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Development of compliance theory based on self-regulation in chronic kidney failure patients on hemodialysis

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ABSTRACT

Self-management in regulating diet, fluids, activities, and medication in chronic renal failure patients which getting hemodialysis is still worse. This research aimed to develop the theory of compliance based on self-regulation to increase patient obedience and awareness. A cross-sectional approach of 130 respondents was recruited using simple random sampling. Structural equation modeling partial least square (SEM-PLS) was the statistical analysis for this study. All indicators in the outer model showed outer loading value >0.7, it declared feasible to predict each of the latent variables. The R-square value of appraisal latent was 0.576, Coping was 0.897, and self-care compliance was 0.713. The model was relevant when applied in other research studies with a Q-Square value=0.832. The goodness of fit (GoF) was 0.832>0.36, which means that the model was applied well. The appraisal variable is the strongest variable that influences coping, based on the hypothesis test. The self-regulation-based compliance model for blood pressure, interdialytic weight gain (IDWG), sodium levels, and functional independence can be developed through analysis of the structural model.

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1. INTRODUCTION

Chronic kidney disease patients undergoing hemodialysis (HD) have complicated to management of health status [1]. Patients find it difficult to follow treatment recommendations [2] and physical activity management [3]. Meanwhile, self-regulation is needed by HD patients to maintain compliance and limit fluid intake [4], treatment of medication [5], diet [6], and physical activity management [7]. Low self-regulation including maintaining fluid needs, medication, diet, and physical activity is the highest risk factor for hemodialysis failure. Evaluation of self-regulation of HD patients can be seen from blood pressure, functional independence, sodium levels, and interdialytic weight gain (IDWG) [8]. Until now, there are still not many studies that focus on studying the effect of self-regulation-based compliance on the management ability of HD patients in self-care management (blood pressure, IDWG, functional independence, and sodium levels).

Chronic Kidney disease in global prevalence is showed increased [9], and about 10% of adults have contracted the disease without realizing it [10]. The prevalence of CKD in Indonesia showed an increase of 0.38% in 2018 according to the Indonesian Basic Health Research [11], which increased twice from 2013 [12]. Howren in his research stated that hemodialysis patient failure occurs because patients do not comply

with fluid and sodium restrictions, so failure can reach 30-60% [13], the estimate of non-adherence in the HD patient population is still below 74% [14]. Patient non-compliance with treatment reached 39-85%, dialysis reached 26-53%, fluid restriction 41.4-67% and physical activity 64-70%, respectively [15], [16]. According to WHO patient compliance in undergoing a series of long-term treatment in developed countries is only 50%, while lower numbers are found in developing countries [17].

Non-adherence to the therapy regimen in HD patients will potentially lead to complications and worsening of the disease [18], which lead to hospitalization risk, morbidity and mortality [19]. The most difficult patient non-compliance is fluid restriction [20], especially in patients receiving diuretic therapy, the mucosa will become dry and make the patient easily thirsty, the impact is that the patient's desire to drink increases [21]. Compliance with HD patients needs to be improved through self-regulation, because patients need the ability to control themselves to manage excessive thirst, take regular medication, maintain diet patterns, especially those that are prohibited, and carry out activities as recommended, but in reality, patient self-regulation is currently still low.

The combination of information motivation and behavioral skill theories in forming hemodialysis patient compliance [22]. Based on the theory of Information Motivation and Behavioral Skills, behavior in carrying out health promotion depends on the patient's sufficient knowledge and abilities, so that the patient will be motivated to make changes to his behavior [23]. The theory combined with Lazarus's coping principles states that understanding the psychosocial effects (primary appraisal, secondary appraisal, and coping strategies) on HD patients' decision making to improve self-regulation [24]. Based on these two theories, researchers are interested in developing a self-regulation based adherence model in HD patients to improve fluid management, control IDWG, diet and sodium levels and reduce morbidity and mortality rates in CKD patients [25], [26]. The aim of this research is to develop a theoretical model of self-regulation-based adherence to IDWG, blood pressure, sodium levels and functional independence in hemodialysis patients.

2. METHOD

This study using explanatory research with quantitative design using a cross sectional approach to developing model of compliance theory based on self regulation. Developing the model have purposed to analyze the influence of personal characteristics, information factors, emotional, disease representation, and motivation on appraisal, the influence of appraisal on coping, and the effect of coping with self-care adherence of HD patients.

2.1. Population, sample, sampling and variable

The population of this study were patients who underwent HD in Sultan Agung Islamic Hospital for a period of one month. The sample size uses the rule of the thumb which is a way of calculating the sample size in multivariate research, which is 5-10 times the number of independent variables needed. So that the sample size is 130 respondents who were recruited through purposive sampling, with criteria: i) Hemodialysis patients with early adulthood to late adulthood (26-45 years); ii) Hemodynamic condition is stable and not in an emergency condition; iii) Able to communicate using Indonesian; iv) Have HD schedule twice a week for 3 months and not cito or traveler hemodialysis. The independent variables in this study are information factors, characteristic factors, disease representation, emotional factors, motivation, appraisal and coping and the dependent variable were self-care compliance (fluid management, medication, diet and physical activity) and outcomes (blood pressure, IDWG, sodium levels, and fungsional independence).

2.2. Data collection and analysis

Data was collected using a questionnaire using likert scale with 4 scale, strongly agree=4, agree=3, disagree=2, strongly disagree=1, interpretation category: Good>75 %, intermediet 56-75%, low<55 %. The knowledge questionnaire was measured using the dialysis quiz adaptation [27], the disease condition awareness questionnaire was adapted from the Chronic Kidney Disease Patient Awareness Questionarre [28], the use of media used a checklist questionnaire. Measurement of patient characteristics using demographic data consisting of age with categories (1) Early adulthood=18-25 years, (2) Middle dulthood=26-35 years, (3) Late adulthood=36-45 years, (5) Early old age=46-55 years. (6) Late old age=56-65 years. (7) Very old age=65–up, gender, education consisting of basic, secondary and higher education, marital status, occupation and income. Measurement of hemoglobin levels using the results of laboratory tests which are categorized into: Male: Normal :3.8 g/dl Anemia:<13.8 g/dl; Female: Normal :>11g/dl Anemia:<11g/dl.

The emotional factor questionnaire was used to explore information factors for hemodialysis patients consisting of Fear, anxiety and depression with a rating scale: "0" Never, "1" sometimes, "2" often, "3" always, categorization of answers Normal: 0 -3, Mild: 4-6, Moderate: 7-9, Heavy: >10. The disease representation factor questionnaire consists of sub-variables of identity, disease, time line, causes, consequences and hamlet control by adapting the illness perception questionnaire. Motivation in patient was

measured with treatment motivation questionnaire (TMQ), primary appraisal and secondary appraisal questionnaire (PASA) was questionnaire to measure appraisal ability [29]. Coping were measured using ways of coping adaptation developed by Lazarus and Folkman [30], self-care was measured using a modified self care of CKD index questionnaire from Riegel, Carlson, Sebern, Hicks and Roland. All of the questionnaires used have been validated and reliability first (r count=0.5410 to 0.986; Cronbach's Alpha=0.685 to 0.827), from these results, all questionnaires is valid and reliable. Data were analysis using structural equation modeling partial least square (SEM-PLS) to find outer model, inner model, and construct path diagrams.

2.3. Ethical clearance

This research was first submitted to the research ethics commission of the Sultan Agung Islamic Hospital, Semarang. The ethical protocol has been reviewed by reviewers and declared ethically worthy by KEPK RSI Sultan Agung with certificate number 12/EC/KEPK/2020.

3. RESULTS AND DISCUSSION

Sociodemographic criteria from respondents at Sultan Agung Hospital majority were late old age (42.3%), female (60%), had junior high school education level (71.5%) and married (85.4%). Almost 60,8% patients are still working and the incomes is under the regional minimum wage (52.3%), 36.9% of HD patients showed anemia symptoms as shown in Table 1.

Table 1. Sociodemographic characteristic of respondent's participant

Sociodemographic	n	%
Age		
Early adulthood	3	2.3
Middle adulthood	6	4.6
Last adulthood	27	20.8
Early old	55	42.3
Late old	33	25.4
Very old	6	4.6
Gender		
Female	78	60.0
Male	52	40.0
Level of education		
Elementary school	15	11.5
Junior high school	93	71.5
Senior high school	22	16.9
Marital Status		
Married	111	85.4
Widow/widower	11	8.5
Single	8	6.2
Occupation		
Working	79	60.8
Do not work	51	39.3
Income		
Above minimum regional income	62	47.7
Under minimum regional income	68	52.3
Hemoglobin criteria		
Anemia	48	36.9
Normal	82	63.1

Model development shows various variables compile a model to form a new model that is developed from a combination of existing theories. The information factor shows that the knowledge of patient is low (32.3%), as same as with awareness of disease conditions low too (23.2%), even though they have received health education. Health education obtained by patients mostly comes from electronic media, which is 43.8%. The emotional factors of fear, anxiety and depression are in the severe category, namely 37.7%, 33.1% and 33.8%. The representation of the disease shows that the identity of the disease shows severe symptoms as much as 46.9%. Patients did not recognize the cause of the disease reached 60.8%, total 51.5% of patient show negative timeline, 53.1% had consequences in negative category and 53.8% patient express negative control. Patient motivation shows low category in personal motivation (53.8%) and social motivation (51.5%). The ability of primary appraisal of patients showed that 51.5% were negative and 53.8% of patients had negative secondary appraisals. While the patient's coping ability in dealing with problems is also low, namely as much as 59.2%. Patient self-care adherence showed that 16.9% patients difficult manage

fluids restriction, 18.5% difficult in diet, 22.3% not adherence in medication, and 17.7% patients were difficult manage in physical activities, see Table 2.

Table 2. Descriptive of research latent variable in model development

Variable	Sub Variable	Category	n	%
Information factors	Knowledge	Less	42	32.3
		Moderate	67	51.5
		High	21	16.2
	Illness condition awareness	Less	30	23.1
		Moderate	69	53.1
		High	31	23.8
	Media	Healthcare	5	3.8
		Written media	6	4.6
		Friends	23	17.7
		Electronic	57	43.8
		Family	32	24.6
		Self-experience	7	5.4
Emotional factors	Fear	Normal	3	2.3
		Mild	24	18.5
		Moderate	54	41.5
		Severe	49	37.7
	Anxiety	Normal	7	5.4
		Mild	18	13.8
		Moderate	62	47.7
		Severe	43	33.1
	Depression	Normal	4	3.1
		Mild	21	16.2
		Moderate	61	46.9
		Severe	44	33.8
Representative of illness	Illness identity	Severe sign	61	46.9
		Mild sign	69	53.1
	Illness caused	Able to recognize	79	60.8
		Unable to recognize	51	39.2
	Time border	Negative	67	51.5
		Positive	63	48.5
	Consequence	Negative	69	53.1
		Positive	61	46.9
	Control	Negative	70	53.8
		Positive	60	46.2
Motivation	Personal motivation	Less	70	53.8
		High	60	46.2
	Social motivation	Less	67	51.5
		High	63	48.5
Appraisal	Primary Appraisal	Negative	67	51.5
		Positive	63	48.5
	Secondary Appraisal	Negative	70	53.8
		Positive	60	46.2
Coping	Problem focus	Negative	64	49.2
		Positive	66	50.8
	Emotional focus	Negative	77	59.2
		Positive	53	40.8
Self-care adherence	Fluid management	Good	21	16.2
		Moderate	87	66.9
		Less	22	16.9
	Physical activity	Good	15	11.5
		Moderate	92	70.8
		Less	23	17.7
	Diet	Good	24	18.5
		Moderate	82	63.1
		Less	24	18.5
	Medicine	Good	13	10
		Moderate	88	67.7
		Less	29	22.3

3.1. Outer model evaluation

All indicators of research variables are valid to predict each of the latent variables (outer loading value >0.7), none of which need to be eliminated from the model see Table 3 and Figure 1. All variable also has a high level of reliability with composite reliability value was >0.6, see Table 4.

Table 3. The outer loading on all variable to determine the validity of the variables

Latent variable	Observational variable	Outer loading
Information factor (X1)	Knowledge (X1.1)	0.931
	Illness awareness (X1.2)	0.935
	Media (X1.3)	0.881
Characteristics factor (X2)	Age (X2.1)	0.817
	Gender (X2.2)	0.717
	Educational background (X2.3)	0.705
	Marital status (X2.4)	0.755
	Occupation (X2.5)	0.788
	Income (X2.6)	0.776
	Hemoglobin level (X2.7)	0.701
Emotional factor (X3)	*Fear* (X3.1)	0.702
	Anxiety (X3.2)	0.909
	Depression (X3.3)	0.716
Disease Representation (X4)	Illness identity (X4.1)	0.898
	Caused (X4.2)	0.875
	Time border (X4.3)	0.885
	Consequence (X4.4)	0.756
	Control (X4.5)	0.749
Motivation (X5)	Personal motivation (X5.1)	0.913
	Social motivation (X5.2)	0.942
Appraisal (X6)	*Primary appraisal* (X6.1)	0.931
	Secondary appraisal (X6.2)	0.899
Coping (X7)	Problem focus (X7.1)	0.947
	Emotional focus (X7.2)	0.943
Self-care obedience (Y1)	Fluid management (Y1.1)	0.848
	Diet (Y1.2)	0.875
	Medicine (Y1.3)	0.892
	Physical activity (Y1.4)	0.763

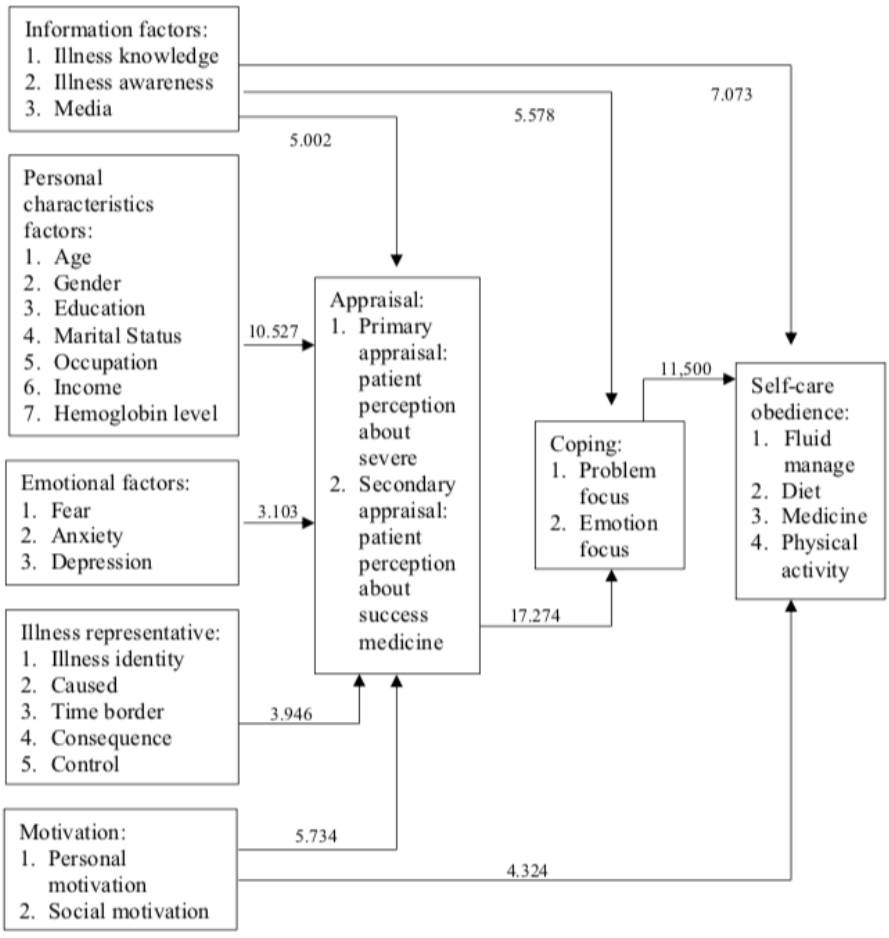

Figure 1. The final model concepts

Table 4. Reliability value of research variables

Variable	Cronbach's Alpha	Average variance extracted	Composite reliability
Information factor (X1)	0.769	0.688	0.868
Characteristics factor (X2)	0.719	0.773	0.872
Emotional factor (X3)	0.859	0.639	0.898
Disease representation (X4)	0.857	0.704	0.904
Motivation (X5)	0.839	0.674	0.892
Appraisal (X6)	0.826	0.744	0.896
Coping (X7)	0.812	0.738	0.643
Self-care obedience (Y1)	0.892	0.701	0.609

3.2. Inner model evaluation

Inner model evaluation measures determinant correlation (R^2), predictive relevance (Q^2), and research hypothesis testing. The R-square value interpreted that Appraisal can be explained by characteristics factors, information factors, disease representation, emotional factors, and motivation of 57.6%. Coping can be explained by Information, Appraisal, and Motivation Factors of 89.7%. Meanwhile, self-care adherence explained of the model in this study about 71.3%, and 38.7 is explained by other variables outside the study, see Table 5. The Q-Square value is 0.832, meaning that the relevancy of the model if applied in other study is 83.2%. The goodness of fit (GoF) value in this research model is 0.832>0.36. which means that Model was applied well.

The results of the study explain that all constructs of this model have a significant effect except motivation on coping, motivation does not have a direct effect on coping (T-Statistic=1.666). The appraisal variable is the strongest variable in influencing coping. Meanwhile, coping itself is the most powerful factor in influencing self-care adherence, see Table 6.

ESRD patients undergoing hemodialysis to improve outcomes (blood pressure, IDWG, sodium levels, and functional independence), the patient need to improve self-care compliance in undergoing hemodialysis therapy regimens [31]. Nursing interventions to increase compliance based on self-regulation are able to improve the expected outcomes in the hemodialysis therapy process [32], so that ESRD patients undergoing hemodialysis are able to maintain good IDWG values, control in sodium level, blood pressure, and functional independence [32].

Research result showed that self-care adherence of hemodialysis patients is influenced by factors of information, motivation, and coping strategies. Information, motivation (personal and social), and coping strategies (focus on problems and focus on emotions) can increase individual compliance in caring for themselves. The new finding in this study is that self-care adherence is not only influenced by coping, but also influenced by information and motivation factors. However, the effect of coping strategies on self-care adherence is almost twice as high as the information and motivation factors. Coping strategies are influenced by information and appraisal factors (primary appraisal and secondary appraisal), good information and appraisal factors can improve each individual's coping strategy [33]. The new finding in this study is that coping strategies are not only influenced by appraisal [34], but also influenced by the information factor. However, the effect of appraisal on coping strategies is known to be 3 times higher than the information factor [35]. Appraisal is influenced by personal characteristics factors, information factors, emotional factors, disease representation, and motivation, which is personal characteristic factors were the highest portion in influencing appraisal.

The contribution of this research is to provide a self-regulatory-based compliance model for IDWG, sodium levels, blood pressure, and functional independence in important theoretical contributions in scientific development, strengthening existing theories, and can be used as a reference for further research. The model can also make a theoretical contribution in strengthening and developing pre-existing theories, namely Leventhal's Self Regulation, Nelson's IBM, and Lazarus's Stress, Appraisal and Coping. As a theoretical contribution to model development in the development of nursing science to strengthen or enrich the competency standards of nurses in the hemodialysis room, as well as a reference for the preparation of Palliative Nursing Care and further research. The application of the optimal model will make a practical contribution to palliative nursing practice [36], namely providing a reference to hemodialysis nurses in improving self-care adherence of ESRD patients undergoing hemodialysis [37].

The limitations of model development research have a lot to do with the pandemic situation because the COVID-19 pandemic condition causes the research team to use complete PPE when providing education in hospitals. so that the research team could not provide touches to the respondents to build emotional bonds personally, this made the chemistry between the giver and recipient of education difficult to build. In addition, the increased activity of hospitals during the COVID-19 pandemic led to a less than optimal concentration of respondents when receiving educational materials.

Table 5. Determinant correlation (R^2) and predictive relevance (Q^2)

Variable	R^2	Q^2
X6. Appraisal	0.576	
X7. Coping	0.897	
Y1. Self-care obedience	0.713	0.832

Table 6. Path coefficient–bootstrap

Hypothesis	Original sample	Sample mean	Standard deviation	T-Statistics	Sig.
Information factors to appraisal	0.102	0.221	0.161	5.002	Significant
Information factors to coping	0.117	0.118	0.228	5.578	Significant
Information factors to self-care obedience	0.116	0.126	0.110	7.073	Significant
Characteristics factors to appraisal	0.152	0.234	0.198	10.527	Significant
Emotional factors to appraisal	0.106	0.089	0.196	3.103	Significant
Illness representative to appraisal	0.336	0.335	0.190	3.946	Significant
Motivation to appraisal	0.482	0.470	0.192	5.734	Significant
Motivation to coping	0.064	0.063	0.062	1.666	Not significant
Motivation to self-care obedience	0.151	0.240	0.146	4.324	Significant
Appraisal to coping	0.820	0.820	0.148	17.274	Significant
Coping to self-care obedience	0.251	0.260	0.155	11.500	Significant

4. CONCLUSION

Self-regulation-based adherence models for blood pressure, IDWG, sodium levels, and functional independence can be developed through structural model analysis. Model development analysis has been successfully proven to be able to provide improvements in kidney failure patients undergoing hemodialysis therapy. The implication of this research is that through the development of a self-regulation based compliance model, it is hoped that nurses in hospitals can apply it to chronic kidney failure patients undergoing hemodialysis therapy to improve blood pressure, IDWG, sodium levels and the patient's functional independence.

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