as well as changes in lifestyle (Chockalingam et al., 1998).

Because hypertension is a relatively common condition, patient adherence to therapeutic regimens has been widely investigated, with an emphasis on determining the psychosocial predictors (Burke & Dunbar-Jacob, 1995; Lee, 1995). Although there were common factors, predictors of adherence identified in previous research were not consistently detected in every study.

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Psychosocial factors that affect patient adherence can be classified into three categories: individual (demographic, knowledge, self-efficacy, depression, and skills), interpersonal (social support and communication), and environmental (culture and physical surroundings) (Burke & Dunbar-Jacob, 1995; Chockalingam et al., 1998; Culos-Reed, Rejeski, McAuley, Ockene, & Roter, 2000). Several variables in these categories might be potential predictors of adherence to therapeutic regimens and modifiable during nursing interventions.

A number of related theoretical frameworks have been applied to understand, predict, and change patient adherence. The commonly investigated theories of adherence to therapeutic regimens in patients with hypertension have been the following: the health belief model (Ha, Chun, Hwang, Kim, & Kim, 2000), social-cognitive theory and self-efficacy (Lee, 1995), the theory of reasoned action (Miller, Wikoff, & Hiatt, 1992), and the theory of planned behavior (Taylor, Bagozzi, & Gaither, 2001).

The ability of most of these models or theories to predict has been modest, and there has been no clear dominance of one of these models in terms of its ability to out predict the others (Baranowski et al., 2003). In addition, although depression and anxiety may be particularly important aspects in patient adherence (DiMatteo, Lepper, & Croghan, 2000), few investigators have made substantial attempts to incorporate emotion-related variables.

Ewart proposed a Social Action Theory model with three dimensions representing self regulation (a desired action state), contextual influences (action contexts), and self-change processes (social interaction process, motivational appraisal, problem solving, generative capabilities). Social Action Theory explains the need in public health for a contextual theory of individual action that incorporates modifiable social and personal mechanisms of self-control within an environmental model (Ewart, 1991).

Major study variables for the study were identified from the literature review and constructs in the Social Action Theory model (Table 1). Selection of the variables was also guided by pragmatic consideration of variables which could be modified during nursing interventions. Investigation of how key constructs operate together to influence patient adherence should lead to a more integrative understanding of adherence to therapeutic regimens in patients with hypertension. Such an understanding would help health professionals to better understand patient adherence to therapeutic regimens and to develop interventions which promote adherence for patients with hypertension.

This study had the following research objectives: (a) to identify factors affecting adherence to therapeutic regimens in patients with hypertension and (b) to develop an explanatory model for adherence to therapeutic regimens of these patients.

METHODS

Design

Structural equation modeling was used to develop an explanatory model for adherence to therapeutic regimens in patients with hypertension.

Participants and procedures

The sample was drawn from patients who were enrolled in the outpatient clinic of a cardiovascular center in Korea. A convenience sampling method was used. The inclusion criteria were (a) 18 years or older, (b) diagnosis of essential hypertension for at least 6 months, and (c) agreement to participate.

Data were collected using a self-administered questionnaire. The data collection period was from September 1 to October 31, 2002. Patients completed an anonymous questionnaire and returned it by mail. Questionnaires with incomplete answers were excluded and 219 questionnaires were included in the final analysis. This sample size is the minimum needed for purposes of meeting the requirements for the estimation of parameters under the maximum likelihood statistical procedures that was used in this study (Joreskog & Sorbom, 1996).

A total of 219 patients with hypertension, 133 (60.7%) men and 86 (39.3%) women participated in the study. Their mean age was 65 years (SD= 8.15) and 72.2% of them were over 60 years old. The median time

Table 1. Translation from Social Action Theory (SAT) to Study Variables

SAT-based constructs	Study Variables
Health Protective Action	Patient adherence
Motivational Appraisal	Self-efficacy
Social Interaction Process	Patient-provider relationship, Social support
Mood	Depression
Generative capabilities	Hypertension-related knowledge
Biological conditions	Health habit, disease characteristics

since diagnosis of hypertension was 12.5 years (SD= 8.15), with a range of 6 months to 48 years. The patients were dichotomized into those with lower than 12.5 years of duration (62.6%) and those with higher than 12.6 years (37.4%). There were no statistically significant differences in the total patient adherence scores (t= .23, p=.82). The diagnosis was made during regular physical examinations for 78 patients (35.6%), 68 (31.1%) were diagnosed due to hypertension-related symptoms, and 46 (21.0%) were diagnosed during incidental checkups of blood pressure. Ninety-two patients (42.0%) had cardiac diseases and 147 (70.0%) had a family history of hypertension. One hundred and nine patients (50.7%) regularly measured their blood pressure at home.

Measurement tools

Measurement included demographics, hypertension-related history, health habits, disease characteristics as well as variables representing constructs from the Social Action Theory model (Ewart, 1991). The endogenous variables were patient adherence, self-efficacy, patient-provider relationship, health habits, and hypertension-related knowledge, and the exogenous variables were social support, depression, and disease characteristics.

Three nursing professors reviewed all of the measurement tools that were translated into Korean for this study to ensure the accuracy of the translation, as well as for reliability, and validity of all measurement tools. Pilot test of 19 patients with hypertension was performed to validate the measures. The Corrected Item-Total Correlations were analyzed to minimize respondent burden. Twelve items having less than .30 for inter-items correlation coefficients suggesting low correlation with overall items were excluded.

Patient adherence to therapeutic regimens was measured using the Hill-Bone Compliance to High Blood Pressure Therapy Scale (Kim, Hill, Bone, & Levine, 2000). This scale assesses three important behavioral domains of high blood pressure treatment: reduced sodium intake, keeping appointments, and taking medications. This scale consists of 14 items and participants are asked to respond on a 4-point Likert-type scale. In the study by Kim et al., reliability was demonstrated by a Cronbach's alpha = .74. The alpha coefficient for the present study was .72.

Self-efficacy was measured using the General Self-Efficacy Scale (Sherer et al., 1982), translated into Korean by Oh (1993). This scale measures the willingness to initiate behavior, willingness to expand effort in completing the behavior, and persistence in the face of adversity. It consists of 17 items and participants are asked to respond on a 5-point Likert-type scale. The alpha coefficient in one study of patients with hypertension (Lee, 1995) was .77; the alpha coefficient for the present study was .83.

Patient-provider relationship was measured using the Patient Reactions Assessment (Galassi, Schanberg, & Ware, 1992). This scale measures the perceived quality of the informative and affective behaviors of the provider, and the patient's perceived ability to initiate communication about an illness. It consists of 15 items and participants are asked to respond on a 7-point Likert-type scale. Alpha coefficients for the scale have been reported as 0.87-0.91 (Galassi et al., 1992); the alpha coefficient for the present study was .83.

Hypertension-related knowledge was measured using the Knowledge of Hypertension Scale (Lee, 1995). This scale measures etiology, complications, therapeutic management, and hypertension-related misconceptions. It consists of 16 items that ask participants to respond, "yes" or "no". The alpha coefficient for the scale in the study by Lee (1995) was .67; the alpha coefficient for the present study was .63.

Social support was measured by the Medical Outcomes Study (MOS) Social Support Survey (Sherbourne & Stewart, 1991). This scale measures multiple dimensions of support: emotional/informational, tangible, affectionate, and positive social interactions. It consists of 20 items and participants are asked to respond on a 5-point Likert-type scale. The alpha coefficient for the scale has been reported as .97; the alpha coefficient for the present study was .96.

Depression was measured using the Center for Epidemiologic Studies Depression scale (CES-D) (Radloff, 1977). This scale measures depressed mood, feelings of guilt and worthlessness, feelings of helpless-

Table 2. Means, SDs of the Major Study Variables (N=219)

Measurement	Number of Items	Mean	SD	Range
Patient adherence	14	52.3	3.15	14-56
Self-efficacy	14	51.4	8.97	14-70
Patient-provider relationship	12	55.4	12.78	12-84
Social support	17	65.6	14.80	17-85
Depression	16	17.3	8.72	0-48
Hypertension-related knowledge	16	12.7	2.34	0-16

ness and hopelessness, psychomotor retardation, loss of appetite, and sleep disorders. It consists of 20 items and participants are asked to respond on a 4-point Likert-type scale. Alpha coefficients for the scale have been reported as .85- .90; the alpha coefficient for the present study was .89.

Data analysis

Descriptive and correlational statistics were used with the SPSS (V12.0 for Windows) program. A confirmatory factor analysis and structural equation modeling procedures were performed using AMOS version 4.0 to examine the relative contributions of each of the hypothesized variables in their relation to patient adherence. AMOS is a program to construct and revise a structural explanatory model. It is similar to the LISREL program. The parameters of the model were estimated using maximum-likelihood methods.

RESULTS

The means and SDs for the major study variables are

Table 3. Comparison of Goodness-of-Fit Indices Between the Hypothesized and Modified Models

Goodness-of-fit index	Standard of fit (p)	Hypothesized model	Modified model	Difference
Chi-square (df)	p > .05	200.9 (163) p=.02	77.5 (77) p=.46	123.4 (86) p < .01
Chi-square/df	1-2	1.23	1.01	
GFI	1	.92	.96	
RMR	<.05	.06	.03	
AGFI	1	.89	.93	
RMSEA	<.05	.03	.01	
NFI	1	.85	.93	
NNFI	1	.96	.99	
PNFI	>.06	.66	.68	
CFI	1	.97	.99	

Note - GFI = goodness-of-fit index, RMR = standardized root-mean-square residual, AGFI = adjusted goodness-of-fit index, RMSEA = root-mean-square error of approximation, NFI = normed-fit index, NNFI = non-normed-fit index, PNFI = parsimony-normed-fit index, CFI = comparative-fit index

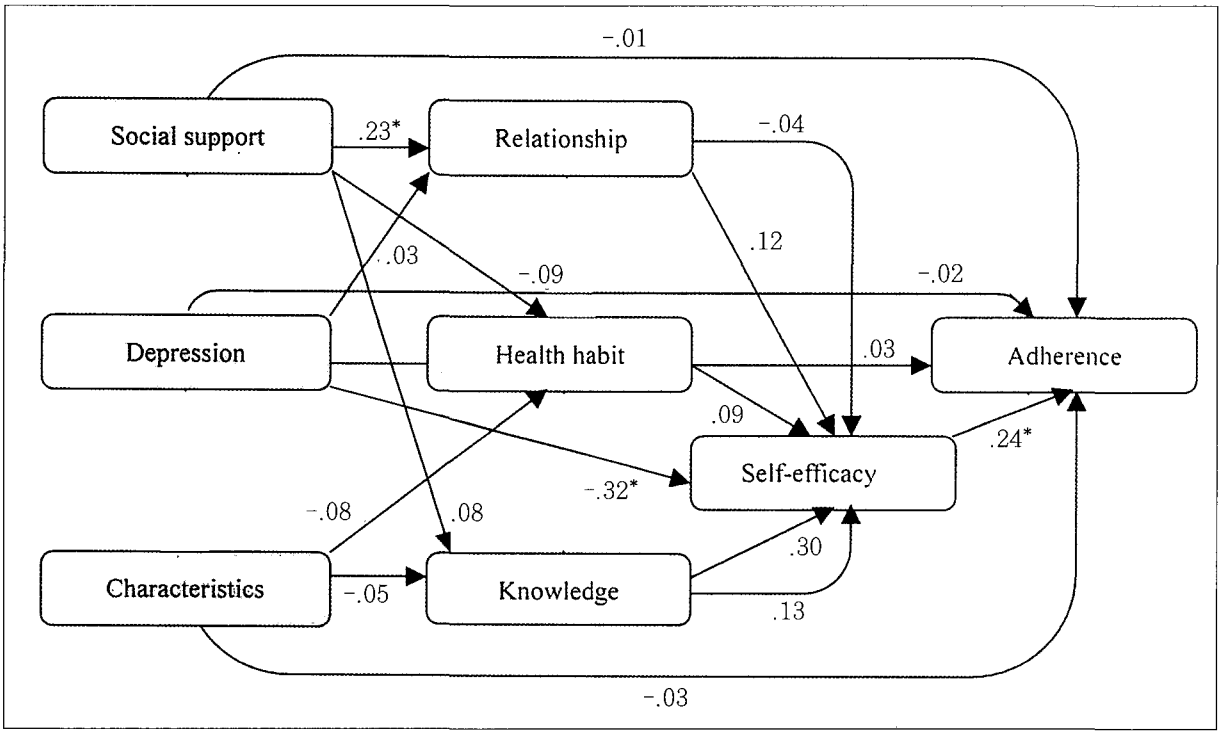

Figure 1. Hypothesized model of adherence in patients with hypertension (*p<.05)

presented in Table 2. To improve the fit of the model, the goodness-of-fit parameters were examined for the hypothetical model. Table 3 compares the goodness-of-fit indices between the hypothesized model and the modified model. The fit statistics are given as chi-square with 163 degrees of freedom = 200.9 (p=.02), chi-square/df=1.23, GFI=.92, RMR=.06, AGFI=.89, RMSEA=.03, NFI=.85, NNFI=.96, PNFI=.66, and CFI=.97.

The hypothetical model was adjusted by utilizing modification indices and the theoretical background. As the chi-square of the hypothetical model was large relative to the degrees of freedom, the modification indices were examined and the parameter with the largest modification index was relaxed. The following path coefficients for this model were not significant: from disease characteristics to health habits (γ = .08), knowledge (γ =- .05), and patient adherence (γ =- .03), and from health habits to self-efficacy (β =.09) and patient adherence (β =.03) (Figure 1). It is more useful to regard chi-square as a measure of the overall fit of the model to the data rather than as a test statistic, where a small chi-square corresponds to a good fit and vice versa (Jö reskog & Sörbom, 1996; Kim, 2001). The chi-square test of an exact fit would reject the model since the probability value would be very small.

After deleting the above paths, the explanatory model for adherence to therapeutic regimens in patients with hypertension was supported by an appropriate structural model with the model of fit indexes of Chi-square with 77 degrees of freedom = 77.5 (p=.46), GFI=.96,

Table 4. Parameter Estimates for Hypothesized Path in Modified Model

Hypothesized path	Estimate	SE	CR
Se → Ad	.32	.09	3.45*
De → Ad	-.01	.07	-.12
Ss → Ad	-.06	.04	-1.55
Re → Ad	-.05	.04	-1.45
Ke → Ad	.27	.16	1.64
Re → Se	.15	.06	2.47*
Ke → Se	-.11	.27	-.42
Ss → Se	.11	.06	1.76
De → Se	-.45	.11	-4.00*
Ss → Re	.28	.11	2.47*
De → Re	-.60	.19	-3.12*
Ss → Ke	.04	.02	2.25*
De → Ke	-.02	.03	-.79

Note - SE = Standard Error, CR = critical ratio, Se = self-efficacy, Ad = patient adherence, De = depression, Ss = social support, Re = patient-provider relationship, Ke = hypertension-related knowledge

* p< .05

Table 5. Direct, Indirect and Total Effects in Modified Model

Endogenous variable	Exogenous variable	Direct effect	Indirect effect	Total effect (t)
Relationship	Social support	.28*		.28*
	Depression	-.60*		-.60*
Knowledge	Social support	.04*		.04*
Self-efficacy	Relationship	.15*		.15*
	Depression	-.45*	-.09*	-.53*
Adherence	Self-efficacy	.32*		.32*

* p< .05

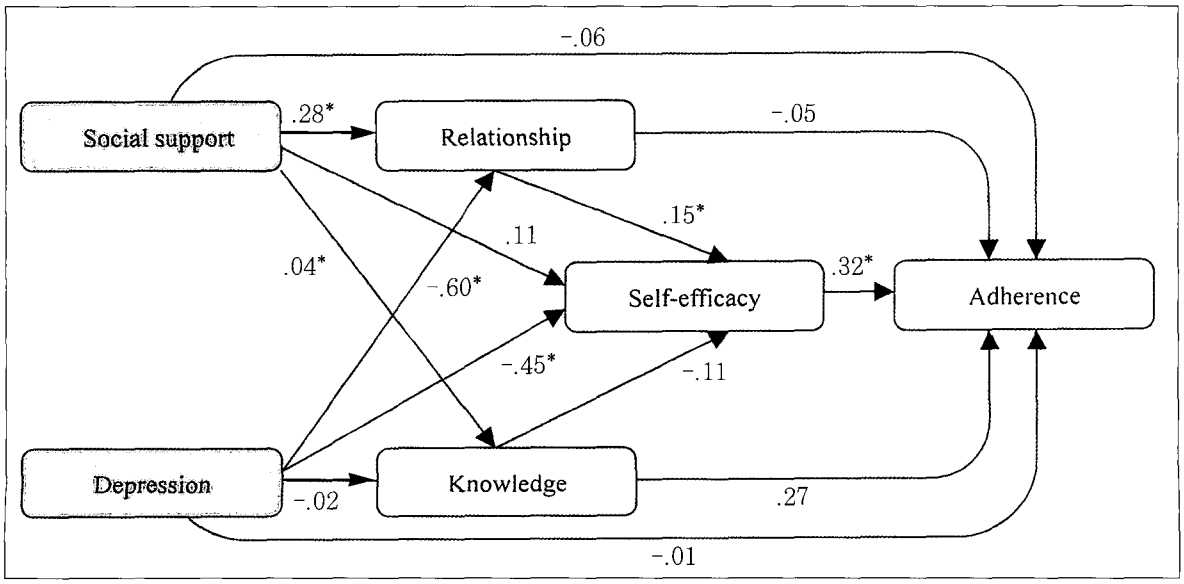

Figure 2. Modified best-fitting model of adherence in patients with hypertension (*p<.05)

RMR=.03, AGFI=.93, RMSEA=.01, NFI=.93, NNFI=.99, PNFI=.68, and CFI=.99 (Figure 2). The difference between the hypothesized model and the modified model was Chi-square with 86 degrees of freedom = 123.4, $p < .01$ and point estimate of RMSEA of less than 0.05, indicating that the modified model fit well and represented a reasonably close approximation to this sample.

The results for the tests of equality of parameter estimates and effects in the modified model are presented in Table 4 and Table 5, which indicate that the six paths were statistically significant. Self-efficacy had the most significant effect on patient adherence directly (β =.32, CR=3.45). Patient-provider relationship had a significant effect on self-efficacy directly (β =.15, CR=2.47). In addition, depression had a significant negative effect on self-efficacy directly and indirectly (γ =-.45, CR=-4.00). In addition, both social support (γ = .28, CR=2.47) and depression (γ =-.60, CR=-3.12) were significant for patient-provider relationship directly, and social support (γ = .04, CR=2.25) was associated directly with hypertension-related knowledge. There were no significant relationships between patient-provider relationship, depression, social support, or hypertension-related knowledge and patient adherence (Figure 2). The final model for adherence to therapeutic regimens in patients with hypertension is shown in Figure 3.

DISCUSSION

The purpose of this study was to identify factors affecting patient adherence and to develop an explanatory model for adherence to therapeutic regimens in patients with hypertension. The results suggest that higher perceived self-efficacy is indicative of higher patient adherence, which is consistent with results of previous studies; the significant effects of an efficacy expectation-promoting program on self-efficacy and self care (Lee, 1995), self-efficacy as a predictor of disease management (Carlson et al., 2001), participation in, and patient adherence in cardiac rehabilitation programs (Daly et al., 2002).

Depression had significant effects on self-efficacy and patient-provider relationship. In other studies, depressed patients have exhibited higher risks for medical morbidity and mortality because of poor patient adherence (DiMatteo et al., 2000). In an earlier study (Arnstein, Caudill, Mandle, Norris, & Beasley, 1999), self-efficacy contributed to patient adherence, thus, the enhancement of self-efficacy beliefs through participation in cognitive-behavioral programs may reduce the symptoms of depression. Therefore, health-care professionals should pay close attention to the relationship between psychosocial status (e.g., depression) and self-efficacy to achieve and maintain patient adherence to therapeutic regimens.

In this study, patient-provider relationship had a significant effect on patient's self-efficacy. Ideally health care providers should integrate information on therapeutic regimens and relevant values to make recommendations, and should spend sufficient time discussing the treatment options with the patients so that they accept the recommendations (Emanuel & Emanuel, 1992). Therefore health-care professionals should provide information and advice about hypertension to their patients in order to enhance self-efficacy for the long-term benefits of patient adherence such as quality of life and well-

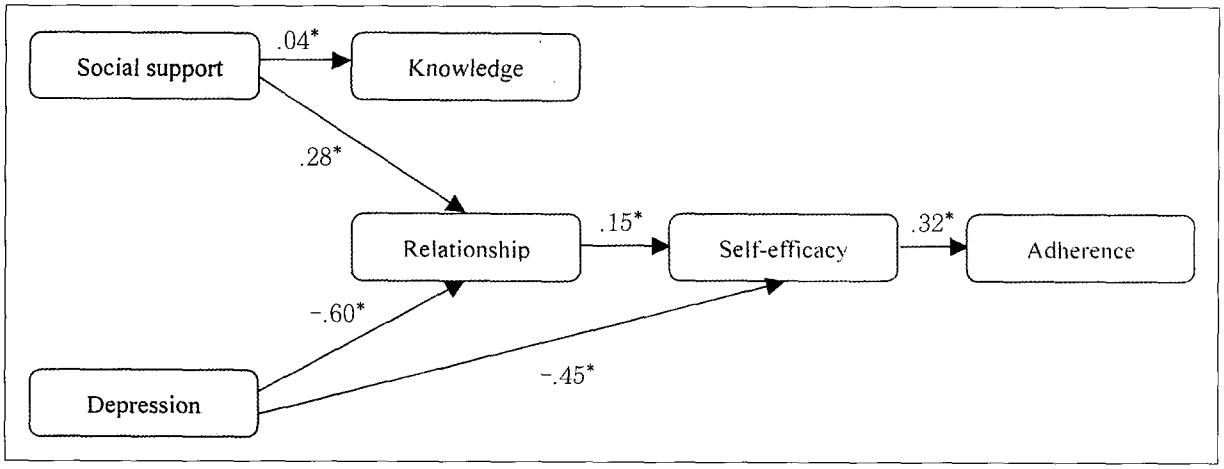

Figure 3. Final model of adherence in patients with hypertension (*p<.05)

being.

Results suggest that although knowledge itself did not have a strong enough effect on self-efficacy or patient adherence, it was significantly related to social support. These finding differ from earlier findings that knowledge of one's disease and regimens is a predictor of patient adherence (Devine & Reifschneider, 1995). Although most established education programs disseminate information on hypertension to patients, these programs have not shown a long-term effect on patient adherence behavior (Kerr, 1985). As self-efficacy was a strong predictor to adherence, perhaps teaching patients to measure their own blood pressure can encourage them to take charge of their own care. Although patients require information to follow through with the medical recommendations, emphasis on developing self-efficacy should be an important dimension of the educational interventions (Clark & Dodge, 1999).

Several investigations have found that strong social support or a strong network is associated with patient adherence (Stanton, 1987) and the control of hypertension (Shah & Cook, 2001). However, social support was not a significant predictor of patient adherence in the present study, a finding that is consistent with several other studies indicating no statistically significant relationship between perceived social support and patient adherence (Carlson et al., 2001; Sherbourne & Stewart, 1991; Wang et al., 2002). As mentioned by Schoenberg (1998), this lack of association may be related to incremental and gradual hypertension management requiring little need for social support. However, family members can assist patients in their adherence to therapeutic regimens. Targeting support strategies at high-risk patients with hypertension and their families would represent a cost-effective means of managing and controlling hypertension.

Limitations of this study should be noted. First, a cross-sectional survey design was used that precludes strong causal inferences. Future research may benefit by testing the model with longitudinal data in newly diagnosed patients with hypertension. Second, the explanatory relationship of self-efficacy with other variables may have been decreased because of the General Self-efficacy Scale (which measures generalized beliefs of self-efficacy). Future research may benefit from the use of a Hypertension-specific Self-efficacy Scale.

Nevertheless, our structural modeling procedures revealed that greater self-efficacy was the significant determinant of adherence in patients with hypertension. Results of this study provide a better understanding of the factors that can be targeted to improve adherence to therapeutic regimens in patients with hypertension.

In conclusion, the results of this study suggest that as greater self-efficacy was the significant determinant of adherence in patients with hypertension, nursing interventions to promote adherence to therapeutic regimens should focus on enhancing self-efficacy, patient-provider relationship, social support and reducing depression of patients with hypertension. Further studies are needed to test the effects of a nursing intervention programs applying the explanatory model in this study to improve adherence to therapeutic regimens in patients with hypertension.

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