Prevalence, Predictors and Correlates of Non-Adherence to a Hemodialysis Regimen: A Review of the Literature

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A review was conducted of the literature on prevalence, predictors and correlates of adherence to the therapeutic regimen in adults receiving hemodialysis (HD). Searches were conducted on Medline, PsycINFO and CINAHL from the years 1950 to 2007. Articles selected for this review met the following inclusion criteria: subjects were adult HD patients, at least one predictor or correlate of adherence was studied and at least one adherence outcome was included. Sixty-nine articles were included in the review. Rates, predictors and correlates of non-adherence (NA) varied widely. Young age and smoking were the only variables that consistently predicted NA. Suggestions for practice and future research are described.

INTRODUCTION

End-stage renal disease (ESRD) has steadily increased in prevalence in the United States (U.S. Renal Data System, 2005). In-center hemodialysis (HD) is the most common treatment, with 90.7% of those with ESRD choosing this modality in 2003 (U.S. Renal Data System, 2005). Adherence to the long-term, complex regimen leading to successful HD treatment has been shown to be challenging with rates of non-adherence (NA) from 2 to 50% (Leggat et al., 1998) and as high as 86% (Bame et al., 1993). The World Health Organization defines adherence as "The extent to which a person's behavior (taking medications, following a recommended diet and/or executing life-style changes) corresponds with the *agreed* recommendations of a health care provider" (Sabate, 2003, p. 13). Successful HD therapy requires adherence to dialysis treatment, diet, medication and fluid goals. Diet intake of protein, sodium and potassium must be limited because excretion by the kidney is compromised. Medications must be taken to treat ESRD and associated morbidities. For example, phosphate binders are routinely administered to enhance intestinal phosphate excretion because normal kidney excretion is limited. Fluids must be restricted because the failing kidney cannot excrete excess fluids. The Dialysis Outcomes and Practice Patterns Study revealed that NA significantly increases the risk of hospitalization and mortality (Saran et al., 2003). NA with dialysis treatments, diet, medications and fluids may result in nausea, weakness, metabolic disturbances, bone demineralization, pulmonary edema, cardiovascular damage and death (Bame et al., 1993; Chan & Greene, 1994). The purpose of this study was to conduct a review of the literature of prevalence, predictors and correlates of adherence to the HD regimen in adults receiving HD.

METHODS

Searches were conducted on Medline, PsycINFO and CINAHL databases using the key words *hemodialysis*, *haemodialysis*, *fluid adherence*, *fluid compliance*, *diet adherence*, *diet compliance*, *medication adherence*, *medication compliance*, *adherence* and *compliance*. Medline was searched from 1950 to 2007, CINAHL from 1982 to 2007, and PsycINFO from 1967 to 2007. Articles written in English were evaluated for inclusion. Finally, ancestry searches were conducted on all eligible studies. Articles selected for this review met the following inclusion criteria: subjects were adult HD patients ages 18 years and older, at least one predictor of adherence was studied using a correlation statistic, and at least one adherence outcome was studied.

The following information was abstracted from each article: author, year, purpose, sample size, age, gender, ethnicity, time on dialysis, country of study, theoretical framework, methods, single- or multi-center study and measures. In addition, the following questions were answered from each study's results: Is smoking, social support, depression, ethnicity, education level, time on dialysis or age a predictor or correlate of NA? What is the diet NA rate? The following outcomes were extracted from the studies: What was the level of serum phosphorus NA? What was the level of serum calcium NA? What was the level of serum albumin NA? What was the level of serum potassium NA? What is the fluid NA rate? What was the level of NA to interdialytic weight gain (IDWG)? What was the level of NA to treatment

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as measured by KT/V? Was the sample adherent to treatment as measured by missed or shortened dialysis treatments? Was the sample adherent to medications? What other demographic predictors were found? What cognitive and affective predictors were found? What other predictors were found? Due to space constraints, Appendix A (page 21) presents the following information collected from the studies: author, year, purpose, sample size, age, gender, ethnicity, time on dialysis, country of study, theoretical framework, methods, single- or multi-center study and measures. A table of the other measures is available from the corresponding author upon request.

RESULTS

Sixty-nine articles were included in the review. The sample sizes ranged from 15 (Zetin et al., 1981) to 11,422 participants (Hecking et al., 2004). The mean age ranged from 24 years (Chan & Greene, 1994) to 70 years (Berman et al., 2004). The percentage of male subjects ranged from 30% (Brady et al., 1997) to 81% (Kimmel et al., 1996). Slightly less than half of the studies (n = 34) reported subject ethnicity with many different ethnicities represented. One study included all African Americans (Long et al., 1998), one all Turkish subjects (Taskapan et al., 2005), one all Chinese subjects (Lee & Molassiotis, 2002) and one all Japanese subjects (Takaki & Yano, 2006). The average number of months on dialysis ranged from 6.7 months (Wenerowicz et al., 1978) to 140.58 months (Wiebe & Christensen, 1997). Seventy-one percent of the studies (n = 49) were conducted exclusively in the United States. Four of the studies were published in the 1970s, 12 in the 1980s, 34 in the 1990s and 19 thus far in the 2000s.

Most studies used a mixed design with the predictor variables typically obtained using a cross-sectional, survey approach while the outcome measures were collected in a longitudinal fashion (averaged over several months). Only 16 articles mentioned using a theory-based intervention. The most frequently used theoretical model was the Health Belief Model, used by six studies. Forty-six (66%) were multi-center in nature.

Gender and NA

Twenty-nine reports examined the relationship between gender and NA. Of them, 17 (59%) reported no statistically significant correlation between gender and NA. Of the remaining 41% (n = 12) that found a significant relationship, the findings were varied with both men and women adherent and non-adherent to outcomes.

Smoking and NA

Of the 69 studies, 6 examined the relationship between smoking and NA. All six studies found that smoking was correlated with poor adherence outcomes. Kugler and colleagues (2005) found that smoking was significantly correlated with diet NA frequency and degree and fluid NA frequency and degree. Leggat and colleagues (1998) discovered that smokers were more likely to be non-adherent than nonsmokers for skipped and shortened treatments, IDWG and elevated phosphorus levels. Saran and colleagues (2003) noted that smokers were 1.53 times more likely to miss treatments, 1.43 times more likely to have increased IDWG, 1.10 times more likely to have elevated phosphorus levels and 0.96 times more likely to have elevated potassium levels. Similarly, Takaki and colleagues (2003) found that smoking was correlated with IDWG (p = 0.0015). Unruh and colleagues (2005) noted that smoking was correlated with missed treatments ($p \leq 0.01$) while Kutner and colleagues (2002) discovered that smoking was correlated with missing treatments (p = 0.01), shortening treatments (p = 0.02) and non-adherent phosphorus levels (p = 0.002).

Social Support and NA

Of the 21 studies that examined the relationship between social support and NA, most of the studies (62%; n = 13) found a significant correlation with lower social support associated with poorer adherence outcomes. One study found mixed results with frequency of fluid NA correlated with social support (p = 0.005), while diet NA was not substantiated (Kugler et al., 2005).

Depression and NA

Eleven studies conducted analyses on the correlation between depression and NA. Of them, six found that depression was not significantly correlated with NA while five found significant correlations. For example, Saran and colleagues (2003) in the DOPPS study found that those who were depressed were 1.62 times more likely to skip treatments (p <0.05) and 1.22 times more likely to shorten treatments (p <0.05). Depression was not significantly correlated with IDWG, elevated phosphorous levels or elevated potassium levels. Taskapan et al. (2005) studied a sample of 40 Turkish subjects and found 65% were depressive, anxious or had a somatoform disorder. In those with depression or a somatoform disorder, IDWG was significantly higher than that of patients without these disorders (p <0.05). Conversely, Berman et al. (2004), using the Beck Depression Inventory, did not find a statistically signifi-

cant correlation between depression and the number of missed or shortened dialysis sessions during a 4-month period. Similarly, Oka and Chaboyer (2001) found no correlation between depression, neurotic tendencies and somatic symptoms, measured by the Mental Health and the Somatic Symptoms Scales, and dietary behavior, measured by the Dietary Behavior Scale, in a sample of 325 Japanese subjects.

Ethnicity and NA

Eighteen of the studies described relationships between ethnicity and NA. Half ($n = 9$) of the studies found a statistically significant association; the others did not. The studies that examined ethnicity most frequently reported differences between Caucasians and African Americans. Those conducted outside of the United States did not typically examine the influence of ethnicity on NA.

Education and NA

Twenty-three of the studies examined the relationship between educational preparation and NA with 21 of 23 documenting no statistically significant relationship between educational preparation and NA. Two studies found a statistically significant relationship (Christensen et al., 1997a; Weed-Collins & Hogan, 1989).

Time on Dialysis and NA

Time on dialysis was examined in 27 of the studies with 11 of 27 finding a significant correlation between time on dialysis and NA; however, 16 of 27 found no significant correlation. Of those finding significant correlations ($n = 11$), seven showed positive correlations between time on dialysis and NA outcomes (i.e., those on dialysis for longer periods of time were more non-adherent). For example, Kugler and colleagues (2005) found that time on dialysis was significantly correlated with degree of diet ($p = 0.003$) and fluid ($p = 0.015$) NA, but not with frequency of diet and fluid NA. Saran and colleagues (2003) noted that those with longer time on dialysis were 1.05 times more likely to shorten treatments, 1.07 times more likely to have IDWG and 1.03 times more likely to have elevated potassium. Saran et al. (2003) also found that a longer time on dialysis was not significantly correlated with shortened dialysis treatments or elevated phosphorus levels. Takaki and colleagues (2003) discovered that higher potassium ($p = 0.0009$) and phosphorus levels ($p = 0.0093$) were correlated with duration of dialysis. On the other hand, 4 of the 11 found negative correlations between time on dialysis and NA (i.e., those on dialysis for shorter periods of time were more non-adherent; Berman et al., 2004; Bollin & Hart, 1982; Boyer et al., 1990; Gordon et al., 2003).

Age and NA

Of the 40 studies that examined the correlation between age and dialysis outcomes, 28 found a significant correlation. Of those 28, 25 found that younger age was correlated with greater NA to dialysis outcomes such as missed or shortened dialysis treatments, potassium and phosphorus blood levels, diet and fluid balance. Only two articles determined that older age was associated with increased NA. One of the 28 found that age was correlated with IDWG ($p < 0.05$), but the correlation disappeared when education was controlled for (Chan & Greene, 1994).

Diet NA Rate

Twelve of the studies identified diet NA rates. The rates varied dramatically from 14% (Cummings et al., 1982) to 74% (Chan & Greene, 1994). Measures of diet NA rates varied as well. For example, Cummings and colleagues (1982) used 2 to 3 weeks of serum potassium levels abstracted from the medical records to measure dietary NA, while Chan and Greene (1994) used potassium and IDWG to measure dietary NA. Measurement in other reports varied as well. Using an author-developed dietary knowledge questionnaire, Durose et al. (2004) found a self-reported 35% NA rate with one or more dietary restrictions. Kugler et al. (2005) used the diet and fluid NA self-report questionnaire to document a dietary NA rate of 81.6% for the previous 14 days. Lee and Molassiotis (2002) used both blood levels and self-report to measure dietary NA. They found 35.5% NA as measured by both serum potassium and phosphorus levels. Self-report over the previous 7 days was documented at a similar rate of 34% using a Likert scale with two questions. Leggat and colleagues (1998), using a single dietary measure of serum phosphorus of greater than 7.5 mg/dL to measure dietary NA, found a rate of 22% NA.

Phosphorus Levels and NA

Twelve studies examined serum phosphorus level and NA. Phosphorus levels were calculated and presented in various ways. Durose et al. (2004) found that 69% achieved a serum phosphorus level of 5.88 mg/dL (1.9 mmol/L). Lee and Molassiotis (2002) found that 43.5% had a mean phosphorus level of 6.8 mg/dL (2.19 mmol/L). Leggat et al. (1998) found 22% had a phosphorus level greater than 7.5 mg/dL. Similarly, Saran et al. (2003) found a rate of phosphorus greater than 7.5 mg/dL

in 13.7% of subjects. Hecking et al. (2004) found that 11.7% were greater than 7.5 mg/dL. Several studies presented mean phosphorus levels that ranged from 4.87 (Kugler et al., 2005) to 6.78 (Lee & Molassiotis, 2002). Although Taskapan et al. (2005) focused on differences in adherence between people with and without psychiatric disorders, the mean phosphorus level was 4.7 mg/dL for those with psychiatric disorders and 5.2 mg/dL for those without.

Several research groups examined the correlation between phosphorus and NA. For example, Kugler et al. (2005) found that a mean phosphorus level of 4.87 mg/dL was positively correlated with NA ($p = 0.002$) and also positively correlated with frequency of fluid NA ($p = 0.0001$). Zrinyi et al. (2003) examined phosphorus level as a predictor for adherence and found that it did not significantly contribute to predicting patients' compliance behaviors (b = –0.019; $p = 0.867$).

Calcium Levels and NA

A single study examined serum calcium levels and NA (Taskapan et al., 2005). Taskapan et al. (2005) examined 40 HD patients to determine the impact of psychiatric disorders on fluid restrictions, nutritional status and quality of life. Those with psychiatric disorders had a mean calcium level of 8.7 mg/dL, whereas those without psychiatric disorders had a mean calcium level of 8.8 mg/dL. The presence of a psychiatric disorder did not predict adherence with diet as measured by serum calcium.

Potassium Levels and NA

Six studies described potassium NA rates but comparison of results is difficult because various normal ranges were used. NA rates ranged from 10.8% (serum potassium >6 meq/L) to 29.1% (goal serum potassium average <5.59 mg/dL; Lin & Liang, 1997; Saran et al., 2003). One study found that serum potassium level was negatively correlated with active coping ($p = 0.0075$; Takaki et al., 2003), while another study found no relationship between serum potassium and NA with IDWG (Sensky et al., 1996).

Albumin Levels and NA

Several studies described correlations between serum albumin levels and NA. For example, Kugler et al. (2005) found that serum albumin level positively correlated with frequency and degree of diet NA ($p = 0.0001$ and $p = 0.0001$, respectively) and frequency and degree of fluid NA ($p = 0.015$ and $p = 0.0001$, respectively). Similarly, Zrinyi and colleagues (2003) discovered that albumin significantly contributed to predicting patients' adherence behaviors (b = 0.102; $p = 0.003$). Taskapan et al. (2005) found that those with psychiatric disorders had a mean level of 3.5 mg/dL, whereas those without psychiatric disorders had a mean albumin level of 3.65 mg/dL. Another study described mixed findings. Unruh and colleagues (2005) showed no significant difference in serum albumin between those who skipped dialysis treatments and those who did not. They also found no significant difference between those with phosphate levels higher than 5.5 mg/dL and those with a phosphate level of 5.5 mg/dL or lower. However, they did find a statistically significant difference in albumin between those with potassium 5.0 mg/dL or lower (albumin 3.62 mg/dL ± 0.36) and those with potassium higher than 5.0 mg/dL (albumin 3.68 mg/dL ± 0.30). Hecking et al. (2004) compared practice patterns in dialysis prescription across countries and found that pre-dialysis albumin ranged from 3.73 g/dL in the United Kingdom to 4.14 g/dL in Germany. No efforts were made to correlate albumin with adherence.

Rate of Fluid NA

Fluid NA rates were reported in 12 studies with ranges from 10% (>5.7% IDWG; Leggat et al., 1998) to 71% (Chan & Greene, 1994). Hecking et al. (2004) noted that relatively high IDWG values were observed in Italy and France, with lowest in United Kingdom and Germany. Taskapan et al. (2005) found that those with psychiatric disorders had significantly higher IDWG ($p < 0.05$) than those without psychiatric disorders.

Medication NA Rate

Six studies calculated medication NA rates. Curtin et al. (1999) found that the medication NA rate was 52% for antihypertensive medications and 70% for phosphate binders as measured by electronic monitoring. Long et al. (1998) showed that medication adherence was 0.11 to 1.00 (M = 0.57; SD = 0.28) for 15 subjects as measured by pill counts. Cummings et al. (1982) recorded high medication NA rates at 70%. Two studies evaluated predictors of medication NA with mixed results (Christensen & Smith, 1995; Christensen et al., 1994). Lower levels of conscientiousness were correlated with NA to medications ($p < 0.05$) while vigilance and dialysis type were not associated with medication NA.

Rates of Missed or Shortened Dialysis Treatments

Thirteen studies described rates of missed or shortened dialysis treatments. Rates of missed dialysis treatments ranged from 0.6% (Hecking et al., 2004) to 38%

(Gordon et al., 2003). Various lengths of time were used to calculate missed or shortened treatments. For example, Hecking et al. (2004) followed treatments for 1 month while Gordon et al. (2003) used 3 months for their analysis.

When shortened treatment rates were examined, Unruh et al. (2005) documented the lowest rate of 1.28% while Gordon et al. (2003) documented the highest rate of 92%. Unruh et al. (2005) examined medical records retrospectively for an average of 938 days for the group.

Other Predictors of Adherence

Varied psychosocial predictors of NA were examined in these studies using diverse instruments. Several predictors were examined in sufficient numbers of studies to warrant discussion here, including locus of control, knowledge and satisfaction. Locus of control was examined in 9 studies. Locus of control may assist in identifying how individuals perceive the link between their behavior and resulting outcomes. Those with an external locus of control believe that outcomes are not influenced by their specific behaviors, while those with an internal locus of control believe that they are responsible for their own well-being. The hypothesis then follows that those with higher levels of external locus of control might be more non-adherent. Four studies found no correlation between external locus of control and NA behaviors (Blackburn, 1977; Bollin & Hart, 1982; Brown & Fitzpatrick, 1988; Pang et al., 2001), four studies found significant correlations between external locus of control and NA (Lin & Liang, 1997; Poll & De-Nour, 1980; Schneider, 1992; Zetin et al., 1981), and one found mixed results with external and internal locus of control correlating with NA (Wenerowicz et al., 1978).

Several studies examined knowledge as a predictor of adherence in HD patients. Durose and colleagues (2004) found that knowledge of dietary restrictions and the medical consequences of NA were predictive of dietary compliance but in the opposite direction expected; those with better phosphorus knowledge and better knowledge about medical complications from NA were less likely to be adherent to phosphorus ($p = 0.03$ and $p = 0.002$, respectively) and those with better knowledge about medical complications from NA were also less likely to be adherent to sodium and fluid restrictions ($p = 0.008$).

Two studies correlated knowledge and NA with results in the direction expected. Chan and Greene (1994) examined dietary adherence in a group of young HD patients (mean age 24 years) and found that those who could identify their sodium regimens had a lower average IDWG that those who could not ($p = 0.05$). The researchers also noted that perceived difficulty in following fluid restrictions was correlated to IDWG ($p < 0.01$). Katz and colleagues (1998) studied 56 HD patients in the United States with an average age of 60.5 years using the health belief model as a framework. They used a composite objective score of NA that incorporated serum potassium, serum phosphorus and IDWG. The researchers found that lower knowledge was correlated with NA ($p = 0.02$) and this association was moderated by age (younger patients were more knowledgeable and more adherent). However, when NA was measured by self-report, no correlation was noted between knowledge scores and NA.

Finally, two studies found no correlation between knowledge and adherence. Lee and Molassiotis (2002) studied dietary knowledge in Chinese HD patients and found no statistically significant correlations between dietary knowledge and adherence. Greater number of perceived barriers ($p < 0.05$), lower residual urine output ($p < 0.01$), more hours on HD ($p < 0.01$), working ($p < 0.01$) and having food prepared by someone else ($p = 0.051$) increased diet and/or fluid NA. In a U.S. study, Weed-Collins and Hogan (1989) found no correlations between knowledge of phosphate-binding medications, health beliefs (susceptibility, severity, benefits) and adherence. The researchers noted that the number of barriers identified by the patient as interfering with his/her ability to adhere was correlated with adherence ($p < 0.05$). The most frequently cited reasons for NA were forgetting by 50% and being away from home by 43% of the respondents.

Patient satisfaction has also been examined as a predictor of medication NA in several studies with mixed results. Kovac and colleagues (2002) found a statistically significant correlation between patient satisfaction and perception of caring shown by staff and patient albumin level. However, no correlation was found between patient satisfaction and phosphorus or KT/V, nor was a correlation found between patient perception of ancillary staff (nurses, dietitians, social work, technical workers) and adherence. However, patient satisfaction with the nephrologist was correlated with better dialysis attendance and total time on dialysis adherence. In another study by Kimmel and colleagues (1995), lower satisfaction with life, less disease severity and depression were correlated with phosphorus NA ($p < 0.05$ for all). However, Unruh et al. (2005) found no significant associations between quality of life, social

support, patient satisfaction and other maladaptive health behaviors and serum phosphorus adherence.

DISCUSSION

The existing research literature on prevalence, predictors and correlates of NA in adult HD patients was reviewed. The number of published articles increased dramatically each decade, indicating attention to this important challenge in adult HD patients.

Study sample sizes varied dramatically. No study reported conducting a power analysis to determine appropriate sample size. Several studies cited limitations in interpreting results due to small numbers of NA outcomes. The samples were typically obtained using a convenience sampling technique, which may limit the ability to make generalizations from these findings. This limitation is balanced by the demographic diversity across the studies. The studies included both younger and older adults. However, as the age at which patients initiating HD increases and those on the therapy live longer, studies of older HD patients' NA issues including NA prevalence, predictors and outcomes will be increasingly important to study.

Only about a quarter (23%) of the studies reported using a theoretical framework. Efforts to develop effective interventions studies to move the science in the area forward must be based on strong theoretical foundations. The reports included varied cultural groups, which provide a foundation for identifying and comparing predicators across cultures. Developing and testing culturally appropriate adherence interventions will also be enhanced with this strong foundational knowledge base (Russell, 2006).

The most frequently used methods involved a longitudinal approach to outcome data collection, over 2 to 6 months, while using a cross-sectional, survey approach to obtain the predictor data. While this approach is appropriate for studies examining stable predictors such as demographic information, this design does not account for possible variation in the unstable predictor variables such as depression, knowledge or satisfaction, which may change over time.

NA rates indicate that NA among HD patients is indeed a concerning problem. Diet NA rates were 14 to 74%, fluid NA from 10 to 71%, medication NA rates as high as 70%, missed dialysis treatments from 0.6 to 38% and shortened treatments with the broadest rate range of 1 to 92%. These broad ranges are likely influenced by the inconsistent use of NA outcome measures.

The link between certain demographic variables such as educational level and NA were clearly not supported in this review of the literature. Other results indicated mixed findings. Gender, time on HD, ethnicity and depression were not consistent predictors. Because many of the studies performed simple regression analyses, and not the more powerful multiple regression techniques, interaction effects between variables may have been overlooked.

Predictors that can be influenced by intervention provide the most value to health care providers for improving adherence. Identifying predictors may also assist in tailoring interventions to individual needs and expectations (Dec, 2006). The behavioral and effective predictors of smoking and low levels of social support were both correlated to HD NA. Nephrology social workers can incorporate this knowledge from our literature review into their clinical work. One suggestion would be implementing a smoking cessation program, which may indirectly improve non-adherent behaviors. Implementing smoking cessation interventions may improve both non-adherent behaviors. Another suggestion would be to focus on developing a network of support for the adult HD population. Interventions to address depression, either through brief therapy or groups, might be beneficial in improving adherence outcomes.

CONCLUSION

In summary, this group of 70 articles describes the prevalence, predictors and correlates of NA in adult HD patients. Demographic predictors, except for younger age, do not provide guidance to health care providers for early identification of those at risk for NA. Methodological issues such as inconsistent use of measures of predictor and outcome variables make comparison across studies difficult. Future research is clearly guided by this review. Future studies should be theory-based, use valid and reliable instruments, be planned with adequate power and use standardized outcome measures.

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APPENDIX A

Article Information

Author, Year, Location	Purpose	Sample Size, Mean Age, Age Range, Average Length of Time on Dialysis	Sex (% male) and Ethnicity (% most prevalent ethnicity)	Methods	Predictor Measures	NA Measure
Bame et al., 1993, Texas	To investigate the prevalence of NA behavior and examine variation in adherence with diet, fluid and medications	*N* = 1230; mean age: 59; age range: 18–90; average length of time on dialysis: NR	47.10% male; 43.4% African American; 14.4% Hispanic; 0.6% Asian	Multi-site cross-sectional, descriptive with longitudinal component	Demographic information	Diet NA: BUN (<100 mg/dL), K (<6.5), Phos med NA: Phos (6.0 or less), IDWG (<1 kg/day)
Basta, 1981, Mid-Atlantic United States	To compare differences in self-concept components between adherent and non-adherent HD patients	*N* = 80; mean age: NR; age range: NR; average length of time on dialysis: NR	NR	Multi-site descriptive, comparative	Background information form, Tennessee Self-Concept Scale, Rosenberg's Global Self-Esteem Scale	Composite score of fluid overload, IDWG, hypertension, K, BUN and missed dialysis treatments
Berman et al., 2004, United States	To describe the relationship between religiosity and with life and medical care satisfaction, social support, depression and adherence	*N* = 74; mean age: 54; age range: 21–84; average length of time on dialysis: 42 months	42% male; 89% African American	Single site survey	Hoge Intrinsic Religiosity Scale, Karnofsky Performance Scale (functional ability), Beck Depression Inventory, Multidimensional Scale of Perceived Social Support, Satisfaction with Life Scale, Satisfaction with Medical Care, Coping Behavior Scale, Schwartz Outcome Scale (satisfaction with life and mental status)	NA (number of missed dialysis treatments and shortened sessions in 4 months)

Author, Year, Location	Purpose	Sample Size, Mean Age, Age Range, Average Length of Time on Dialysis	Sex (% male) and Ethnicity (% most prevalent ethnicity)	Methods	Predictor Measures	NA Measure
Blackburn, 1977, Texas	To examine predictors of adherence to HD	*N* = 53; mean age: 42.55; age range: 7–72; average length of time on dialysis: 18.6 months	64% male; 60% Caucasian	Single-site longitudinal, descriptive	Demographic information; questionnaire to assess cognitive understanding of diet, fluid and medication instructions; Rotter Internal-External Scale; staff perceptions	K (3–5 mEq/L), phos 3.5–5.0 mg/100 mL, IDWG (>4 lb) for 3–14 months prior to survey
Bollin & Hart, 1982, Iowa	To examine the relationship between health beliefs, locus of control and relative health valuing and dietary adherence	*N* = 30; mean age: 51; age range: 21–76; average length of time on dialysis: 37.4 months	57% male; ethnicity NR	Multi-site cross-sectional, descriptive with longitudinal component; theory: health belief model	Health beliefs: Standardized Compliance Questionnaire, Health Locus of Control Scale, Relative Health Value	Fluid: 24-hour urine and IDWG calculation every fifth dialysis for 5 months, then scored; K: 6-month period scored, urine excretion also included; recall of dietary habits: scored
Borkman, 1976, United States	To identify the usefulness of staff's estimates of patients' intelligence levels or level of understanding of a restriction predicting dietary adherence	*N* = 661; mean age: NR; age range: 83% between 25–54; average length of time on dialysis: 22% on dialysis 18 months or more	75% male; ethnicity NR	Multi-site secondary data analysis; data from 1967	Staff-completed questionnaire regarding patient understanding of restrictions, estimated patient intelligence; physicians and nurses completed most questionnaires	Staff rated patients on water, salt and protein intake adherence

Boyer et al., 1990, New York	To explore the relationship between demographic variables, social support, situational factors and adherence	*N* = 60; mean age: NR; age range: NR; average length of time on dialysis: NR	71% male; 71% Caucasian	Multi-site cross-sectional, descriptive with longitudinal component	Social support: author-developed survey; patient's perception of social support, negative feed-back, absence of social support, family support, family report of negative feelings, staff-reported medical support, demographic and situational factors	Serum phos and BUN (5 months); K (13 dialysis treatments)
Brady et al., 1997, United States	To examine the impact of fluid adherence efficacy expectations, fluid adherence outcome expecta-tions and fluid adherence motivation on IDWG	*N* = 50; mean age: 61; age range: NR; average length of time on dialysis: 54.83 months	30% male; 74% African American	Multi-site descriptive, correlational; theory: Bandura's self-efficacy theory	Marlowe-Crowe Social Desirability Scale Short-Form, Fluid Adherence Self-Efficacy Questionnaire, Fluid Adherence Motivation Rating	IDWG (weekend)
Brown & Fitzpatrick, 1988, London	To examine psychosocial variables on dietary adherence	*N* = 41; mean age: 52; age range: NR; average length of time on dialysis: 81.6 months	51% male; ethnicity NR	Single-site cross-sectional, descriptive with longitudinal component	Multidimensional health locus of control, family support and the acceptance of dialysis questionnaires, patient's self-reported dietary adherence	IDWG, K, BUN; composite score calculated

Author, Year, Location	Purpose	Sample Size, Mean Age, Age Range, Average Length of Time on Dialysis	Sex (% male) and Ethnicity (% most prevalent ethnicity)	Methods	Predictor Measures	NA Measure
Chan & Greene, 1994, Pennsylvania	To describe dietary adherence in young chronic HD patients	*N* = 31; mean age: 24; age range: 15–30; average length of time on dialysis: 50.4 months	52% male; 71% Caucasian	Multi-site longitudinal survey	Dietary sodium and K-Hartman and Becker survey of factors associated with adherence, food frequency questionnaire	IDWG <2 kg; K <5.5 mEq/L
Christensen et al., 1990, Utah	Tested predictive interactive effects of person and treatment on self-reported depression and laboratory measures of adherence with both dietary and fluid-intake restrictions	*N* = 53 (34 in-center and 19 home HD patients); mean age: 42.37; age range: NR; average length of time on dialysis: in-center: 53.33 months, home: 115.74 months	In-center, 62% male; home, 42% male; ethnicity NR	Single-site cross-sectional, descriptive with longitudinal component	Krantz Health Opinion survey, behavioral involvement subscale, Beck Depression Inventory	Fluid: IDWG >4.5 lb averaged over 25 dialysis sessions; diet: serum K >5.5 mEq/L
Christensen et al., 1992, Utah	To examine the effects of social support and illness-related physical impairment on adherence	*N* = 81; mean age: 51.9; age range: NR; average length of time on dialysis: 75.3 months	51% male; ethnicity NR	Multi-site cross-sectional, descriptive with longitudinal component	Social support: family relationship index of the Family Environment Scale; physical impairment: Sickness Impact Profile	IDWG >4.5 kg averaged over 25 dialysis sessions; serum K >5.5 mEq/L

Christensen et al., 1994, Utah	To examine the effects of dialysis type and coping style (information vigilance and active coping) on diet and medication adherence	*N* = 86; 52 in-center HD patients and 34 CAPD patients; mean age: in-center HD 50.14, CAPD 46.49; age range: NR; average length of time on dialysis: 75.90 months (in-center), 67.89 months (CAPD)	In-center, 52% male; CAPD, 53% male; ethnicity NR	Single-site	Coping: internal and powerful others health locus of control subscales from the Multidimensional Health Locus of Control Scale and behavioral involvement and information preference subscales of the Krantz Health Opinion Survey and Miller Behavioral Styles Scale; depression: Beck Depression Inventory	Phos (≤2.0 mmol/L); K (3.5–6.5 mmol/L); IDWG (≤4% of dry body weight)
Christensen et al., 1995, Iowa	To examine the relationship of coping to adherence in two different types of stress situations (controllable and uncontrollable)	*N* = 57; mean age: 56.91; age range: NR; average length of time on dialysis: 73.02 months	44% male; ethnicity NR	Multi-site, cross-sectional, descriptive with longitudinal component	Coping: Ways of Coping Inventory; participant appraisals of the stressful encounter	Fluid NA-IDWG >2.5 kg averaged over 12 dialysis sessions
Christensen & Smith, 1995, Utah	To examine the association of the NEO Five-Factor Inventory to adherence	*N* = 72; mean age: 46.39; age range: NR; average length of time on dialysis: 73.11 months	54% male; ethnicity NR	Single-site, cross-sectional, descriptive with longitudinal component	NEO Five-Factor Inventory (extraversion, agreeableness, conscientiousness, neuroticism, openness to experience)	Diet: K; medication: phos

Author, Year, Location	Purpose	Sample Size, Mean Age, Age Range, Average Length of Time on Dialysis	Sex (% male) and Ethnicity (% most prevalent ethnicity)	Methods	Predictor Measures	NA Measure
Christensen et al. 1997a, Iowa	To describe how the relationship between self-monitoring and adherence is mediated by the tendency of high monitors to use avoidant coping strategies; control was also examined as a mediating variable	*N* = 51; mean age: 56.72; age range: 21–78; average length of time on dialysis: 51.28 months	59% male; ethnicity NR	Multi-site, cross-sectional, descriptive with longitudinal component; theory: monitoring process model	Monitoring dimension of the Miller Behavioral Styles Scale; A trait anxiety scale of the State-Trait Anxiety Scale; distancing and escape-avoidance subscales of the Ways of Coping Inventory; perceived control measured by Multidimensional Health Locus of Control Scales and a question about situation-specific control	Medication NA: phos >5.5 mEq/L; dietary NA: serum K <5.5 mEq/L
Christensen et al., 1997b, Iowa	To examine the role of cynical hostility and powerful others health locus of control expectancies in predicting regimen adherence	*N* = 48; mean age: 56.2; age range: 23–88; average length of time on dialysis: 65.09 months	54% male; ethnicity NR	Multi-site, cross-sectional, descriptive with longitudinal component	Patient expectations about health care providers was measured by the Multidimensional Health Locus of Control Scales; cynical hostility was measured by the Cook-Medley Hostility Scale	Fluid NA: IDWG >2.5 kg averaged over 12 dialysis sessions; diet and medication NA: phos >5.5 mg/dL

Cummings et al., 1982, Michigan	To examine the relationships of health beliefs, knowledge about the treatment regimen, regimen complexity, family and provider support and personal characteristics to adherence	*N* = 116; mean age: 54.8; age range: 21–74; average length of time on dialysis: 29 months	54% male; 50% Caucasian	Multi-site, cross-sectional, descriptive with longitudinal component	Survey on health beliefs, knowledge of regimen, knowledge of treatment instructions, regimen complexity, support from family and friends, support from medical staff and family problems	Med adherence: serum phosphorus (2–4 months before survey); diet: K (2–3 weeks), IDWG (2–3 weeks); patient self-report of adherence to outcomes
Curtin et al., 1999, United States	To describe the prevalence, severity, patterns and predictors of noncompliance with prescribed medications among HD patients	*N* = 135; mean age: 63.2; age range: 28–89; average length of time on dialysis: 15% on dialysis <1 year; 22% on dialysis for >5 years	47% male; 45% African American	Single-site, longitudinal descriptive	Demographic information from medical record	Medication adherence: electronic monitoring, pill counts, self-report (Wisconsin Brief Medication Questionnaire)
Cvengros et al., 2004, United States	To examine the joint role of perceived restriction of control and individual differences in preference for control in predicting adherence to the HD regimen	*N* = 49; mean age: 55.6; age range: NR; average length of time on dialysis: 60.8 months	55% male; ethnicity NR	Multi-site, observational; surveys	Preference for Information and Preference for Behavioral Involvement subscales, Krantz Health Opinion survey, six-item tool developed for this study	IDWG >2.5 kg averaged over 12 dialysis sessions

Author, Year, Location	Purpose	Sample Size, Mean Age, Age Range, Average Length of Time on Dialysis	Sex (% male) and Ethnicity (% most prevalent ethnicity)	Methods	Predictor Measures	NA Measure
De-Nour & Czaczkes, 1972, Israel	To explore personality factors as determinants of NA	*N* = 43; mean age: NR; age range: NR; average length of time on dialysis: NR	66% male; ethnicity NR	Multi-site, longitudinal descriptive	Psychiatric exam, personality traits	Excellent: IDWG not above 500 g, predialysis K never >6 mEq/L, predialysis BUN steady; good: IDWG 500–1000 g, K ≤6 mEq/L, BUN steady with some jumps; fair: IDWG 1,000–1,500 g, K 6–6.8 mEq/L; some abuse: IDWG 2,500–2,000 g, K near 7.0 mEq/L; great abuse: IDWG >2000 g; K >7 mEq/L
DeOreo, 1997, Ohio	To correlate the SF-36 with survival, hospitalization and dialysis attendance adherence	*N* = 1000; mean age: 58.2%; age range: NR; average length of time on dialysis: NR	50% male; 23% Caucasian	Multi-site, historical, prospective	Medical Outcome Study Short Form (MOS SF-36)	Serum albumin, BUN, variable volume, Kt/V, protein catabolic rate, skipping treatments (≥2 dialysis treatments per month)
Durose et al., 2004, United Kingdom	Examine dietary knowledge of K, phos sodium, fluid restrictions and complications in relationship to knowledge of dietary compliance	*N* = 71; mean age: NR; age range: 44% were 18–54; 56% were 55–84; average length of time on dialysis: 51% were on dialysis ≤2 years	58% male; 86% Caucasian	Single-site survey	Author-developed dietary knowledge questionnaire	Phos (≤2.0 mmol/L); serum K (3.5–6.5 mmol/L); IDWG (≤4% of dry body weight)

Friend et al., 1997, United States	To determine whether patients' evaluations (attributions) of their past fluid adherence would also predict changes in fluid adherence from one time to another; whether health beliefs would act as a motivational force to reduce fluid adherence over time; and whether negative emotions (depression, trait anxiety, anger) would influence fluid adherence over time	*N* = 39; mean age: 55.8; age range: 20–77; average length of time on dialysis: 39.6 months	74% of the original 50 subjects were male; 78% were Caucasian	Multi-site, longitudinal, descriptive correlational	Attribution (three questions); Health Belief (three questions)	IDWG: for the preceding 8 weeks and 4 months later; calculated the percentage of 24 sessions at each time point in which each subject gained more than 3 kg was calculated
Gordon et al. 2003, Ohio	To develop reasons for shortened or skipped treatments	*N* = 168; mean age: 55; age range: 23–88; average length of time on dialysis: 48 months	73% male; 72% African American	Multi-site, cross-sectional study, survey	Author-developed survey reasons for shortened or skipped dialysis treatments	Shortened or skipped dialysis treatments over 3 months
Hecking et al., 2004, France, Germany, Italy, Spain and United Kingdom (DOPPS also used Japan and United States, but they were not analyzed for this article.)	To evaluate the practice patterns of HD facilities and patients across continents, focusing on dialysis prescription, adherence and nutrition	*N* = 11,422 patients from 101 units, targeted 4,591 patients for study; mean age: 59.5; age range: 57–61; average length of time on dialysis: NR	62% male; ethnicity NR	Multi-site, prospective, observational study	Medical record review for co-morbidities, lab values, quality of life variables, medication, hospitalization history, vascular access history	Adherence (missing and shortening dialysis, hyperkalemia, hyperphosphate-mia, high IDWG, malnutrition)

Author, Year, Location	Purpose	Sample Size, Mean Age, Age Range, Average Length of Time on Dialysis	Sex (% male) and Ethnicity (% most prevalent ethnicity)	Methods	Predictor Measures	NA Measure
Hilbert, 1985, United States	To investigate the relationship of social support to adherence	*N* = 26; mean age: 46.9; age range: 22–75; average length of time on dialysis: 54 months	35% male; ethnicity NR	Single-site, cross-sectional, descriptive with longitudinal component	Social support: support question-naire with 18 items from the Inventory of Socially Supportive Behaviors	Self-report on diet, medications and fluid for total adherence score
Hitchcock et al., 1992, United States	To examine the effects of stress on dietary adherence	*N* = 57; mean age: 57.6; age range: 26–81; average length of time on dialysis: NR	49% male; 67% African American	Single-site, cross-sectional, descriptive with longitudinal component	Schedule of Recent Events, Weekly Stress Inventory, Social Support Questionnaire	Diet: K and BUN (baseline 2 weeks before predictor survey and outcome 2 weeks after)
Katz et al., 1998, United States	To assess knowledge of disease and its impact on NA	*N* = 56; mean age: 60.5; age range: NR; average length of time on dialysis: 30 months	54% male; ethnicity NR	Single-site, cross-sectional, descriptive with longitudinal component; theory: health belief model	Kidney Disease Questionnaire	K, phos, IDWG composite score; self-report of adherence

Kimmel et al., 1996, United States	To investigate the relationship between psychological and social factors to adherence in new HD patients (<6 months)	*N* = 99; mean age: 54.5; age range: NR; average length of time on dialysis: NR	81% male; 92% African American	Multi-site	Beck Depression Inventory, Illness Effects Questionnaire, Multidimensional Scale of Perceived Social Support, Satisfaction with Life Scale, Psychologic Adjustment to Illness Scale, Karnofsky Scale, ESRD Severity Coefficient, Syadic Adjustment Scale	Shortened or skipped dialysis treatments, total time (shortened and missed) for 5 month, K, phos, IDWG, anthropometry, protein catabolic rate, Kt/V for 3 months
Kimmel et al., 1998, United States	To determine the contribution of compliance and psychosocial factors to patient survival	*N* = 295; mean age: 54.6; age range: 19–84; average length of time on dialysis: 56.6 ± 51.9 months	71% male; 90.1% African American	Multi-site, prospective, longitudinal	ESRD Severity Coefficient; nutritional and dialytic parameters: protein catabolic rate and Kt/V, dialyzer type, serum albumin, arm and circumference arm muscle area; Beck Depression Inventory, Cognitive Depression Index; Multidimensional Scale of Perceived Social Support; Illness Effects Questionnaire; Satisfaction with Life Scale	Percent time compliance (shortening dialysis); percent attendance (skipping dialysis); total time compliance (shortening and skipping)

Author, Year, Location	Purpose	Sample Size, Mean Age, Age Range, Average Length of Time on Dialysis	Sex (% male) and Ethnicity (% most prevalent ethnicity)	Methods	Predictor Measures	NA Measure
Kimmel et al., 1995b, Washington, DC (Aspects of QOL in HD Patients [same study as Kimmel, 1995a])	To assess the relationship between several QOL measures and patient adherence	*N* = 149; mean age: 54.4; age range: 23–83; average length of time on dialysis: NR	67% male; 93% African American	Multi-site, longitudinal, descriptive	Depression: Beck Depression Inventory, Cognitive Depression Index, Perception of Illness Effects Scale; social support: Multidimensional Scale of Perceived Social Support; patient satisfaction with marital/partner situation: Dyadic Adjustment Scale	Shortened or skipped dialysis treatments, total time (shortened and missed) for 5 months, serum K, serum phosphorus, IDWG, anthropometry, protein catabolic rate, Kt/V for 3 months
Kimmel et al., 1995a, Washington, DC (same study as Kimmel, 1995)	To assess whether different behavior adherence measurements have similar relationships with psychological and medical parameters; to investigate the relationship of adherence to dialysis unit, gender, psychological factors and social support	*N* = 149; mean age: 54.4; age range: 23–83; average length of time on dialysis: NR	67% male; 93% African American	Multi-site, longitudinal, descriptive	Depression: Beck Depression Inventory, Cognitive Depression Index, Perception of Illness Effects Scale; social support: Multidimensional Scale of Perceived Social Support; patient satisfaction with marital/partner situation: Dyadic Adjustment Scale	Shortened or skipped dialysis treatments, total time (shortened and missed) for 5 months, serum K, serum phosphorus, IDWG, anthropometry, protein catabolic rate, Kt/V for 3 months

Kovac et al., 2002, Washington, DC	To determine whether associations exist between patient satisfaction with care, depression and social supports with prescribed HD treatment	*N* = 79; mean age: 52.8; age range: 20–85; average length of time on dialysis: 57.7 months	59.50% male; 93.7% African American	Multi-site, cross-sectional, survey	Karnofsky, Beck Depression Inventory, social support, patient satisfaction and lab values	Skipping or shortening treatments, K and phos
Kugler et al., 2005, Belgium and Germany	To describe the prevalence and predictors of NA with diet and fluid restrictions in European HD patients	*N* = 916; mean age: 67; age range: 19–91; average length of time on dialysis: 47 months	52.90% male; ethnicity NR	Multi-site, cross-sectional, descriptive with longitudinal component; self–report; medical records	Dialysis Diet and Fluid NA questionnaire	IDWG, phos, K, albumin, Kt/V
Kutner et al., 2002, Georgia	To determine predictors of NA	*N* = 119 HD, *N* = 51 PD; mean age: NR; age range: NR; average length of time on dialysis: NR	NR	Multi-site	Perceived health status: physical and mental component summary scores of the Medical Outcomes Study Short Form; smoking status: self-report; perceived global self-health care and control over future health: National Health Interview Survey; depression: Primary Care Evaluation of Mental Disorders Brief Patient Health Questionnaire; other psychosocial variables: disease-specific scales from the Kidney Disease Quality of Life Short Form instrument	Missed appointments, shortened treatments (≥10 minutes during past 4 weeks); phos >7.5 mg/dL (3-month average)

Author, Year, Location	Purpose	Sample Size, Mean Age, Age Range, Average Length of Time on Dialysis	Sex (% male) and Ethnicity (% most prevalent ethnicity)	Methods	Predictor Measures	NA Measure
Lee & Molassiotis, 2002, China	To understand how dietary knowledge and health beliefs affect compliance	*N* = 62; mean age: 46; age range: 22–73; average length of time on dialysis: 11.5 months	50% male; 100% Chinese	Single-site, cross-sectional study, descriptive correlational design; theory: health belief model	Knowledge scale (author-developed); health belief scale	Medical record for K, phos, IDWG
Leggat et al., 1998, Iowa	To better describe the demographics of NA patients and the survival differences between compliant and non-compliant patients	*N* = 6,251; mean age: 57.8; age range: NR; average length of time on dialysis: 44.4 months	49.70% male; 39% African American	Multi-site, sample was taken from two studies of the U.S. Renal Datea System: Case Mix Adequacy Study (CMAS) and Dialysis Morbidity and Morality Study (DMMS)	Used data from the two studies of the U.S. Renal Data System	Skipping dialysis sessions, shortening sessions, IDWG, phos
Lin & Liang, 1997, Taiwan	To examine health locus of control and adherence	*N* = 86; mean age: 55.1; age range: 26–86; average length of time on dialysis: 42.1 months	45% male; ethnicity NR	Multi-site, cross-sectional, descriptive with longitudinal component; theory: social learning theory-locus of control	Demographic questionnaire, the Multidimensional Health Locus of Control Scale, Multi-Method Compliance Assessment	Multi-method adherence assessment: IDWG (4 weeks prior), K (4-month average), phos (4 months prior), all three converted into an adherence score; nurses rated patients on a scale, patients' self-report

Long et al., 1998, Southeastern U.S. inner-city dialysis unit	To identify relationships between demographic factors, psychosocial characteristics and medication adherence rates in older patients receiving HD	*N* = 26; mean age: 70; age range: 65–83; average length of time on dialysis: 100% on dialysis for ≥1 year or longer	36% male; 100% African American	Single-site, descriptive correlational; theory: King	Iowa Self-Assessment Inventory (psychosocial variables)	Pill counts
Oka & Chaboyer, 2001, Japan	To examine the influence of self-efficacy and other factors on dietary behaviors	*N* = 325; mean age: 57.2; age range: NR; average length of time on dialysis: 88.8 months	7% male; Japanese	Multi-site, cross-sectional, descriptive with longitudinal component, survey; theory: Bandura's theory of self-efficacy	Dietary management self-efficacy, self-repressive behavior, dialysis acceptance, mental health, family support, staff support, character surveys	Dietary Behavior Scale Survey
Pang et al., 2001, China	To determine psychosocial correlates of fluid NA	*N* = 92; mean age: 51.36; age range: 22–79; average length of time on dialysis: 79.08 months	39% male; Chinese	Multi-site, cross-sectional, descriptive with longitudinal component survey	Center for Epidemiological Studies Depression Scale, Multidimensional Health Locus of Control Form C Scale, Social Support Questionnaire, Short Form Scale, Socio-Demographic Scale	IDWG (>0.9 kg/day had poor fluid adherence; those with ≤0.9 kg/day had good adherence)

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Poll & De-Nour, 1980, Israel	To investigate the relationship between locus of control and diet adherence	*N* = 40; mean age: NR; age range: NR; average length of time on dialysis: NR	45% male; ethnicity NR	Multi-site, cross-sectional, descriptive with longitudinal component	Rotter's locus of control	Excellent: IDWG ≤500 g, predialysis K never >6 mEq/L, predialysis BUN steady; good: IDWG 500–1,000g, K ≤6 mEq/L, BUN steady with some jumps; fair: IDWG 1,000–1,500 g, K 6–6.8 mEq/L; some abuse: IDWG 2,500–2,000 g, K near 7.0 mEq/L; great abuse: IDWG >2,000 g, K >7 mEq/L 3 months prior to study
Rocco & Burkart, 1993, North Carolina	To determine adherence to HD medical regimen	Mean: 231 patients (31,599 HD sessions scheduled); mean age: 61.9; age range: 24–91; average length of time on dialysis: NR	52% male; 67% African American	Single-site, longitudinal, descriptive	None	Missed appointments; shortened treatments

Rorer et al., 1988, United States	To examine the impact of nursing verbal interactions on patient adherence	38 patients, 13 nurses; mean age: 53.2 (patients); NR (nurses); age range: 30–67 (patients); NR (nurses); average length of time on dialysis: 45.3 months	Patients, 46% male; nurses, 100% female; ethnicity NR	Single-site survey	Nurses' verbal interactions with patients	IDWG (4 weeks prior to study)
Rosenbaum & Smira, 1986, Israel	To determine if patient's self-evaluation of past adherence and efficacy expectations are associated with adherence	*N* = 53; mean age: NR; age range: 20–68; average length of time on dialysis: NR	59% male; ethnicity NR	Multi-site, cross-sectional; theory: Mischel's social learning analysis of delayed gratification	Learned resourcefulness: Rosenbaum's Self-Control Schedule; Process-regulating cognitions: past adherence, efficacy expectations, health beliefs, coping with the illness	IDWG
Saounatsao, 1999, Athens, Greece	To evaluate the relationship between response to illness and adherence	*N* = 60; mean age: 49.4; age range: NR; average length of time on dialysis: 50.4 months	53% male; ethnicity NR	Multi-site quantitative; theory: Orem	Pritchard Response to Illness questionnaire	IDWG: 72 values <4.4 lb, K: 3.3–5.5 meq/L, phos 3.5–5.0 mg/dL, the degree of adherence was evaluated along a 4-point scale

Author, Year, Location	Purpose	Sample Size, Mean Age, Age Range, Average Length of Time on Dialysis	Sex (% male) and Ethnicity (% most prevalent ethnicity)	Methods	Predictor Measures	NA Measure
Saran et al., 2003, United States, Japan, France, Germany, Italy, Spain, United Kingdom	Describe the magnitude, distribution and predictors of NA	*N* = 7,676; mean age: 60.3; age range: NR; average length of time on dialysis: 38.4 months	57.50% male; 19.8% African American; 5.4% Hispanic	Multi-site, observational, prospective; medical records	Same measures used in the DOPPS study	Skipping dialysis sessions, shortening sessions, IDWG >5.7% of body weight, phos >7.5 mg/L, K >6.0 mEq/L
Schneider et al. 1991, New York	To examine the role of cognitive and emotional variables in fluid NA, symptomatology and stress	*N* = 50; mean age: 55.8; age range: 20–77; average length of time on dialysis: 39.6 months	74% male; 78% Caucasian	Multi-site, longitudinal descriptive	Depression: Beck Depression Inventory; anxiety: Speilberger Trait Anxiety Scale, Anger-Siegal Multidimensional Anger Inventory; cognitive measures: Locus of Control of Behavior Scale; compliance perceptions	IDWG for 8 weeks (24 sessions) prior to the surveys; Somatic Symptom Distress Scale; Dialysis Stress Scale

Schneider, 1992, Baltimore, Maryland	To examine the ability of health locus of control to predict diet adherence	*N* = 137; mean age: 51.1; age range: NR; average length of time on dialysis: 26.4 months	54% male; 56.9% African American	Multi-site survey	Multidimensional Health Locus of Control	Phos
Sehgal et al., 1998, Ohio	To examine the relationship between delivered amount of dialysis and barriers	*N* = 721; mean age: 62; age range: 20–89; average length of time on dialysis: 39.6 months	51% male; 51% Caucasian	Multi-site, cross-sectional, descriptive with longitudinal component	Systolic and diastolic blood pressure, treatment time missed due to low blood pressure, nursing intervention for low blood pressure, interdialytic symptoms, nursing intervention for patient symptoms	Delivered dialysis: Kt/V, NA: minutes of prescribed treatment time missed due to these barriers
Sensky et al., 1996, United Kingdom	To explore the psychosocial and cognitive factors associated with diet and fluid adherence	*N* = 45; mean age: 41; age range: 25–65; average length of time on dialysis: NR	62% male; ethnicity NR	Single-site cross-sectional	Hospital Anxiety and Depression Scale, Multidimensional Health Locus of Control, Social Adjustment Scale, global rating of social support	K (15 levels prior to study) and IDWG (10 measures prior to study) approximately 3–6 months

Author, Year, Location	Purpose	Sample Size, Mean Age, Age Range, Average Length of Time on Dialysis	Sex (% male) and Ethnicity (% most prevalent ethnicity)	Methods	Predictor Measures	NA Measure
Sherman et al. 1994, United States	To explore the deficiencies in delivered HD therapy due to missed and shortened treatments	*N* = 860; mean age: 53.6; age range: NR; average length of time on dialysis: NR	50.8% male; 53.7% Caucasian	Multi-site, longitudinal, descriptive	Demographics	Missed or shortened treatments
Somer & Tucker, 1992, unsure	To investigate racial difference in the relationship between spouse marital adjustment and dietary adherence	*N* = 68; mean age: 59 (patients), 61 (spouses); age range: 30–79 (patients), 34–79 (spouses)	72% male; 48% African Americans	Multi-site cross-sectional, descriptive with longitudinal component	Locke Marital questionnaire	IDWG and K (previous 3 months)
Steidl et al., 1980, Connecticut	To investigate the relationship between medical condition, adherence to treatment and patterns of family interaction	*N* = 23 (on PD); mean age: 43; age range: NR; average length of time on dialysis: 22 months	56% male; ethnicity NR	Single-site	Family structure among nine areas rated from video of family interaction, medical assessment evaluated by staff	Staff evaluated patients' adherence and assigned a composite score
Takaki & Yano, 2006, Japan	To assess differences between the relationships of self-efficacy and the internal health locus of control with compliance in HD patients	*N* = 397; mean age: 59.7 (men), 60.8 (women); age range: 21–89 (men), 29–88 (women); average length of time on dialysis: 99.0 months (men), 116.5 (women)	53% male; ethnicity NR	Multi-site cross-sectional, descriptive with longitudinal component study, survey, observational: theory: Bandura's theory of self-efficacy; transtheoretical model; theory of planned behavior	Self-efficacy of Health-Related Behavior Scale, Japanese version of the Health Locus of Control Scale	KT/V, BUN level, K level, IDWG

Takaki et al., 2003, Tokyo, Japan	To assess the possible variances of blood urea nitrogen, serum K and serum phosphorus levels and IDWG accounted for adherence of uremic patients on HD	*N* = 310; mean age: 59.2; age range: 21–88; average length of time on dialysis: 115 months	65.2% male; 100% Japanese	Multi-site, cross-sectional, descriptive with longitudinal component	Coping and self-efficacy scale	BUN, K, phos, IDWG
Taskapan et al., 2005, Turkey	To determine impact of psychiatric disorders on fluid restrictions, nutritional status and quality of life for HD patients	*N* = 40; mean age: 48.3; age range: NR; average length of time on dialysis: 28.4 months	62.5% male; 100% Turkish	Multi-site, cross-sectional, descriptive with longitudinal component, survey	Hamilton Depression Rating Scale, Hamilton Anxiety Rating Scale, Primary Care Evaluation of Mental Disorders, Mini-Mental State Examination, Short Form Health Survey 36	Medical records for IDWG, nutritional status
Testa & Plou, 2001, France	To investigate the clinical determinants of IDWG	*N* = 32; mean age: 71.3; age range: 25–88; average length of time on dialysis: 54.1 months	59% male; ethnicity NR	Single-site cross-sectional, descriptive with longitudinal component	Blood pressure and mean arterial pressure, dietary protein intake, calorie intake, sodium intake from calorie count, urea kinetic parameters calculated, defined those regularly high or normal on IDWG; sodium load was calculated, albumin, transferrin, C reactive protein	IDWG

Author, Year, Location	Purpose	Sample Size, Mean Age, Age Range, Average Length of Time on Dialysis	Sex (% male) and Ethnicity (% most prevalent ethnicity)	Methods	Predictor Measures	NA Measure
Thomas et al., 2001, United States	To identify theory-based factors pertinent to adherence with diet	*N* = 276; mean age: NR; age range: NR; average length of time on dialysis: NR	46% male; 72.5% African American	Multi-site survey; theory: Bandura's social cognitive theory; health belief model; stages of change	Block Dietary Assessment Screening questionnaire, Knowledge questionnaire, Perceived Severity of Illness, attitudes toward adherence, environmental factors, perceived barriers, self-efficacy scale, perceived health beliefs/benefits	Diet: conformity in fulfilling the pertinent requirements of a prescribed diet on most occasions most days of the week
Tucker et al., 1991, Florida	To explore the relationship between nurses' attitudes toward patients and adherence	*N* = 29 patients; 8 nurses; mean age: 47 (patients), 34 (nurses); age range: 24–72 (patients), 30–39 (nurses); average length of time on dialysis: 48 months	NR	Single-site, cross-sectional, descriptive with longitudinal component	Nurses' attitudes	IDWG; K (averaged 3 months prior to study and 1 month during study)
Unruh et al., 2005, United States	To assess dialysis attendance and markers of dietary NA in HD patients	*N* = 1,041; mean age: >17 years; age range: NR; average length of time on dialysis: NR	53.70% male; 62.5% African American; 62.5% Caucasian; 5.3% other	Multi-site, cross-sectional, descriptive with longitudinal component, survey	Self-report questionnaire; Karnofsky Index for Functional Status, Index of Coexistent Disease, Health Experience Questionnaire	Lab values for albumin, creatinine, phos, K and hematocrit, as well as KT/V

Vives et al., 1999, Spain	To study the relationship between the level of adherence to treatment and diet and locus of control	*N* = 31; mean age: 63.32; age range: 40–82: average length of time on dialysis: 35.06 months	74% male; ethnicity NR	Single-site, cross-sectional, descriptive with longitudinal component	Nottingham Health Profile, Multidimensional Health Locus of Control	K (>5.5 mmol/L), phos (>1.94 mmol/L), IDWG (>2.5 kg); drug treatment
Weed-Collins & Hogan, 1989, Ohio	To determine the extent to which knowledge and health beliefs relating to phosphate-binding medications predict adherence	*N* = NR; mean age: NR; age range: 25–80; average length of time on dialysis: NR	43% male; ethnicity NR	Single-site, cross-sectional, descriptive with longitudinal component	Knowledge and health beliefs survey (by Cummings, 1982)	Average of three consecutive phos measured once per month; NA if >5.5 mg/dL
Wenerowicz et al., 1978, Wisconsin	To examine the impact of locus of control on adherence	*N* = 19; mean age: 36; age range: 19–70; average length of time on dialysis: 6.7 months	68% male; ethnicity NR	Single-site, cross-sectional, descriptive with longitudinal component	Rotter Internal-External Locus of Control	Diet: K <5.5 mEq/L); medication (antacid ingestion): phos (>4.5 mg%); fluid and salt: IDWG (>2.6 kg); dietary protein: BUN (>100; 3 months prior to study)
Wiebe & Christensen, 1997, Iowa	To examine the ability of health beliefs and personality to predict adherence	*N* = 70; mean age: 55.95; age range: NR; average length of time on dialysis: 140.58 months	60% male; ethnicity NR	Single-site, cross-sectional, descriptive with longitudinal component; theory: health belief model	Health Belief Model, conscientiousness for the NEO Five Factor Inventory	Fluid: IDWG (six before survey and six after); diet and medication: phos (mean of two closest to survey)

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Yanagida et al., 1981, United States	To examine the relationship between denial and fluid adherence	*N* = 46; mean age: 45; age range: 15–66; average length of time on dialysis: 36 months	52% male; ethnicity NR	Single-site, cross-sectional, descriptive with longitudinal component	Marlow-Crowne Social Desirability Scale; Beck Depression Inventory, Nowicki-Strickland Internal-External Scale; Response to Illness questionnaire	Physiological data including weight, hematocrit, BUN, creatinine, calcium, phos, K, sodium, choloride, carbon dioxide (9 months prior to survey)
Zetin et al., 1981, California	To examine the relationship between locus of control and adherence	*N* = 15; mean age: 49.7; age range: 20–68 (males), 22–74 (females); average length of time on dialysis: 30.2 months	53% male; ethnicity NR	Single-site, cross-sectional, descriptive with longitudinal component	Rotter Internal-External Locus of Control, Zung Anxiety, Zung Depression, Beck Depression Inventory, Hamilton Anxiety and Hamilton Depression Scales	Diet: K <5.5 mEq/L); medication (antacid ingestion): phos (>4.5 mg%); fluid and salt: IDWG (>2.6 kg); dietary protein: BUN (>100; 3 months prior to study); global compliance score was calculated
Zrinyi et al., 2003, Location not reported but researchers are from Switzerland and Hungary and one inclusion criteria was to speak Hungarian	To determine how dietary self-efficacy is related to biochemical markers and self-report behavioral outcomes	*N* = 107; mean age: 57.6; average length of time on dialysis: NR	49.5% male; ethnicity NR	Multi-site cross-sectional, descriptive with longitudinal component; self-report; medical records; theory: Bandura's self-efficacy	Situational Dieting Self-Efficacy Scale; Patient reactions assessment (staff patient relations), Renal Adherence Attitude questionnaire (self-reported attitude to adherence)	Renal Adherence Behavior Questionnaire (self-reported diet/fluid restriction, K, phos self-care, sodium adherence)

Abbreviations: BUN, blood urea nitrogen; CAPD, continuous ambulatory peritoneal dialysis; HD, hemodialysis; K, potassium; PD, peritoneal dialysis; IDWG, interdialytic weight gain; med, medication; NA, non-adherence; NR, not reported; phos, phosphorus.