



Factors Influencing Stress Perception among Hemodialysis Patients: a Systematic Review

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Abstract

Context: Stress is a common comorbid disorder among hemodialysis patients, and diverse factors contribute to stress perception in such individuals. Although numerous findings have been consistent across the literature, there has been a lack of consensus on which factor is the most influential on stress perception. This systematic review aimed to provide an executive review on factors contributing to stress perception among hemodialysis patients.

Evidence Acquisition: A detailed search was carried out on Cumulative Index to Nursing and Allied Health Literature, PubMed, EBSCOhost, Google Scholar, Medline, and Web of Science databases. Rigorous search narrowed to 16 observational studies (n=3,567 participants) on factors determining stress perception among hemodialysis patients. Preferred Reporting Items for Systematic Reviews and Meta-Analysis guideline was incorporated. The selected 16 articles were used in the qualitative synthesis.

Results: Stressors were grouped as biological, psychological/behavioral, or social/environmental factors. It was revealed that the effects of socio-demographic factors on stress perception were scarce and inconsistent, while fatigue and itching were distressing biological factors. Limitations on time and place on vacation, limitation of food and fluid are psychological stressors and decrease in social life with substantial economic burden were enlightened as social stressors.

Conclusion: Multidisciplinary factors were found for stress perception among hemodialysis patients. Nursing care plans should address the holistic nature of stress with appropriate nursing interventions. Although this review adopted the strict selection criteria, it remains difficult to conclude determinants due to methodological drawbacks. Therefore, future research in this scope is highly appreciated with prospective longitudinal nature to produce solid clinical conclusions.

Keywords: Factors, Hemodialysis patients, Influences, Stress perception

1. Context

Hemodialysis is a renowned Renal Replacement Therapy for end-stage renal disease (ESRD) patients. Patients with ESRD are required to undergo dialysis either until a kidney transplant or as a lifelong therapy. Overall, the health of a hemodialysis patient is attributed to a variety of factors. Among these factors, psychosocial factors are imperative and yet understudied. Stress is a remarkable psychosocial factor that negatively affects the prognosis of dialysis treatment (1).

The concept of stress was first described by Selye (2) in 1970 and further explained with social, psychological, spiritual, and cultural traits of healthy and unhealthy cohorts. Stress refers to environmental, social, or internal demand that results in a psychological, physiological, or behavioral response (3). The overall status of stress would be represented as a concomitant chronic

illness if organisms' adaptive capacity exceeds the threshold against threats/stressors. The Biopsychosocial model is used to underpin this review as it narrates how various factors affect health and illness. The evolution of the Biopsychosocial model in 2004 by Suls and Rothman (4) further describes the integrity of the sub-components explicated in the original model. Therefore, it provides the details of how biological, psychological, and social factors are integrally and interactively involved in physical health and illness. The influence of biopsychosocial factors (4-6) on stress perception is illustrated in Figure 1.

Since hemodialysis therapy is a long-term treatment, patients predominantly experience stress or the concomitant of a chronic illness as they have to live with the disease. Simultaneously, biopsychosocial stressors catastrophize the stress perception multi-dimensionally. In the last two decades, scientists in the field of "psycho-nephrology" have found

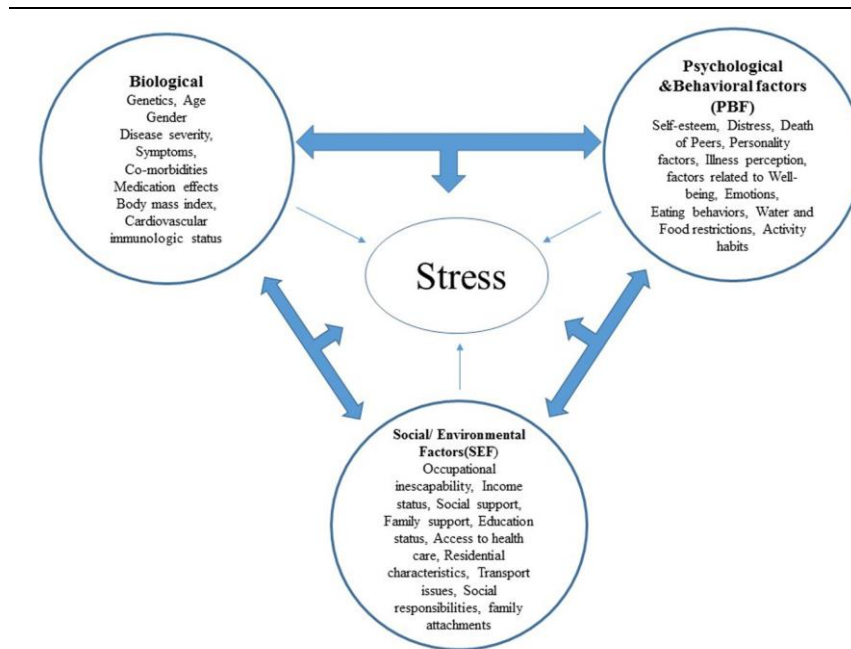


Figure 1. Biopsychosocial model

heterogeneous factors in diverse population groups. Although an effort has been made to review this phenomenon in 2007 (6), an elaborated description has not been provided yet. A recent review narrowed the search to studies conducted in Gulf and neighboring countries only (7). Therefore, the current review would help to explore this research gap. This systematic review would allow clinical experts to implement purposive clinical interventions among stressed hemodialysis patients, which in a return, would enhance the patient's prognosis. Nurses would also benefit since they would better understand stress from the patient's perspective, and consequently, be able to conceptualize a comprehensive nursing care plan by considering the holistic nature of stress.

The objective of this systematic review was to provide an overall view of factors affecting the stress perception among hemodialysis patients and identify which domain of the Biopsychosocial model was predominantly expressed in hemodialysis patients while perceiving stress.

2. Evidence Acquisition

2.1. Eligibility criteria

The literature on stress is characterized by a broad spectrum of confounders, concurrence definitions, a wide range of animal and human analytical studies with the heterogeneity of results in uniform care setting/patient groups, and positive and/or negative outcomes of pharmacological and non-pharmacological interventional studies. In the light of these factors and considering the

unavailability of a comprehensive view on influential factors on stress perception, the inclusion criterion was research studies published in English in peer-reviewed journals between 1995 and 2018 designed to assess the factors/stressors/stress perception among hemodialysis populations. On the other hand, conference abstracts, editorials, review articles, dissertations /thesis, and unpublished materials were eliminated.

2.2. Search strategy

The process of the literature review was conducted by each author to prioritize the research articles. A detailed search was carried out on Cumulative Index to Nursing and Allied Health Literature, PubMed, EBESCOhost, Google Scholar, Medline, and Web of Science databases. The search process was performed using the following keywords: "Influences", "Causes", "Predictors", "Stress", "Stressors", "Hemodialysis therapy", and "Dialysis", synonyms, and Boolean commands (i.e., "AND", "OR", and "NOT"), and studies on oxidative stress was restricted with "NOT". Collectively, a total of 16 articles were obtained to conceptualize this article.

2.3. Study selection and data collection process

An extensive methodological assessment was performed for full-text articles of identified abstracts. A comprehensive evaluation was conducted using the determined inclusion and exclusion criteria to extract the final set of included studies. Figure 2 shows this step-by-step selection process adopting the Preferred Reporting Items for Systematic Reviews and Meta-Analysis 2009 (8).

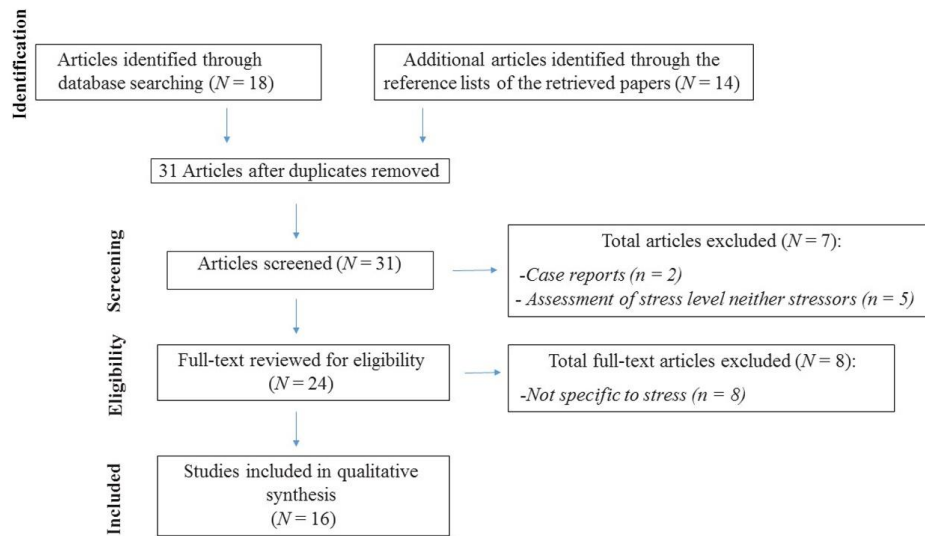


Figure 2. Flow diagram of Preferred Reporting Items for Systematic Reviews and Meta-Analyses 2009

Eighteen articles were extracted after database searching, and 14 articles were derived from the reference lists of the selected articles. A total of 31 articles were identified after the removal of duplicates, out of which, 2 case reports and 5 studies that assessed stress levels but not influencing factors/stressors were excluded. Following a full-text reading, 8 articles were excluded as irrelevant, thus leaving 16 articles for the synthesis of the results. Each manuscript was critically scanned for information on study characteristics, stressors, and other summarized information.

2.4. Quality assessment

Since quantitative and qualitative studies were considered in this review, Mixed Methods Appraisal Tool (MMAT) Version 2018 (9) was adopted to appraise the included 16 studies. The studies were critically evaluated by the first and second authors for risk of biases, and input from the third author was requested to moderate the review till a consensus was reached. As per the guideline of MMAT, the

extent of achievement of each criterion was checked to ensure the quality of the appraisal process instead of calculating a total score for appraisal. Table 1 summarizes MMAT criteria to assess the quality of selected papers.

Considering the biasness of quantitative studies, all studies, except one (10), produced a comprehensive description of their study subjects, their eligibility, and the method used in sample selection processes. Moreover, almost all studies clearly outlined the participants' inclusion and exclusion criteria. However, the validity and reliability tests of data collection tools were not implemented by several studies (10-12) (Table 1). Of the 15 quantitative studies, only 8 studies reported non-response bias of eligible participants (10, 13-19). Similarly, the encountered limitations were poorly documented; accordingly, only three studies outlined limitations (16, 20, 21). Although the recruited qualitative study (22) explained the data collection and data analysis method, the qualitative approach used in the study was not mentioned (Table 1).

Table 1. Critical appraisal of selected articles

Study (quantitative)	Reporting of study population			Reporting of variables			Other potential biases	
	Representation of target population	Clear description on sampling technique	Eligibility criteria	Clear definition of outcome measure(s)	Reliability/ validity of measurements	Detailed description of statistical methods	Non-responses biases	Description of limitations
Logan et al. (1)	+	+	+	+	+	+	-	+
Mok and Tam (2)	+	+	+	+	+	+	+	-
Yeh et al. (3)	+	+	+	+	+	+	+	-
Ahmad et al. (4)	+	+	+	+	+	+	+	+
Tu et al. (5)	+	+	+	+	+	+	+	+
Shinde et al. (6)	+/-	+/-	+/-	+/-	-	+	-	-
Shahrokhi et al. (7)	+	+	+	+	+	+	-	+/-
Tchape et al. (8)	+	+	+	+/-	-	+	-	+
Ekelund and Andersson (9)	+	+	+	+	+	+	+	+/-

Table 1. Continued

Bukhary et al. (10)	+	+	+	+	-	+	-	-
Gorji et al. (11)	+	+	+	+	+	+	-	+
Cinar et al. (12)	+	+	+	+	+	+	-	+/-
Cristóvão (13)	+	+	+	+	+	+	+	-
Lok (14)	+	+	+	+	+	+	+	+
Cormier-Daigle and Stewart (15)	+	+	+	+	+	+	+	+
Study (Qualitative)	Qualitative approach	Reporting of Data collection methods			Reporting of results			Implementati on of results
	Appropriate phenomenology	Source of data collection	Method of data collection	Form of data collection	Relevancy of analysis method to research question	Use of multiple analysis methods	Used Phenomenology	Sufficiently substantiated by data
Tarachand and Lee (16)	+/-	+	+	+	+	+	+	+

3. Results

3.1. Socio-demographic characteristics

Table 2 summarized the methodology of and patients' demographic characteristics in the extracted studies. All studies were conducted based on the quantitative cross-sectional design, except for one study which was qualitative. The median sample size was obtained at 75 (range 30-2,642), the age of the samples ranged from 15 to more than 81 years, and a total of 3,961 subjects were considered for analysis. Another cross-sectional study (23) included only elderly hemodialysis patients aged above 65 years, and

the rest of the studies recruited patients from all age groups. The study subjects of all studies were active hemodialysis patients, except for two studies (16, 17). One study compared predialysis and hemodialysis patients' experiences with the stressors and stress (16), whereas another study investigated hemodialysis and Peritoneal Dialysis (continuous ambulatory peritoneal dialysis) patients (17). It was decided to include both studies, as the analysis was performed separately for hemodialysis patients and stressors were mentioned separately for the hemodialysis group. Therefore, the findings of the hemodialysis group were considered for the current review.

Table 2. Study characteristics and factors associated with stress perception

Author(s)	Year	Country of origin	Study		Subjects				Factors associated with stress				
			Design	Durati on	N	Mean age (years)	Gender (Male %)	Ethnicit y origin	Inclusion criteria	Stress/stress or definition	Biological	Psychological and behavioral	Social and environmental
Logan et al. Pelletier-Hibbert (1)	2006	Canada	Descriptive co-relational study	NR	50	76.4±6.43	54	NR	(a) No cognitive impairment (b) Hemodialysis for at least 1 month	"As an event that is appraised as taxing or exceeding an individual's resources"	1. Feeling tired 2. Itching	1. Limitations on time and place for vacation 2. Limitations on liquids 3. Limitations on physical activities 4. Sleep disturbance 5. Length of treatment	1. Decrease in social life 2. Change in family responsibilities Transportation to and from the unit
Mok and Tam (2)	2001	China	Descriptive co-relational study	NR	50	NR	60	NR	(a) Regular hemodialysis of ≤ 6 months (b) Aged ≥16 years old	NR	1. Itching 2. Fatigue	1. Limitations on liquids 2. Limitations on food 3. Uncertainty about future 4. Length of treatment 5. Changes in body appearance	1. Decreased social life 2. Cost factors Job interference
Yeh et al. Huang (3)	2008	Taiwan	Descriptive cross-sectional study	October 2002 to January 2003	2,642	57±14	46	NR	(a) ESRD patients aged ≥15 years old (b) HD for at least 3 months	NR	1. Presence of co-morbidities	-	-
Ahmad et al. Al Nazly (4)	2015	Jordan	Descriptive cross-sectional correlation study	NR	123	46.15±15.45	61.1	Jordan Muslim (96.2%)	(a) HD for at least 6 months twice a week (b) At least 18 years of age (c) Able to read and write Arabic	"Particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being"	1. Nausea and vomiting	1. Limitations on time and place for vacation 2. Limitations on liquid intake 3. Length of dialysis treatment 4. Limitations on clothing styles	1. Reversal in family roles with your children

Table 2. Continued

Tu et al. Shao (5)	2014	Southern Taiwan	Descriptive cross-sectional correlation study	NR	88	38.55±5.55	54.5	Chinese	(a) Aged 20-45 years old (b) HD for at least 1 month (c) Absence of acute illnesses during the survey (d) Consciousness (e) Able to read and write Chinese	NR	1 Gender 2 Fatigue 3 Itching	1. Limitations on liquids 2. limitations on food 3. Sleep disturbances 4. Length of treatment 5. Limitations on physical activities	1. Decrease in social life 2. Interference in job 3. Changes in family responsibilities
Shinde and Mane (6)	2014	India	Descriptive cross-sectional study	NR	30	50.25±9.31	56.7	NR	(a) No cognitive impairment (b) Age ≥25 years (c) Voluntary and consented participation	"Stress in human life is often equated with tension, anxiety, worry and pressure"	1. Fatigue 2. Muscle cramps 3. Loss of body functions 4. Joint stuffing 5. Nausea/Vomiting 6. Reproductive functions 7. Decreased sexual drive 8. Decreased ability to procreate	1. Limitations on daily physical activities 2. Limitations on vacation 3. Uncertainty about future 4. Changes in body appearance 5. Limitations on clothing styles 6. Dependent on the staff 7. Limitations on food and liquids	1. Transportation to/from unit 2. Role ambiguity 3. Role reversal with spouse and children 4. Changes in family responsibilities 5. Cost factors
Shahrokhi et al. (7)	2014	Iran	Descriptive cross-sectional analytical study	2012	70	51.32±1.021	60	NR	(a) Aged ≥18 years old (b) HD for at least 4-months (c) Absence of major psychiatric disorders (d) Not being treated by a psychiatrist and lack of consumption of psychotropic drugs (e) Absence of cognitive disorder	"Stress is an inevitable event in everybody's life; it impairs the body's homeostasis and causes stress and tension" (17)	1. Age 2. Fatigue 3. Arterial and venous stick	1. Limitations on the time and place of vacation 2. Limitations on liquid and food 3. Boredom 4. Sleep disturbances	1. Reversal in the family role
Tchape et al. (8)	2018	Cameroon	Descriptive cross-sectional study	December 2016 to January 2017	40	39.42±1.12	52.5	NR	(a) Diagnosed with ESRD (b) Current hemodialysis (c) Aged 18-65 years old (d) English or French speaking (e) Voluntary and consented participation	"Stressor: A chemical or biological agent, environmental condition, external stimulus or an event that causes stress to an organism"	1. Feeling tired 2. Decrease in sexual drive	1. Limitations on time and place of vacation 2. Limitations on clothing style 3. Limitations on physical activities 4. Changes in body appearance 5. Limitations on liquids	1. Transportation to and from the hospital 2. Cost of treatment 3. Decrease in social life
Ekelund and Andersson (9)	2007	Sweden	Descriptive cross-sectional study	NR	145 72 (pre-dialysis), 73 (hemodialysis)	Pre-dialysis Men-60.2±13.18 Women-50.6±17.37 Dialysis Men-58.6±13.49 Women-55.9±15.54	72	NR	(a) Aged 18-84 years old (b) Attended renal education and rehabilitation program earlier	NR	1. Fatigue 2. Itching 3. Muscle cramps 4. Body problems 5. limited movements 6. Loss of body function 7. Effects on sexuality	1. Limitations on vacation activities 2. Dependent on physicians and others 3. Sleep disturbances 4. Anger, sadness, or fear 5. Uncertainty about future	1. Limited work capacities 2. Inability to work 3. Economic/cost issues
Bukhary et al. (10)	2013	Egypt	Descriptive correlation study	January 2011 to July 2011	250	NR	55.2	NR	NR	"Part of human life and it can cause either beneficial or detrimental effects on human beings which can affect physical, emotional, economical, spiritual and social aspects"	1. Female gender 2. Young age <20 years old 3. Unmarried 4. Educational status		1. Living in an urban area
Gorji et al. (11)	2013	Iran	Cross-sectional study	January 2011 to November 2011	80	47.98±12.53	55	NR	(a) Age 18-65 years (b) HD for at least for 2 months in a dialysis center (c) No disability or other chronic disease (except diabetes and hypertension)	NR	1. Fatigue	1. Worried about fistula 2. Limitations on drinking water 3. Limited time and places for enjoyment and entertainment 4. Low quality of life 5. Low life expectancy 6. Limited physical function	1. Traveling difficulties to the dialysis center 2. Treatment cost

Table 2. Continued

Cinar et al. (12)	2009	Turkey	Descriptive correlational study	NR	224	51.54±14.03	60	NR	(a) HD for more than one year (b) Able to speak and read Turkish (c) Absence of communication problems (d) Consented participation	NR	1. Fatigue 2. Muscle cramping 3. Joint stiffening 4. Hypotension	1. Limitations on vacation 2. Uncertainty about future 3. Limitations on activity 4. Life dependency on HD machine 5. Length of HD treatment 6. Limitations on liquids	1. Decreased social life
Cristóvão (13)	1999	Portugal	Descriptive analytical cross-sectional	NR	75	50.24±10.16	61.33	NR	(a) Aged 18-65 years old (b) Regular HD for at least one year (c) Consciousness (d) Oriented to time, place and person and without mental disorders	NR	1. Fatigue 2. Stiffening of joints 3. Muscle cramps	1. Uncertainty about future 2. Limitations on time and place for vacation 3. Loss of body function 4. Physical activities 5. Limitations on liquids 6. Length of treatment 7. Limitations on food	1. Cost factors
Lok (14)	1996	Australia	Questionnaire survey	NR	64	42.5	62	NR	NR	NR	1. Fatigue 2. Muscle cramps	1. Limitations on physical activities 2. Uncertainty about future	1. Decrease in social life
Cormier-Daigle and Stewart (15)	1997	Canada	Descriptive-correlational study	NR	30	52.7	100	NR	(a) In-center male dialysis patients (b) Aged ≥18 years old (c) Able to speak, read, and comprehend English or French	NR	1. Weakness 2. Chronic fatigue 3. Sleep disorder 4. Drug-induced cardiac arrhythmias	1. Fears related to surgery 2. Travel difficulties 3. Time management problems 4. Onset of hemodialysis 5. Limitations on liquids 6. Post-surgical complications 7. Fear of a coagulating fistula	1. Travel difficulties
Tarachand and Lee (16)	2015	India	A phenomenological study	NR	6 males and 4 females	31-62	60	NR	(a) Aged ≥18 years old (b) HD for at least for 3 years	NR	1. Pain 2. Tiredness 3. Loss of appetite 4. Itching 5. Swelling 6. Muscle cramps	1. Shock 2. Depression 3. Uncertainty about life 4. Fear of complication 5. Compliance to therapeutic regimen 6. Feeling of being a burden on family	1. Loss of employment 2. Financial problems 3. Limited social life 4. Loss of normalcy in life

ESRD: End-stage renal disease; HD: Hemodialysis; NR: Not reported; SD: Standard deviation; M: Mean

Considering gender representation, one study was conducted only on male hemodialysis patients (14), while in all the other studies, male hemodialysis patients comprised more than 50% of the samples (10, 16, 18). None of the studies reported the ethnicity of the participants, except two ones (13, 14). Thirteen studies reported the mean years of a hemodialysis patient on treatment, with a maximum time reported at 7.53±6.25 years (13).

3.2. Stress/stressor definition

Table 2 presents the stress/stressor definitions, employed instruments, measures of each study, and factors affecting the stress perception of the study samples. Out of the 16 studies, 5 studies defined stress (10, 11, 13, 21, 23) and Tchape (12) defined what does stressor means. Based on the definition provided by five authors, stress is an event that often transcends its own resources (13, 23). Nevertheless, another researcher, Bukhary (11), defined stress as a part of human life, accompanied

by positive or negative effects on the physical, emotional, economic, spiritual, and social life of a person. Tachape (12) described stressors as an agent that could arise from holistic sources to make a status of stress.

3.3. Data collection instruments, outcome measures, and statistical analysis

Although the study design was uniform, only 11 quantitative descriptive studies used the translated and validated version of the Hemodialysis Stressor Scale (HSS) or modified HSS to evaluate and rank the stressors (10, 12, 13, 17-21, 23-25). The other quantitative descriptive studies (11, 14-16) used adopted questionnaires from the literature. However, the qualitative study (22) used a semi-structured questionnaire to assess stressors. The questionnaires were administered in the form of either self-administered or interviewer-administered, and all the studies documented the demographic information of their subjects. All quantitative

descriptive studies performed descriptive analysis, correlation coefficients, and a t-test using Statistical Package for Social Sciences (SPSS) software versions 11 to 21. Few studies performed hierarchical regression analysis (19), point biserial correlation (13), analysis of variance (ANOVA) (18), and linear multiple regression analysis (20). Interpretative content analysis, along with coding and thematic analysis, was integrated into qualitative data analysis (22). As a result, stressors were cataloged into three domains: namely biological, psychological, and social, as defined in the Biopsychosocial model (4) illustrated in Figure 1.

3.4. Biological factors

The biological domain included genetic and socio-demographic factors, co-morbidities, complications, and disease-related factors (e.g., symptoms and adverse effects of medication or treatments) (Table 2). Genetic factors affecting stress perception were not identified by any of the studies. Only six studies found a different positive association between stressors and socio-demographic factors, including age (11, 18, 21), marital status (11, 22), literacy level (11, 13), and female gender (11, 13, 24). Only one study found the direct effect of co-morbidities on stress (19).

However, disease-related factors, such as perceived symptoms, were inconsistent predictors; in this regard, ten studies found fatigue as the first ranked physiological symptom (10, 12, 15-17, 20-23, 25), whereas other studies found itching (18), nausea and vomiting (13), body weakness (14), and pain (22) as the most reported physical symptoms. Other than fatigue and itching, four studies reported the next prevailing symptoms as muscle cramps (10, 15, 17, 20), one study as limited physical function (25), and another study as arterial venous stick (21). Three studies identified joint stiffness as a stressor (10, 15, 20). Finally, three studies found reproductive functions, such as decreased sexual drive, decreased ability to procreate (10, 12), and effects on sexuality (16), and one study reported hypotension (20) as biological stressors.

3.5. Psychological and behavioral factors

Among the three defined domains, the factors in the psychological and behavioral domains were predominant and diverse in nature. Psychological distress, personality-related factors, illness perception, well-being, emotions, beliefs, habits, and eating behaviors were reported as psychological and behavioral influences in stress perception. The findings of the selected studies found the heterogeneous nature of psychological and behavioral factors (PBFs), which induced stress on hemodialysis patients (Table 2). Among prioritized psychological factors, the limitation on time and place for vacation was reported as the first line stressor by

six studies (12, 13, 16, 20, 21, 23). Two studies found the limitation of liquids and food (18, 24) and the limitation of daily physical activities (10, 17) as leading psychological stressors.

The next troublesome psychological factors were worries about fistula (25), uncertainty about the future (15), fear related to surgery (14), and shock and depression (22). Six research also reported the length of hemodialysis treatment as an upcoming psychological stressor (13, 15, 18, 20, 23, 24). Moreover, sleep disturbance was highlighted by four studies (16, 21, 23, 24), change of body appearance by three studies (10, 12, 18), limited styles in clothing by three studies (10, 12, 13), dependency on dialysis staff by two studies (10, 16), and post-surgical complications by two studies (14, 22) as apparent psycho-behavioral stressors, which would affect the health of hemodialysis patients (Table 2).

The history of low quality of life and low life expectancy associated with hemodialysis were reported as psychological stressors (25). The other some psychological stressors were expressed as a life-long dependency on a hemodialysis machine (20), anger, sadness, and fear (16), boredom (21), fear of coagulation fistula, problems in time management (14), and compliance to the therapeutic regime (22), which affected patients' psychological status while on hemodialysis.

3.6. Social and environmental factors

Factors related to occupation, financial status, social and family support, accessibility to health care, residential characteristics, social belongings, and family were affiliated to social and environmental domains (Table 2). The majority of studies reported that a decrease in social life (12, 17, 18, 20, 22-24) and economic/cost factors related to illness (10, 12, 15, 16, 18, 22, 25) were the leading social and environmental factors (SEFs) for stress perception. Transportation to and from the dialysis unit (10, 12, 14, 23, 25) and the change of family responsibilities following the diagnosis of chronic kidney disease and hemodialysis (10, 12, 13, 23, 24) were recognized by numerous researchers.

Nevertheless, only two research findings witnessed the influence of job interference (18, 24) and limited occupational capacity, including an inability to work (16, 22), as probable SEFs. Other than above mentioned socio-economic factors, sudden change of role in the family with children and spouse (10) was also recognized as a SEF (Table 2).

5. Discussion

The purpose of this systematic review in using strict inclusion and exclusion criteria was to identify the latest information on factors/stressors affecting stress perception among hemodialysis patients. Although a special article and a review article (6, 26)

discussed stress, none of them focused on factors influencing stress perception. A recent review by Rojas (7) only aimed to review stress and coping mechanisms among hemodialysis patients in the Gulf and neighboring countries. Therefore, the current review provided a summary of factors including their representing domain to understand the factors affecting stress among the hemodialysis patients.

The Biopsychosocial model explicates interaction among three dimensional factors, namely biological, psychological, and social. By incorporating this model, we attempted to answer the question: "What factors contributed to stress among patients undergoing hemodialysis?" Considering all 16 appraised papers, psychological/behavioral factors were mostly and diversely reported in this regard, whereas few biological factors were identified. Although the number of biological factors was less, they were perceived more intensively than other factors (15, 16, 21).

5.1. Synthesis of biological factors

A few socio-demographic factors, such as age, marital status, literacy level, and gender, were shown to influence stress perception. A study by Bukhary (11) found that hemodialysis patients aged less than 20 years were more vulnerable to stress, whereas two studies reported elevated stress among elders (18, 21). One of these studies (21) reported different age strata for specific types of stressors; accordingly, the patients in the age group of 41-60 years had the highest psychosocial stress and those in the 61-80-year-old age group had more physiological stress. Controversial findings were reported regarding marital status; in this regard, some research (11, 12) found that unmarried patients perceived stress, and another study (22) showed that patients with spouses or children had more physiological stressors. This would be affected by the presence or absence of family support from other members. As such, if hemodialysis patients excessively depend only on their partner/siblings, it would be possible that a strong attachment be developed among them, and uncertainty about the future and the possibility of missing them due to poor prognosis cause more stress on them. On the other hand, those who were single, might not have a close family member to share life experiences, and therefore, would be worried about their own future of life. Hence, it is possible to experience an elevated stress level on either occasion.

Similarly, contrast findings were reported on literacy status; regarding this, a study by Ahmad (13) reported a negative relationship between education level and stress, while Bukhary (11) found a positive relationship in this regard. Three studies reported that physiological and psychosocial stress were more prevalent among females than males (11, 13, 22). The results of a cross-sectional study indicated that

hemodialysis patients with co-morbidities perceived an increased level of stress (19). Notably, it is possible to have inconsistent research findings in relation to socio-demographic factors and stress as they are subjective phenomena.

Several researchers reported the existence of an association between cognitive-behavioral factors (e.g., depression, anxiety, and poor sleep quality) and fatigue among ESRD patients (1). However, little evidence is available on stress and fatigue. Fatigue is known to be a leading physical symptom in 42-89% of ESRD patients globally (26, 27). The findings of 10 out of the 16 studies in the current review showed fatigue as a top-ranked physiological symptom affecting stress perception. Moreover, stress and sleep disturbance were strongly associated with fatigue among hemodialysis patients (28). Another key biological factor was physical activity, and its consequences, such as muscle cramps, pain, and body weakness, were found to be influenced by stress/distress. Among the other reviewed biological factors, the effects on sexuality were of paramount importance, which tended to be less expressed by the patients (29). Therefore, future research is needed on factors related to sexuality among hemodialysis patients.

5.2. Synthesis of psychological and behavioral factors

Among three interactive factor clusters of the Biopsychosocial model, PBFs were reported recently and often as the foremost reason for stress perception (12, 23). However, inconsistency was observed regarding the first-ranked reason. The majority of patients perceived the lack of vacation and recreation as key stressors (12, 13, 16, 20, 21, 23). Since living with frequent hemodialysis and symptom burden due to the accumulation of waste products is horrible, patients should follow a therapeutic regime rather than recreation or vacation. The arrangement of recreational activities within dialysis premises, if the unit can afford it, is the best alternative to reduce the stress as these patients spend much time on the premises of the dialysis facility.

Limitation on diet and liquids was also revealed as a key stressor, known as the most difficult factor to be controlled, and researchers found that educational intervention would be more beneficial than food and water limitation (30). On the other hand, hemodialysis patients anticipated future uncertainty (15), and in one qualitative study, it was found that "uncertainty" was the most noteworthy and deeply attached psychological symptom among ESRD patients (31). Sleep disturbances or poor sleep quality was another front-line influencer. Characteristics and patterns associated with poor sleep quality were extensively assessed in relation to distress (32).

A few studies recorded body appearance changes

(10, 12, 18) and limited clothing styles (10, 13) as the sources of causing stress in patients. According to a researcher's suggestion, it was possible to overcome these negative thoughts through understanding the nature of chronic diseases, life dependency on a machine, prognostic criteria, and stress relieving methods (34). Finally, low quality of life and short life expectancy (25) were documented as the factors psychologically impairing the person's capabilities. Another study was dedicated to investigating how the quality of life was threatened by stress, and particularly, how coping mechanisms affected quality improvement processes (35).

5.3. Synthesis of social and environmental factors

Factors related to social and environmental domains were relatively homogeneous and less descriptive in nature. The factors in this domain usually interacted with psychological and behavioral domains; therefore, they were described in some studies as psychosocial factors. Seven appraised studies in this review identified the decrease in social life as the foremost stressor. However, there was insufficient discussion on how decreased social life became a stressor. This limitation may be due to the lack of sensitivity in the HSS items. As an example, Cormier-Daigle and Stewart (14) used Interpersonal Relationship Inventory, which has separate components to assess social support. However, the findings of a qualitative study reported that patients could not attend social activities due to spending time in dialysis units (22). Considering the stressor "lack of social support", it was reported in the literature that in hemodialysis units, social activities were absent and cherished activities were scarce (36). Secondly, a widespread description was provided of economic/cost factors related to illness and its consequences, such as unemployment due to physical restraints (16, 18) and transportation (11, 12). Lastly, role reversal with spouse and changes in family responsibility triggered stress in hemodialysis patients (10). Perhaps this would be irreversible since these patients depend on their close family members.

5.4. Strengths and limitations

The review of the diverse stressors affecting hemodialysis patients would contribute to clinical applicability for patient care and call for improved research in this area. Due to resource constraints, it should be noted that the criteria of accepting only English articles in this review could have led to language biasness as suitable studies published in other languages were possibly left out. In this respect, the generalization of the findings in this review must be made with caution.

5.5. Next steps: research and clinical needs

The development of disorders, such as stress,

anxiety, and psychological distress, related to chronic kidney disease does not occur in hours and days. Therefore, the altered psychological status may persist with them for a considerable time, even if they attend the hemodialysis treatments. Anxiety and stress, similar to psychological alterations, would gradually upgrade, decrease, or remain steady depending on one's own perception of disease, biological processes related to disease, positive or negative environmental stimuli, and due to some other reasons.

For the practicing clinicians and nurses, as well as other therapeutic professionals, these findings may be nebulous from a perspective of guidance. Thoughtlessness and subjective dissimilarity of assessment prevent prompt diagnosis in clinical settings. Moreover, inappropriate data collection instruments inhibit the possibility of early identification of altered psychological status. Even research studies on such aspects are scanty.

For practicing nurses at hemodialysis centers, the nomination of the assessment of psychological status would be a beneficial measure rather than having legislation since underrepresentation or negligence in assessing these elements may unintentionally reduce therapeutic alliances. From the perspective of nursing practice, mentoring nurses, who perform beneficial psychological assessments on psychosocial health, is an integral element of a holistic health care plan (36). Perhaps, pharmacological and non-pharmacological interventions can be used appropriately; in this case, referring to literature on such interventions is highly appreciated prior to implementation. Furthermore, the medical professionals and clinical environments should rearrange in a way that helps patients to overcome stress and provide proper counseling and recreational activities (37). Possibly, dialysis facilities could be empowered with some social interaction activities as patients spend much of their time in dialysis units. Moreover, a comprehensive assessment of socio-demographic, psychosocial, and environmental factors would be an advantage when developing clinical guidelines and public health strategies (37, 38, 39).

Intra and inter relationships between biopsychosocial factors would trigger the cause-effect relationship between stress and possible influential factors. Hence, such a longitudinal research hypothesis would add more advantages in the future. Additionally, considering chosen hemodialysis population is also crucial because although, some have argued that chronic hemodialysis patients would be better than a newly hemodialysis initiated population, it is required to perform further scientific analysis among the two hemodialysis groups to obtain more evidence in this regard. However, the majority of the subjects in the present review were chronic hemodialysis patients.

6. Conclusion

This review provided a comprehensive overview of the biological, psychological, and social factors that generally contributed to stress perception in hemodialysis patients. Among three broad categories of influential factors of stress, psychological factors were commonly perceived by hemodialysis patients. Nevertheless, factors contributing to stress perception were holistic, while complex associations could be expected among the factors. Cross-sectional studies alone would not help to describe this phenomenon. Further methodological issues, including small sample size, the absence of power calculations, and the lack of rigorous criteria for the chosen sampling method were predominant in some of the studies in this review. Hence, there is a need for both high-quality quantitative and qualitative studies to uncover any unknown contributing factors.

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Footnotes

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