Published in final edited form as:
J Behav Med. 2008 December ; 31(6): 489–497. doi:10.1007/s10865-008-9173-4.

The Association of Emotional Well-being and Marital Status with Treatment Adherence among Patients with Hypertension

Ranak B. Trivedi, PhD[1], **Brian Ayotte, PhD**[2], **David Edelman, MD**[1,2], and **Hayden B. Bosworth, PhD**[1,2]

[1]Department of Medicine, Duke University Medical Center

[2]Durham Veterans Affairs Medical Center

Introduction

Four decades of clinical trials have produced an enormous body of evidence showing that controlling hypertension improves cardiovascular and renal outcomes (Chobanian et al., 2003; Psaty et al., 2003; The ALLHAT Officers and Coordinators for the ALLHAT Collaborative Research Group, 2002). The mechanisms for achieving control, including following medication regimens and lifestyle recommendations (e.g., diet, exercise, smoking cessation), are well known and widely accepted (Chobanian et al., 2003; Elmer et al., 1995; Lichtenstein et al., 2006; Miller et al., 2002; Sacks et al., 2001; Whelton et al., 1998). However, many patients do not adhere to these recommendations. Non-adherence to antihypertensive medications may be as high as 50% (Garfield & Caro, 1999), and has been cited as the principal reason behind poor hypertension control in the population (Burnier, 2006). Estimates of lifestyle recommendations also reflect high degrees of non-adherence. In a primary care setting, (Burt et al., 1995) estimated that only 67% patients reported adherence to any one of four lifestyle recommendations (weight management, dietary sodium reduction, moderate alcohol consumption, and regular exercise).

While a variety of psychosocial factors are thought to influence treatment adherence and blood pressure (BP) control, the effects of emotional well-being are relatively understudied. Of the studies examining the dimension of mental health, the focus has been largely on clinical depression or depressive symptoms. A recent meta-analysis suggested that depressed patients were three times more likely to be non-adherent to medical treatment, across medical conditions (M. R. DiMatteo, Lepper, & Croghan, 2000). Less attention has been paid to subclinical emotional distress and emotional well-being in medical illness in general, and hypertension in particular. One study examined the impact of emotional well-being on medication adherence (Wang et al., 2002). They found that for each point change on a depression scale, hypertensive patients were 7% less likely to adhere to their medications. Similar to medication adherence, the impact of emotional health on adherence to lifestyle changes in hypertension is relatively unknown. This is despite strong evidence in other chronic illnesses that emotionally healthy patients show greater adherence to maintaining lifestyle changes (Daly et al., 2002; M. R. DiMatteo et al., 2000; Koertge et al., 2003; Sherbourne, Hays, Ordway, DiMatteo, & Kravitz, 1992). Lastly, little is known about the impact of emotional well-being on BP in hypertensives although clinical depression has been shown to reduce BP control (Simonsick, Wallace, Blazer, & Berkman, 1995). The sparseness of the literature belies the importance of establishing the impact of emotional well-being in hypertension since hypertensives appear to have a poorer quality of life

Corresponding Author: Ranak Trivedi, Ph.D., Mailing Address: 2424 Erwin Rd, Hock Plaza Ste 1105 Box 2720 Durham, NC 27705, Ph: (919) 668-2361, Fax: (919) 668-1300, Ranak.trivedi@duke.edu.

compared to normotensives (Banegas et al., 2006; Bardage & Isacson, 2001; Dimenas et al., 1989; Moum, Naess, Sorensen, Tambs, & Holmen, 1990).

In addition to emotional well-being, marital status may play an important role in hypertension. Marital status is considered a measure of social network, and is associated with improved hypertension control (Caldwell et al., 1983; He et al., 2002). It is speculated that married hypertensives may have better hypertension control partly through improved adherence to recommendations. While some studies support this relationship (Kulkarni, Alexander, Lytle, Heiss, & Peterson, 2006; Kyngas & Lahdenpera, 1999), others have not found a relationship between marital status and adherence to treatment recommendations in hypertensives (Cummings, Becker, Kirscht, & Levin, 1982). A recent meta-analysis of the general medical literature concluded that adherence to medical recommendations were higher in married patients (M.R. DiMatteo, 2004). In light of the evidence in the general medical literature, the relationship between marital status and treatment adherence deserves closer scrutiny in hypertension. Furthermore, it is important to investigate whether marital status is related to pharmacological and lifestyle recommendations separately examined within the same sample, as the current state of literature is unable to answer this question.

The purpose of this study was to examine whether emotional well-being and marital status were related to baseline BP levels and adherence to medications and lifestyle recommendations. Results can be used to further our understanding regarding psychosocial factors which may impact adherence to medication and lifestyle changes.

Methods

Participants

Six hundred and thirty-six hypertensive patients were recruited from two Duke University Medical Center primary care clinics that were part of the Take Control of Your Blood Pressure (TCYB) Study (Bosworth et al., 2007). Briefly, TCYB tested two interventions (tailored behavioral intervention and BP self-monitoring) in a sample of hypertensive patients. This study represents secondary, cross-sectional analyses of the baseline data from TCYB.

Inclusion/Exclusion Criteria

Patients were included if they had documented hypertension according to medical records (ICD-9 codes 401.9, 401.0, 401.1), if they were enrolled in one of the two primary care clinics for at least a year, and if they were using a hypertensive medication (e.g., ACE inhibitor, beta blockers). Patients were excluded if they were not on BP medication, a family member was already enrolled in the study, they did not live in an eight-county catchment area, were receiving kidney dialysis, were pregnant or were planning to be pregnant, had arms that exceeded the BP cuff limits, had been hospitalized for a stroke, myocardial infarction, coronary artery revascularization within the last 3 months, had been diagnosed with metastatic cancer, had been diagnosed with dementia, resided in a nursing home or received home health care, did not speak or understand English, were enrolled in another hypertension study, were not receiving the majority of their healthcare through Duke University, had severely impaired hearing or speech, and/or had a history of organ transplant. The final sample was derived from initially screening 7646 patients of which 1325 eligible patients were contacted. Five hundred and forty-nine patients refused participation. For more details regarding the study design, refer to (Bosworth et al., 2007).

Measures

Patients underwent a BP screening involving two successive digitally derived BP values taken by study staff. These were averaged to determine baseline systolic and diastolic BP (SBP and DBP, respectively). In addition, each participant completed a battery of questionnaires at the time of their initial visit, described next.

Emotional well-being was measured using the Mental Component Summary Scale (MCS), a 5-item subscale of the MOS Short Form 12 (SF-12; (Gandek et al., 1998; Ware, Kosinski, & Keller, 1996). The MCS subscale is not a diagnostic tool for depression but rather is a measure of mental health-related quality of life. Items assess general mental health and its impact on daily functioning. Answers are provided on Likert scales tailored to each item. The mean of the MCS is 50, the standard deviation is 10 and the reliability of MCS ranges from .77–.97 (Gandek et al., 1998; Ware et al., 1996).

Adherence to medication was assessed using the Self-reported Medication Taking Scale (Morisky, Green, & Levine, 1986). This 4-item measure assesses medication-taking behavior. Respondents rate whether they forget to take medications, are careless about taking their medications, or stop taking their medications based on whether they feel better or worse. Items are rated on a 4-point scale, from “strongly agree” to “strongly disagree”. The predictive validity of this measure is .60 and reliability is 0.85 (Morisky et al., 1986).

As medication non-adherence may also depend on undesirable side effects, participants were asked to report whether or not they had experienced any of sixteen common antihypertensive side effects, including dry mouth, sweating, swelling, and sexual problems.

Adherence to dietary and exercise recommendations were assessed with one item each, asking respondents to rate the difficulty of following the recommendation. Respondents answered on a 1 to 10 scale, with higher scores indicating more difficulty in following recommendations. Smoking status was determined by a single yes/no item asking whether participants smoked cigarettes at the time of the assessment.

Finally, a demographic questionnaire was administered to determine participants’ age, gender, race, and marital status.

Data Analyses

Participants were classified as non-adherent to medications if they endorsed at least 1 item with “strongly agree” or “agree” on the Self-reported Medication Taking Scale. Otherwise, participants were considered adherent to medications. This system follows established protocols (Bosworth et al., 2006). To determine difficulty adhering to dietary or exercise recommendations, scores were recoded such that scores greater than 5 on the 10 point scale indicated greater difficulty with adherence. The cutoff of 5 reflects the median split in our sample for both variables.

Simple correlations were conducted to examine the relationship between all variables of interest. Pearson’s correlations were conducted where at least one variable was continuous. If both variables were categorical, phi coefficients were calculated to determine the simple correlations.

Dependent variables were baseline SBP, baseline DBP, adherence to medications, difficulty adhering to dietary recommendations, difficulty adhering to exercise recommendations, and current smoking status. SBP and DBP were treated as continuous variables. Adherence to medications, difficulty adhering to dietary recommendations, difficulty adhering to exercise recommendations, and current smoking status were coded such that analyses yielded greater

probability of being adherent to medications, having greater difficulty adhering to dietary and exercise recommendations, and being a current smoker.

Independent variables were emotional well-being as measured by the MCS and marital status. Emotional well-being was treated as a continuous variable such that higher scores on the MCS represent better emotional well-being. Marital status was coded as “married” or “not married”, with “not married” as the referent.

It is well-established non-White race have poorer BP control and report poorer adherence. Similarly, younger age and male gender are well-established predictors of BP and non-adherence (Morris et al., 2006). Therefore, age, race, and gender were included in all models because not including these in models may potentially bias the results in favor of finding spurious effects. Age was treated as a continuous variable. The referents for race and gender were non-white race and male gender, respectively. In addition, the number of reported side effects was added to the model where adherence to medications was the criterion, because side-effects may confound medication adherence. Significance was set at $p<.05$. All analyses were conducted using SAS 9.1® (SAS, Cary, NC).

Multiple linear regression analyses were conducted to test whether emotional well-being and marital status were associated with baseline SBP and baseline DBP (models 1 and 2, respectively). Logistic regression analyses were conducted to test whether emotional well being and marital status were associated with adherence to medications (model 3). Logistic regression analyses were also conducted to test whether MCS scores and marital status were related to difficulty adhering to dietary and exercise recommendations (model 4 and 5, respectively). Lastly, logistic regression analyses were used to test whether emotional well-being and marital status were associated with current smoking status (model 6). MCS scores and marital status were tested simultaneously in all models. As these were cross-sectional analyses, the results are presented as associations between the independent and dependent variables.

In *post hoc* analyses, it was hypothesized that the four adherence variables (adherence to medications, current smoking, adherence to dietary recommendations, adherence to exercise recommendations) would mediate the associations of emotional well-being and marital status with BP control. A series of analyses were conducted wherein each mediational variable was introduced into regression analyses where the dependent variables were either SBP or DBP, and the independent variables were either emotional well-being or marital status. Using unstandardized estimates and the corresponding standard errors, the Sobel test (Sobel, 1982) was used to then test for the significance of the mediational pathways. This method tests for the significance of the indirect effects by hypothesizing that there are no differences between the direct and indirect effects.

Results

Baseline characteristics of this sample, including baseline SBP and DBP, are presented in Table I. At baseline, the mean MCS score was 50.59 (SD=10.7). Fifty-nine percent of the sample reported adherence to medications. Approximately 16% of participants reported that they were smokers at the time of assessment. The results of the simple correlations between all the variables of interest are shown in Table II. The shaded cells represent phi coefficients. As can be seen in Table II, higher MCS scores were significantly correlated with lower DBP ($r=-.14$, $p<.001$), better adherence to medications ($r=.16$, $p<.001$), better adherence to dietary recommendations ($r=.18$, $p<.001$), better adherence to exercise recommendations ($r=.18$, $p<.001$) and lower incidence of current smoking ($r=-.16$, $p<.001$). Being married was associated with better medication adherence ($r=.19$, $p<.001$), better adherence to

exercise recommendations (r=.10, p<.001), and lower incidences of current smoking (r=−.18, p<.001). Examining the zero-order correlations with race revealed that White participants had greater emotional well-being (r=.11, p<.01), lower SBP (r=−.19, p<.001), lower DBP (r=−.23, p<.001), were more likely to be married (r=.35, p<.01), reported better medication adherence (r=.27, p<.001), and were more likely to be current smokers (r=.14, p<.05). Finally, zero order correlations with gender showed that males had better emotional well-being (r=.11, p<.01), were less likely to be married (r=−.30, p<.01), and had less difficulty adhering to exercise recommendations (r=−.01, p<.01).

Adjusted regression analyses were conducted to explore the relationships between emotional well-being, marital status, and BP. Results of adjusted multiple linear regression analyses showed that neither MCS scores nor marital status were significant correlates of baseline SBP or DBP values after considering the effects of race, gender and age (Table III). Age was associated with higher SBP (p<.05) but lower DBP (p<.0001). Non-white race was associated with higher baseline SBP and DBP (p's<.0001), and male gender was associated with higher baseline DBP (p<.01).

Table IV shows the results of adjusted logistic regression analyses examining the association between MCS scores and marital status, and adherence to medication and lifestyle recommendations. In adjusted logistic regression analyses, MCS scores were not associated with adherence to medication (p=.12). However, married participants were 66% more likely to be adherent to medications (OR=1.66, p<.05), supporting the role of social network in medication adherence. Participants who reported higher MSC scores were likely to report less difficulty adhering to dietary and exercise recommendations. For every 1 point increase in MCS scores, the probability of having difficulty adhering to dietary recommendations decreased by 3.1% (OR= .969, p<.001). Similarly, for every 1 point increase in MCS scores, the probability of having difficulty adhering to exercise recommendations decreased by 2.8% (OR=.972, p<.001). Marital status was not significantly associated with difficulty adhering to dietary or exercise recommendations (p=.75 and .06, respectively).

With regard to smoking status, each 1 point increase in MCS scores was associated with a 2.4% decrease in the probability that the participant was a current smoker (OR=.976, p<.05). Being married was associated with a nearly 70% lower likelihood of being a current smoker (OR=.34, p<.0001).

Consistent with expectations, White participants were more than 2 times more likely to report adherence to medication than non-White participants (OR=2.381, p<.0001). Each additional side effect was significantly associated with lower adherence to medications (OR=.930 per side effect, p<.05). Older participants reported less difficulty adhering to diet (OR=.985, p=.0375) and exercise recommendations (OR=.972, p<.001). Older participants were also less likely to be currently smoking (OR=.970, p<.01). Being female was associated with greater reported adherence to medications (OR=1.503, p<.05) and non-smoking status (OR=.504, p<.01).

The multiplicative effects of MCS scores and marital status were examined in regression analyses by introducing the interaction term "MCS X Marital Status" in the analyses described earlier. This interaction term was not a significant correlate of SBP levels, DBP levels, adherence to medications, current smoking status, difficulty adhering to dietary recommendations, or difficulty adhering to exercise recommendations (p's>.05). Therefore, models were refit to retain only the main effects to create parsimonious final models.

Post hoc mediational analyses were conducted as complete mediation could potentially explain the lack of relationship between the independent variables and BP levels. Results of the Sobel test demonstrated that none of the adherence variables (i.e., medication adherence,

smoking status, difficulty adhering to exercise recommendations, difficulty adhering to dietary recommendations) were significant mediators of the relationship between emotional well-being and BP level, or marital status and BP level (p>.05 for all analyses). This was true for models that were unadjusted, and those models that were adjusted for the effects of race, gender, and age.

Discussion

Key findings from this study suggest that emotional well-being and marital status may play important but potentially different roles in hypertension management. Emotional well-being may be important in maintaining important lifestyle changes, whereas marital status may be important in maintaining medication adherence and non-smoking. Neither variable appeared to directly impact BP levels. Although previous studies have documented the impact of clinical depression on adherence (Glassman et al., 1990; Kim, Han, Hill, Rose, & Roary, 2003; Wang et al., 2002; Wells et al., 1989), this study is among the first to document that subclinical emotional distress may be detrimental to adherence to lifestyle recommendations, including diet, exercise, and tobacco use, in hypertensive patients.

Despite the presence of a bivariate relationship, emotional well-being was not associated with medication adherence or DBP in regression analyses, after accounting for the effects of marital status, age, race, gender, and side-effects. Notably, adjusted regression analyses did not reveal a relationship between emotional well-being and DBP levels above the effects of age, race, marital status, and gender. The possibility that this lack of relationship may be explained by mediation through adherence was tested in post hoc analyses. However, none of the mediational pathways were significant in either adjusted or unadjusted analyses.

These findings may be explained in at least two ways. First, the zero-order correlations between emotional well-being and medication adherence, and emotional well-being and DBP were small in magnitude. Their lack of significance in adjusted regression analyses may indicate the absence of a true relationship. The relationship observed in zero-order correlations may be the effect of emotional well-being acting as a proxy for race and gender, especially given that scores on the MCS were significantly correlated with both race and gender. Race and gender are consistent correlates of BP and adherence. In particular, being White is associated with better hypertension control (Bosworth, Bartash, Olsen, & Steffens, 2003; Rehman, Hutchison, Hendrix, Okonofua, & Egan, 2005). It has been speculated that both biology and sociology play important roles in this relationship (White, 2008). Although gender shares a more complex relationship with BP, studies largely indicate that men are biologically predisposed to higher BP compared to women (Rosenthal & Oparil, 2000). The decision to include these demographic variables was predicated on this theoretical framework in an effort to control for their potential confounding effects.

Second, it is possible that emotional well-being may not impact medication adherence in emotionally healthy, hypertensive patients with adequate BP control. The differential impact of emotional well-being on adherence to pharmacological versus non-pharmacological recommendations is consistent with previous reports in non-hypertensive patients (M. R. DiMatteo, Hays, & Sherbourne, 1992; Sherbourne et al., 1992). One possible explanation may lie in the effort necessary to effect and maintain medication-taking versus lifestyle behaviors (M. R. DiMatteo et al., 2000). The Health Belief Model (Rosenstock, Strecher, & Becker, 1988) posits that people will avoid illness if the preventive action is perceived to be less negative than the illness itself (Becker & Maiman, 1975; Sherbourne et al., 1992). As a patient's emotional well-being declines, lifestyle adherence might be abandoned prior to medication adherence due to the greater effort required to maintain lifestyle changes. In our

sample of emotionally healthy patients, the impact of subclinical emotional distress may be noticeable in adherence to lifestyle behaviors but not medications.

These results may be translated into clinically relevant information. A 10-point change on the MCS represents one standard deviation in national validation studies (Gandek et al., 1998). Therefore, a 10 point (or 1 standard deviation) change in MCS may be associated with a 31% change in the probability that patients will report difficulty adhering to dietary recommendations, a 28% change in the probability that patients will report difficulty adhering to exercise recommendations, and a 24% change in the probability that the patient will be a current smoker.

In this sample, being married increased the probability of being adherent to medications and being a non-smoker. Spousal assistance may be associated with increased adherence through providing practical support (e.g., reminding patient to take medications) or by improving patients' self-concept (Shumaker & Hill, 1991). Interestingly, no relationship was found between marital status and difficulty adhering to dietary and exercise recommendations. This contradicts earlier studies that have demonstrated the positive impact of marital status on promoting diet and exercise changes (Kyngas & Lahdenpera, 1999). Future research will help understand the differential impact of marital status on adherence to a variety of recommendations in hypertension management.

Results from this study provide further evidence that assessing emotional distress in a primary care setting may be an important component of hypertension management. We speculate that interventions targeting emotional health may impact adherence to lifestyle recommendations without impacting medication adherence. On the other hand, interventions enhancing social resources may improve medication adherence and increase chances of smoking cessation, but may not mitigate difficulty adhering to dietary or exercise recommendations. The latter is consistent with randomized clinical trials demonstrating that enhancing the network through follow-up from medical personnel and a strong physician-patient alliance can improve adherence to medication regimens and smoking cessation (Cobb, Brown, & Davis, 2006; Fuertes et al., 2007; Lumley, Oliver, Chamberlain, & Oakley, 2004; Pi-Sunyer, 2006; Stewart et al., 2005). Future investigations examining treatment adherence should consider the impact of support received by various sources such as spouses, family or other friends.

This study has certain limitations. First, this study is based on cross-sectional data which limits any interpretation regarding causal direction. Therefore, while it is possible that emotional well-being impacts adherence to lifestyle recommendations, the reverse also may be true. Second, adherence was based on self-report rather than an objective measure, such as pill-counting or pharmacy records of refills. This may have skewed the data in the direction of social desirability leading to over-estimated adherence rates. This is a widely documented limitation of self-report adherence measures (Bosworth et al., 2006; Morisky et al., 1986). Although objective measures of adherence are available, such as microelectric event monitoring, no one method is accepted as the "gold standard" for measuring medication adherence. In the absence of a "gold standard", the Morisky instrument (Morisky et al., 1986) affords ease of administration through a brief, valid, and reliable measure. As a measure of medication taking behavior, the Morisky instrument has been used in studies looking at cross-sectional data as well as prospective studies (Hamilton, 2003; Li, Wallhagen, & Froelicher, 2008). It has been validated against microelectric event monitoring, with a sensitivity of 72% and specificity of 74% for 80% or more adherence to tricyclic antidepressants (George, Peveler, Heiliger, & Thompson, 2000).

A third limitation concerns the use of marital status as a measure of social network. Marital status is a unidimensional measure that does not account for the quality of the relationship, the type of support (emotional versus instrumental), or the presence of other friends or family that may form a patients' social network. Fourth, single-item measures are psychometrically not as reliable or valid compared to multiple item measures of the same construct (McHorney, Ware, Rogers, Raczek, & Lu, 1992). In reality, this limitation would reduce our chances of finding an effect. The robust findings in this study despite using single-item measures provide impetus to future investigations using more sophisticated measures of social network, and adherence to dietary and exercise recommendations. Finally, findings related to smoking status should be interpreted with caution, as only 16% of our sample was current smokers.

Despite these limitations, this study adds to the sparse literature examining the direct impact of psychosocial factors on BP levels in hypertensive patients. The results provide preliminary support for the need to assess emotional well-being and the presence of social support in a primary care setting. Future investigations will help determine whether early detection of and intervention on subclinical emotional distress might benefit the hypertensive patient through improved adherence to dietary and exercise recommendations, and whether enhancing social support will improve medication adherence.

Acknowledgments

This study was supported by NHLBI Grant R01 HL070713, the Pfizer Health Communication Initiative Award, and the American Heart Association Established Investigator Award, all awarded to Dr. Hayden Bosworth. Dr. Trivedi is supported by NRSA Grant 5-T32 HS000079-10. Dr. Ayotte is supported by a post-doctoral fellowship from the VA Office of Academic Affairs. The views expressed in this article are those of the authors and do not necessarily represent the views of the Department of Veterans Affairs. The PI of the study, Dr. Bosworth, has full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

References

Banegas JR, Guallar-Castillon P, Rodriguez-Artalejo F, Graciani A, Lopez-Garcia E, Ruilope LM. Association between awareness, treatment, and control of hypertension, and quality of life among older adults in Spain. American Journal of Hypertension. 2006; 19(7):686–693. [PubMed: 16814122]

Bardage C, Isacson DG. Hypertension and health-related quality of life. an epidemiological study in Sweden. Journal of Clinical Epidemiology. 2001; 54(2):172–181. [PubMed: 11166533]

Becker MH, Maiman LA. Sociobehavioral determinants of compliance with health and medical care recommendations. Medical Care. 1975; 13(1):10–24. [PubMed: 1089182]

Bosworth HB, Bartash RM, Olsen MK, Steffens DC. The association of psychosocial factors and depression with hypertension among older adults. International journal of geriatric psychiatry. 2003; 18(12):1142–1148. [PubMed: 14677147]

Bosworth HB, Dudley T, Olsen MK, Voils CI, Powers B, Goldstein MK, et al. Racial differences in blood pressure control: potential explanatory factors. American Journal of Medicine. 2006; 119(1): 70 e79–15. [PubMed: 16431192]

Bosworth HB, Olsen MK, Dudley T, Orr M, Neary A, Harrelson M, et al. The Take Control of Your Blood pressure (TCYB) study: Study design and methodology. Contemporary Clinical Trials. 2007; 28(1):33–47. [PubMed: 16996808]

Burnier M. Medication adherence and persistence as the cornerstone of effective antihypertensive therapy. American Journal of Hypertension. 2006; 19(11):1190–1196. [PubMed: 17070434]

Burt VL, Whelton P, Roccella EJ, Brown C, Cutler JA, Higgins M, et al. Prevalence of hypertension in the US adult population. Results from the Third National Health and Nutrition Examination Survey, 1988–1991. Hypertension. 1995; 25(3):305–313. [PubMed: 7875754]

Caldwell JR, Theisen V, Kaunisto CA, Reddy PJ, Smythe PS, Smith DW. Psychosocial factors influence control of moderate and severe hypertension. Social Science & Medicine. 1983; 17(12): 773–782. [PubMed: 6879236]

Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL Jr, et al. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. JAMA. 2003; 289(19):2560–2572. [PubMed: 12748199]

Cobb SL, Brown DJ, Davis LL. Effective interventions for lifestyle change after myocardial infarction or coronary artery revascularization. Journal of the American Academy of Nurse Practitioners. 2006; 18(1):31–39. [PubMed: 16403210]

Cummings KM, Becker MH, Kirscht JP, Levin NW. Psychosocial factors affecting adherence to medical regiments in a group of hemodialysis patients. Medical Care. 1982; 20(6):567–580. [PubMed: 7109740]

Daly J, Sindone AP, Thompson DR, Hancock K, Chang E, Davidson P. Barriers to participation in and adherence to cardiac rehabilitation programs: a critical literature review. Progress in Cardiovascular Nursing. 2002; 17(1):8–17. [PubMed: 11872976]

DiMatteo MR. Social support and patient adherence to medical treatment: A meta-analysis. Health Psychology. 2004; 23(2):207–218. [PubMed: 15008666]

DiMatteo MR, Hays RD, Sherbourne CD. Adherence to cancer regimens: implications for treating the older patient. Oncology (Williston Park). 1992; 6(2 Suppl):50–57. [PubMed: 1532737]

DiMatteo MR, Lepper HS, Croghan TW. Depression is a risk factor for noncompliance with medical treatment: meta-analysis of the effects of anxiety and depression on patient adherence. Archives of Internal Medicine. 2000; 160(14):2101–2107. [PubMed: 10904452]

Dimenas ES, Wiklund IK, Dahlof CG, Lindvall KG, Olofsson BK, De Faire UH. Differences in the subjective well-being and symptoms of normotensives, borderline hypertensives and hypertensives. Journal of Hypertension. 1989; 7(11):885–890. [PubMed: 2607142]

Elmer PJ, Grimm R Jr, Laing B, Grandits G, Svendsen K, Van Heel N, et al. Lifestyle intervention: results of the Treatment of Mild Hypertension Study (TOMHS). Preventive Medicine. 1995; 24(4):378–388. [PubMed: 7479629]

Fuertes JN, Mislowack A, Bennett J, Paul L, Gilbert TC, Fontan G, et al. The physician-patient working alliance. Patient Education & Counseling. 2007; 66(1):29–36. [PubMed: 17188453]

Gandek B, Ware JE, Aaronson NK, Apolone G, Bjorner JB, Brazier JE, et al. Cross-validation of item selection and scoring for the SF-12 Health Survey in nine countries: results from the IQOLA Project. International Quality of Life Assessment. Journal of Clinical Epidemiology. 1998; 51(11): 1171–1178. [PubMed: 9817135]

Garfield FB, Caro JJ. Compliance and hypertension. Current Hypertension Reports. 1999; 1(6):502–506. [PubMed: 10981113]

George CF, Peveler RC, Heiliger S, Thompson C. Compliance with tricyclic antidepressants: the value of four different methods of assessment. British Journal of Clinical Pharmacology. 2000; 50(2): 166–171. [PubMed: 10930969]

Glassman AH, Helzer JE, Covey LS, Cottler LB, Stetner F, Tipp JE, et al. Smoking, smoking cessation, and major depression. JAMA. 1990; 264(12):1546–1549. [PubMed: 2395194]

Hamilton GA. Measuring adherence in a hypertension clinical trial. European Journal of Cardiovascular Nursing. 2003; 2(3):219–228. [PubMed: 14622630]

He J, Muntner P, Chen J, Roccella EJ, Streiffer RH, Whelton PK. Factors associated with hypertension control in the general population of the United States. Archives of Internal Medicine. 2002; 162(9):1051–1058. [PubMed: 11996617]

Kim MT, Han HR, Hill MN, Rose L, Roary M. Depression, substance use, adherence behaviors, and blood pressure in urban hypertensive black men. Annals of Behavioral Medicine. 2003; 26(1):24–31. [PubMed: 12867351]

Koertge J, Weidner G, Elliott-Eller M, Scherwitz L, Merritt-Worden TA, Marlin R, et al. Improvement in medical risk factors and quality of life in women and men with coronary artery disease in the Multicenter Lifestyle Demonstration Project. American Journal of Cardiology. 2003; 91(11): 1316–1322. [PubMed: 12767423]

Kulkarni SP, Alexander KP, Lytle B, Heiss G, Peterson ED. Long-term adherence with cardiovascular drug regimens. American Heart Journal. 2006; 151(1):185–191. [PubMed: 16368315]

Kyngas H, Lahdenpera T. Compliance of patients with hypertension and associated factors. Journal of Advanced Nursing. 1999; 29(4):832–839. [PubMed: 10215974]

Li WW, Wallhagen MI, Froelicher ES. Hypertension control, predictors for medication adherence and gender differences in older Chinese immigrants. Journal of Advanced Nursing. 2008; 61(3):326–335. [PubMed: 18197867]

Lichtenstein AH, Appel LJ, Brands M, Carnethon M, Daniels S, Franch HA, et al. Diet and lifestyle recommendations revision 2006: a scientific statement from the American Heart Association Nutrition Committee. Circulation. 2006; 114(1):82–96. [PubMed: 16785338]

Lumley J, Oliver SS, Chamberlain C, Oakley L. Interventions for promoting smoking cessation during pregnancy. Cochrane Database System Reviews. 2004; (4):CD001055.

McHorney CA, Ware JE Jr, Rogers W, Raczek AE, Lu JF. The validity and relative precision of MOS short- and long-form health status scales and Dartmouth COOP charts. Results from the Medical Outcomes Study. Medical Care. 1992; 30(5 Suppl):MS253–265. [PubMed: 1583937]

Miller ER 3rd, Erlinger TP, Young DR, Jehn M, Charleston J, Rhodes D, et al. Results of the Diet, Exercise, and Weight Loss Intervention Trial (DEW-IT). Hypertension. 2002; 40(5):612–618. [PubMed: 12411452]

Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of a self-reported measure of medication adherence. Medical Care. 1986; 24(1):67–74. [PubMed: 3945130]

Morris AB, Li J, Kroenke K, Bruner-England TE, Young JM, Murray MD. Factors associated with drug adherence and blood pressure control in patients with hypertension. Pharmacotherapy. 2006; 26(4):483–492. [PubMed: 16553506]

Moum T, Naess S, Sorensen T, Tambs K, Holmen J. Hypertension labelling, life events and psychological well-being. Psychology & Medicine. 1990; 20(3):635–646.

Pi-Sunyer FX. Use of lifestyle changes treatment plans and drug therapy in controlling cardiovascular and metabolic risk factors. Obesity. 2006; 14(Suppl 3):135S–142S. [PubMed: 16931495]

Psaty BM, Lumley T, Furberg CD, Schellenbaum G, Pahor M, Alderman MH, et al. Health outcomes associated with various antihypertensive therapies used as first-line agents: a network meta-analysis. JAMA. 2003; 289(19):2534–2544. [PubMed: 12759325]

Rehman SU, Hutchison FN, Hendrix K, Okonofua EC, Egan BM. Ethnic Differences in Blood Pressure Control Among Men at Veterans Affairs Clinics and Other Health Care Sites. Archives of Internal Medicine. 2005; 165(9):1041–1047. [PubMed: 15883244]

Rosenstock IM, Strecher VJ, Becker MH. Social learning theory and the Health Belief Model. Health Education Quarterly. 1988; 15(2):175–183. [PubMed: 3378902]

Rosenthal T, Oparil S. Hypertension in women. Journal of Human Hypertension. 2000; 14(10–11): 691–704. [PubMed: 11095160]

Sacks FM, Svetkey LP, Vollmer WM, Appel LJ, Bray GA, Harsha D, et al. Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. DASH-Sodium Collaborative Research Group. New England Journal of Medicine. 2001; 344(1):3–10. [PubMed: 11136953]

Sherbourne CD, Hays RD, Ordway L, DiMatteo MR, Kravitz RL. Antecedents of adherence to medical recommendations: results from the Medical Outcomes Study. Journal of Behavioral Medicine. 1992; 15(5):447–468. [PubMed: 1447757]

Shumaker SA, Hill DR. Gender differences in social support and physical health. Health Psychology. 1991; 10(2):102–111. [PubMed: 2055208]

Simonsick EM, Wallace RB, Blazer DG, Berkman LF. Depressive symptomatology and hypertension-associated morbidity and mortality in older adults. Psychosomatic Medicine. 1995; 57(5):427–435. [PubMed: 8552732]

Sobel, ME. Asymptotic intervals for indirect effects in structural equations models. In: Leinhart, S., editor. Sociological methodology. San Francisco: Jossey-Bass; 1982. p. 290-312.

Stewart A, Noakes T, Eales C, Shepard K, Becker P, Veriawa Y. Adherence to cardiovascular risk factor modification in patients with hypertension. Cardiovascular Journal of South Africa. 2005; 16(2):102–107. [PubMed: 15915277]

The ALLHAT Officers and Coordinators for the ALLHAT Collaborative Research Group. Major outcomes in high-risk hypertensive patients randomized to angiotensin-converting enzyme inhibitor or calcium channel blocker vs diuretic: The Antihypertensive and Lipid-Lowering Treatment to Prevent Heart Attack Trial (ALLHAT). JAMA. 2002; 288(23):2981–2997. [PubMed: 12479763]

Wang PS, Bohn RL, Knight E, Glynn RJ, Mogun H, Avorn J. Noncompliance with antihypertensive medications: the impact of depressive symptoms and psychosocial factors. Journal of General Internal Medicine. 2002; 17(7):504–511. [PubMed: 12133140]

Ware J Jr, Kosinski M, Keller SD. A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. Medical Care. 1996; 34(3):220–233. [PubMed: 8628042]

Wells KB, Stewart A, Hays RD, Burnam MA, Rogers W, Daniels M, et al. The functioning and well-being of depressed patients. Results from the Medical Outcomes Study. JAMA. 1989; 262(7):914–919. [PubMed: 2754791]

Whelton PK, Appel LJ, Espeland MA, Applegate WB, Ettinger WH Jr, Kostis JB, et al. Sodium reduction and weight loss in the treatment of hypertension in older persons: a randomized controlled trial of nonpharmacologic interventions in the elderly (TONE). TONE Collaborative Research Group. JAMA. 1998; 279(11):839–846. [PubMed: 9515998]

White WB. Improving blood pressure control and clinical outcomes through initial use of combination therapy in stage 2 hypertension. Blood pressure monitoring. 2008; 13(2):123–129. [PubMed: 18347448]

Table I

Baseline Characteristics

N	**636**
Age (M ± SD), years	61.25 ±12.32 (Range: 25–92 y)
Gender, N (%)	420 Female (66%)
Race	48.4% White, 49.06 % Black, 2.5% Other
Married, N (%)	320 (50.47%)
Current Smokers, N (%)	130 (16.4%)
Baseline SBP, mm Hg	125.0 ± 17.7
Baseline DBP, mm Hg	71.3 ±10.8

Table II

Simple Correlations between Explanatory and Criterion Variables[a]

Variables	SBP	DBP	MCS	Age	Race	Marital Status	Medication Adherence	Difficulty Adhering to Diet	Difficulty Adhering to Exercise	Current Smoking	Gender
SBP	-										
DBP	.58*†	-									
MCS	−.06	−.14*†	-								
Age	.04	−.40*†	.26*†	-							
Race	−.19*†	−.23*†	.11**	.16*†	-						
Marital Status	−.03	−.02	.14*†	.02	.35**	-					
Medication Adherence	−.12**	−.16*†	.16*†	.13**	.27*†	.19*†	-				
Difficulty Adhering to Diet	−.01	−.02	.18*†	.13**	.08	.01	.08*	-			
Difficulty Adhering to Exercise	−.01	−.01	.18*†	.14*†	.06	.10*	.09*	.39*†	-		
Current Smoking	−.05	.06	−.16*†	−.17*†	.14*	−.18*†	−.09*	.01	−.06	-	
Gender	−.01	.07	.11**	.05	.18**	−.30**	−.01	−.04	−.01**	−.03	-

[a]Shaded cells represent phi co-efficients between two dichotomous variables

*p<.05,

**p<.01,

*†p<.001

Table III

Correlates of Baseline Blood Pressure

Variable	Systolic Blood Pressure		Diastolic Blood Pressure	
	β	*p*	β	*p*
MCS†	−.08	.06	−0.4	.21
Marital Status (Married vs. Not Married)	.05	.25	.02	.56
Age	.10	<.05	−.37	<.0001
Race (White vs. Non-white)	−.22	<.0001	−.19	<.0001
Gender (Female vs. Male)	−.02	.66	−.12	<.01

β=Standardized co-efficient

†Standardized β's represent the increase in SBP or DBP per 1 unit change in MCS Scores

Table IV

Correlates of Adherence to Medications and Lifestyle Recommendations (Diet, Exercise, & Smoking)

Variable	Adherence to Medications	Difficulty Adhering to Dietary Recommendations	Difficulty Adhering to Exercise Recommendations	Current Smoking Status
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
MCS†	1.01 (1.00, 1.03)	.97*† (.95, .99)	.97** (.96, .99)	.98* (.96, .99)
Marital Status (Married vs. Not married)	1.66** (1.14, 2.41)	1.06 (.74, 1.52)	.70 (.49, 1.01)	.34*† (.20, .57)
Age	1.01 (1.00, 1.03)	.99* (.97, .999)	.98** (.97, .996)	.97** (.95, .99)
Race (White vs. Non- white)	2.38*† (1.66, 3.41)	1.18 (.83, 1.68)	1.41 (.99, 2.01)	.73 (.45, 1.189)
Gender (Female vs. Male)	1.50* (1.03, 2.20)	1.14 (.80, 1.64)	1.43 (.99, 2.07)	.50** (.31, .83)
Medication Side Effects	.93* (.88, .99)	—	—	—

OR=Odds Ratio; 95% CI=95% Confidence Interval;

* $p<.05$,

** $p<.01$,

*† $p<.0001$

† ORs represent the probability of having the outcome per 1 unit increase in MCS scores