ORIGINAL ARTICLE

Associations Between Knowledge on Optimal Control of Serum Phosphate, Perceived Social Support, Dietary Phosphorus Intake and Phosphate Compliance Among Hemodialysis Patients

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ABSTRACT

Introduction: Hyperphosphatemia is common among hemodialysis patients, often accompanies with unfavourable clinical outcomes. Several factors affect phosphate compliance among hemodialysis patients, with lack of such information at the local context. Thus, this cross-sectional study aimed to determine the associations of sociodemographic factors, knowledge on optimal control of serum phosphate, perceived social support from family, dietary phosphorus intake and phosphate compliance among hemodialysis patients. **Methods:** Structured questionnaire was used to obtain information on socioeconomic factors, knowledge, family social support and dietary phosphorus intakes of hemodialysis patients, with serum phosphate level was used as the surrogate marker for phosphate compliance. **Results:** A total of 76 patients (Mean age of 52 years old) were recruited. Hyperphosphatemia was prevalent with approximately 60% of the patients failed to achieve the target. Approximately 90% of the patients perceived low level of family social support. Young patients had significant higher serum phosphate compared to their older counterparts (r = -0.297, p =0.009). Serum phosphate was positively correlated with dietary intake of phosphorus, dialysis vintage (r = 0.301, p = 0.006) and comorbidity score (r = 0.325, p = 0.008) while negatively correlated with dialysis dose (r = -0.582, p = 0.002) and family social support (r = -0.263, p = 0.024). **Conclusion:** The promising role of dietary phosphorus intake in managing hyperphosphatemia deserves further attention. Innovative approaches are needed to promote self-adherence on serum phosphate especially the younger patients. It is imperative to promote family social support in the management of hyperphosphatemia among hemodialysis patients.

Keywords: Hyperphosphatemia, Knowledge, Perceived family social support, Dietary phosphorus intake

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INTRODUCTION

Maintaining optimal phosphate homeostasis is of crucial importance for physiology processes including bone mineralization in chronic kidney disease patients (1). Over the past two decades, despite a bourgeoning body of research has focused on the epidemiology, causes, consequences, and treatment of hyperphosphatemia, which has advanced our understanding of the manifestations and management on this medical issue, hyperphosphatemia remains prevalent among end-stage renal disease (ESRD) patients undergoing for hemodialysis in Malaysia, ranged from 33.5% to 81.5% (2-4), which is consistent with international scenario (5-6). Despite dietary phosphorus intake is imperative in the management of hyperphosphatemia besides compliances on dialysis schedules and medications, the correlation between dietary phosphorus intake and serum phosphate concentration was reported to be weak (7), which suggest that hyperphosphatemia is multifactorial. Several factors had been proposed being the determinants of hyperphosphatemia including perceived poor social support from family (8-9) and poor knowledge on optimal control of serum phosphate such as dietary source of high phosphorus, timing to take phosphate binders (10). However, there are inconsistency on the findings on how knowledge (11-12) or family social support (13-15) can affect patient's serum phosphate level. Such discrepancies can be explained probably by the methodological issue or the social support expectations in different populations.

There is dearth of information on this aspect at the local context. The purpose of this study is therefore to identify whether sociodemographic factors, perceived social support from family, knowledge on optimal control of serum phosphate and dietary phosphorus intake may associate with level of serum phosphate among the hemodialysis patients.

MATERIALS AND METHODS

This was a cross-sectional study conducted at three purposively selected hemodialysis centres in Selangor. Centres within 30 km of radius from Faculty of Medicine and Health Sciences Universiti Putra Malaysia and contained at least 30 dialysed patients were approached. While a total of 18 centres were identified, only three consented to study. A total of 76 eligible hemodialysis patients were recruited. The sample size was calculated based on equation for correlation analysis (16). The inclusion criteria comprised all ethnic groups; aged 18 years and above; duration of dialysis of more than three months and medically stable; undergone hemodialysis for four hours thrice weekly; sufficient cognitive function to complete the questionnaires and measurements. Prior to the commencement of the study, ethical approval for the study protocol was obtained from the Ethics Committee for Research Involving Human Subjects, Universiti Putra Malaysia (JKEUPM-2019-013). Approval letters from the selected hemodialysis centres were also obtained prior to data collection. Upon approval from ethics review board, the detailed of the study was explained to potential participants. Anonymity and confidentially of patients were assured before individual written informed consent was obtained. A set of structured questionnaire which was pre-tested earlier among 15 hemodialysis patients was administered by the interviewer via face-to face interview to obtain information on sociodemographic factors, knowledge on optimal control of serum phosphate, perceived family social support and their dietary phosphorus intake. Objective adherence to phosphate was obtained retrospectively from the medical records using the pre-dialysis serum phosphate levels as secondary data. Patients were considered non-adherent when the average of the pre-dialysis serum phosphate levels (past 3 months from data collection) exceeded 1.6 mmol/l based on recommendations from Clinical Practice Guidelines on Renal Replacement Therapy of Ministry of Health Malaysia (17). Other clinical factors obtained included presence of polypharmacy (prescribed with more than five types of medication), duration of dialysis (dialysis vintage), adequacy of dialysis (delivered dose of dialysis, Kt/V urea) and patients' comorbidity scores (ascertained according to modified Charlson's Comorbidity Index).

A total of 23-items which was adopted and adapted from the Knowledge Questionnaire (KnQ) (18) was used to assess patient's knowledge on optimal control of serum phosphate, dietary restrictions (e.g., what foods are high in phosphorus?), phosphate binders (e.g., when to take phosphate binders?) and dialysis (e.g., why adequate dialysis is important for me?). The questions were prepared which required patients to answer with a simple "yes" or "no", with an additional "don't know" category to avoid possible bias due to guessing. Each correct response was given a score of one while incorrect or "don't know" response was scored zero. The scores were weighted and standardized, giving a maximum score of 100. Cronbach's coefficient alpha of the instrument was 0.82, denoting the good reliability of measurement. On the other hand, the homogeneity among raters or intrarater reliability of the instrument based on intra-class efficiency was reported to be 0.79, denoting a good degree of reproducibility. Meanwhile, Perceived Social Support - Family (PSS-Fa), a 20-item questionnaire was used to asses patients' perceived level of social support from their family members (19). By assessing the verbal and behavioural expression of intimacy tolerance, PSS-Fa is a universal family support measure whereby higher social support indicates a greater ability to accept intimacy. Patients were requested to describe best about their perceptions on family social support. Statements include patients' feeling of being taken care by family, experiences such as interests shared between members There were three possible answers for each statement namely, Yes, No, Don't Know. Response indicatives for perceived social support was scored as one with the other two scores being zero. The possible scores ranged from 0 (indicating no perceived social support) to 20 (indicating maximum perceived social support). This questionnaire had high test-retest reliability (r = 0.83) and internal consistency (Cronbach α = 0.90) (11). An additional of 10 self-developed questions were included to complement the understanding on the perceived family support in term of dietary phosphorus control, dialysis and phosphate binders. The scores (perceived family support on dietary phosphorus, phosphate binders and dialysis) were weighted and standardized, giving a maximum score of 100. In the absent of universal cut-off for this instrument, a score of 60% was used as the arbitrary cut-off.

In assessing patients' dietary intake, a two-day 24 hour-diet recall were used where one day was assessed on dialysis day while the other day was on non-dialysis day. The information needed from the dietary recall comprised of the meal time, source of foods, food items and amount of the food. In aiding patient's memory to estimate sizes of food portions, a food photo album was used as a guide (20) besides household measurements (bowls, plates, glass, cups, teaspoon and tablespoon). Nutrients intake of patients include macronutrients (carbohydrate, protein and fats), minerals (phosphorus, potassium, calcium, sodium) and vitamins (A, B, C, E, K) were analysed using Nutritionist Pro™ Diet Analysis Software (Version 2.4.1. Axxya System, LLC, USA). The database used in the Nutritionist Pro was from

USDA and Nutrient Composition of Malaysian Food database (21). A dietitian reviewed the completed food records for clarification of food details and amounts. Considering high possibility of underreporting of energy intake among hemodialysis patients (22), possibility of underreporting of energy intake of the patients was ascertained according to established protocol (23). A total of 18.4% of the patients had energy intake to resting energy expenditure ratio (EI:REE) of less than 1.27, which was much lower as compared to earlier studies (22-23). Statistical analysis and processing were computed using SPSS version 22.0. Besides dietary recalls, consumption pattern of patients on foods rich in phosphorus was ascertained with the administration of a food frequency questionnaire. Frequency of intake of high phosphorus foods was evaluated based on habitual intake over the previous month. Food frequency consumption of each item was evaluated using six categories: never or rarely; 1-3 times per month; once a week; 2-4 times per week; 5-6 times per week and every day. Univariate analysis was used to analyse descriptive data and the results were presented as frequencies and percentages for categorical and as means and standard deviations for continuous variable. Correlations between continuous variables with serum phosphate were tested using Pearson's Product Moment Correlation while student t test was used to test the mean differences of serum phosphate of categorical variables. The level of statistical significance was set at $p<0.05$.

RESULTS

Table I presented the distribution of patients according to sociodemographic factors and level of serum phosphate. A total of 76 patients comprising of 59.2% females and 40.8% males were involved. Mean age of patients was 52 ± 14 years old, comprised of one-third of older adults. A majority of the patients (86.8%) were Malay, married and had possessed either secondary or tertiary education. In general, the financial status of the patients was unsatisfactory, with only 1 in 5 patients were employed, while approximate 90% were in the B40 or M40 categories. The main paymaster for hemodialysis treatment for patients was Public Service Department. Approximately two-third and 90% of the patients were on polypharmacy and received adequate dialysis, respectively. Mean level of serum phosphate was 2.11 ± 0.64 mmol/L ranging from 0.77 to 4.00 mmol/L, with more than 80% had elevated serum phosphate levels.

As shown in Table II, mean knowledge score of patients on optimal control of serum phosphate was slightly higher than 50%. Mean scores of knowledge ranged from 28.62% to 56.64%, depends on the domains assessed. Knowledge of patients was highest on phosphate binder, followed by knowledge on dietary phosphorus. Patients had the lowest score on dialysis. Mean score for knowledge on dietary phosphorus aspect was less than 50%, indicating that patients had insufficient knowledge on dietary phosphorus aspect, including the inability to identify food sources rich in phosphorus. A total of 65.8%, 46.1% and 30.3% of the patients were aware that hyperphosphatemia will lead to bone and joint disease, high blood pressure and cardiac disease, respectively. On the other hand, slightly more than half of the patients were not aware that hyperphosphatemia

Table I: Distribution of patients according to sociodemographic and clinical factors (n = 76)

Variables	n (%)	Mean ± SD	Range
Age (years)		52 ± 14	21-79
Less than 60 years old	52 (68.4)		
60 years old and above	24 (31.6)		
Sex			
Female	45 (59.2)		
Male	31 (40.8)		
Ethnicity			
Malay	66 (86.8)		
Chinese	4 (5.3)		
India	6 (7.9)		
Marital status			
Single	11 (14.5)		
Married	55 (72.4)		
Divorced	1 (1.3)		
Widow/ widower	9 (11.8)		
Educational level			
No formal education	3 (3.9)		
Primary	5 (6.6)		
Secondary	39 (51.3)		
Tertiary	29 (38.2)		
Employment status			
Employed	16 (21.1)		
Unemployed	28 (36.8)		
Retired	32 (42.1)		
Monthly Household Income (RM) [1]		4143.42 ±	
B40 (< 3,860)	23 (30.3)	1778.38	
M40 (3,860 – 8,319)	44 (57.9)		
T20 (≥ 8,320)	9 (11.8)		
Paymaster for dialysis treatment			
Public Service Department	35 (46.1)		
SOCSO	23 (30.3)		
Zakat	16 (21.1)		
Self-paid	2 (2.6)		
Presence of polypharmacy	49 (64.5)		
Charlson's Comorbidity Score		5.04 ± 1.84	
Dialysis Treatment Measures			
Duration of dialysis (months)		82.6 ± 20.5	
Dialysis dose (Kt/V)		1.32 ± 0.5	
Dialysis adequacy (Kt/V ≥ 1.2)	69 (90.8)		
Serum Phosphate Level (mmol/L)[2]		2.11 ± 0.64	0.77 –
Low (< 0.8)	2 (2.6)		4.00
Normal / Optimum (0.8 – 1.6)	11 (14.5)		
High (> 1.6)	63 (82.9)		

Data were presented as mean ± SD or n (%)
[1] Classified according to Eleventh Malaysia Plan (2016–2020); B40: bottom 40%; M40: middle 40%; T20: top 20%; RM 1 was equivalent to approximately USD 0.25 at the time of data collection
[2] Classified according to Clinical Practice Guidelines on Renal Replacement Therapy, Ministry of Health Malaysia (2017)

Table II: Knowledge on Optimal Control of Serum Phosphorus, Perceived Social Support from Family and Dietary Phosphorus Intake of respondents

	Mean ± SD or n(%)	Range
Total Knowledge on Optimal Control of Serum Phosphate	53.28 ± 20.02	0-78.7
Knowledge on Phosphate Binders	56.64 ± 19.23	0-91.3
Knowledge on Dietary Phosphorus	49.66 ± 25.53	0-81.63
Knowledge on Dialysis	28.62 ± 20.11	8.33-100
Total Perceived Social Support from Family	6.47 ± 4.01	0-18
Perceived Social Support from Family on Phosphate Binders	61.6 ± 21.2	0-100
Perceived Social Support from Family on Dietary Phosphorus	64.5 ± 30.4	0-100
Perceived Social Support from Family on Dialysis	23.7 ± 14.9	0-100
Dietary Phosphorus Intake		
Dialysis Day (mg/day)	817 ± 570	96-2892
Excessive intake*	20 (26.3)	
Optimal intake*	56 (73.7)	
Non-dialysis Day (mg/day)	858 ± 565	54-2689
Excessive intake*	30 (39.5)	
Optimal intake*	46 (60.5	

Data were presented as mean ± SD or n (%)
* Classification was based on recommendation from Medical Nutrition Therapy for CKD patients on dialysis

Table III: Associations between serum phosphate levels and selected variables

Variables	Serum Phosphate	
	r / t	***p*-value**
Sociodemographic factors		
Age	-0.297	0.009**
Household Income	-0.057	0.628
Sex (0 = male, 1 = female)	-2.010	0.045*
Education level (0 = primary or secondary, 1 = tertiary)	0.085	0.126
Employment status (0 = non-employed, 1 = employed)	1.231	0.078
Clinical Factors		
Duration of dialysis	0.301	0.008**
Dialysis dose	-0.360	0.002**
Charlson's Comorbidity Score	0.325	0.006**
Polypharmacy (0 = No, 1 = Yes)	-2.174	0.036*
Total Knowledge on Optimal Control of Serum Phosphate	0.157	0.160
Knowledge on Phosphate Binders	0.083	0.561
Knowledge on Dietary Phosphorus	-0.192	0.053
Knowledge on Dialysis	-0.185	0.109
Total Perceived Social Support from Family	-0.263	0.024*
Perceived Social Support from Family on Phosphate Binders	0.018	0.951
Perceived Social Support from Family on Dietary Phosphorus	-0.133	0.067
Perceived Social Support from Family on Dialysis	-0.085	0.172
Dietary Phosphorus Intake		
Dialysis Day	0.200	0.047*
Non-Dialysis Day	0.228	0.032*

*Correlation / association was significant at $p < .05$
**Correlation / association was significant at $p < .001$

may lead to osteodystrophy. Among the symptoms of hyperphosphatemia, a highest proportion of patients (76.3%) were aware that high serum phosphate can cause itchy skin, compared to other common symptoms including dizziness or muscle cramp. On the other hand, mean score for total Perceived Social Support from Family was relatively low at 6.47± 4.01, with none of the patients achieved the maximum score of 20. Using 60% as the arbitrary cut-off, a total of 86.8% of the patients perceived low level of social support from family. On the other hand, perceived social support on phosphate binders, dietary phosphorus and dialysis ranged from 23.7% to 64.7%. There was comparable perceived social support from family on the two pertinent components or domains namely phosphate binders and dialysis (t = 0.98, $p > 0.05$), with a significantly lower perceived social support on dialysis in the aspects of seeking assistant on financial and transportation (F = 3.31, $p = 0.031$). There was significantly lower intake of phosphorus on dialysis (817 ± 570 mg/day) than non-dialysis days (858 ± 565 mg/day) (t = 2.00, $p = 0.046$). It is worth noting that excessive intake of phosphorus is prevalent among the patients with approximately one-quarter and 40% of the patients had excessive dietary phosphorus intake on dialysis day and non-dialysis day, respectively.

Correlations between serum phosphate levels with sociodemographic factors, knowledge on optimal control of serum phosphate, perceived social support from family and dietary phosphorus intake were dictated in Table III. A statistically significant negative correlation was found between age and serum phosphate (r = -0.297, p = 0.009), indicating younger age was associated with higher serum phosphate level. Male patients were found to have higher serum phosphate level compared to their female counterparts (t = 2.01, p<0.05). Patients with polypharmacy had significant higher level of serum phosphate as compared to their counterparts (t=2.174, p<0.05). There were no significant associations between serum phosphate level and ethnicity, educational level, employment status or household income. Similarly, there were no significant associations between serum phosphate levels and knowledge on optimal control of serum phosphate (r = 0.157, $p = 0.160$), neither knowledge on phosphate binders (r = 0.083, $p = 0.561$), dietary phosphorus (r = -0.192, $p = 0.053$) nor dialysis (r = -0.185, $p = 0.109$). With regards to clinical factors, serum phosphate was negatively associated with dialysis dose (r = -0.582, $p = 0.002$) while positively associated with dialysis vintage (r = 0.301, $p = 0.006$) and Charlson's comorbidity score (r = 0.325, $p = 0.008$). There was a significant correlation between perceived social support from family and serum phosphate levels (r = -0.263, $p = 0.024$). Weak but significant correlations were found between serum phosphate levels and dietary phosphorus intake on dialysis day (r = 0.200, $p = 0.047$) and non-dialysis day (r = 0.228, $p = 0.032$).

DISCUSSION

Hyperphosphatemia or elevated serum phosphate is prevalent among our hemodialysis patients. This finding was consistent with earlier studies (3-6). The high prevalence of hyperphosphatemia is alarming when considering a majority of the patients in this study cohort was less than 60 years old. Optimal control of

phosphate balance depends on three major aspects namely compliance to phosphate binders, dietary phosphorus and dialysis. The complexity of the dietary regimen that causes greater difficulty for the hemodialysis patients to restrict the phophorus-rich food items that are commonly found in daily life may have contributed to this. The lack of freedom might also reduce the enjoyment and pleasure while eating resulting in renal patients demonstrate poor-compliance towards dietary phosphorus restriction 11, 24-25). This data should however be interpreted cautiously as serum phosphate level was obtained retrospectively as secondary data in this study, it may not necessarily reflect the current and actual state of phosphate compliance of the patients.

Despite a majority of the patients were relatively young, many of them were retirees or unemployed. Hemodialysis patients often anticipate in an early retirement or sacrificing employment or their job opportunities to fit well into the hemodialysis schedule (26-27). Half of the patients scored less than 60% of total knowledge on optimal control of serum phosphate. This finding was in congruent with previous studies (2, 11, 28-31) who reported low level of knowledge on dietary phosphorus compared to other nutrients. Hemodialysis patients may have a hard time identifying phosphorus-rich food sources due to the lack of noticeable physical properties to which patients can easily relate and recognize (11). For example, high sodium foods are generally taste salty while foods with high fluid content are liquid at room temperature, at which such obvious physical properties are not obvious for foods with high phosphorus content. The perceived level of social support from family was relatively low compared to previous studies (32-33). Culture and religious beliefs that emphasize on the role of family member providing care and support to the family members may have attributed to this (34-35).

There were approximately one-quarter and 40% of the patients with excessive dietary phosphorus intake on dialysis day and non-dialysis day, respectively. This finding was parallel with earlier works (36-37). It is generally acknowledged that hemodialysis patients are less likely to adhere to dietary phosphorus restrictions because they are less educated about diet itself and the consequences of hyperphosphatemia (10,38). Our findings also showed approximately two-third of the patients consumed inorganic phosphorus foods such as sausages, hot dogs, frankfurter, burgers or carbonated drinks on a regular basis (data not shown). Owing to its high bioavailability, consumption of inorganic phosphorus foods should be avoided.

Age appeared to be a profound factor indicating phosphate compliance in this study. Younger age was associated with higher serum phosphate level. This finding was parallel with other works (8,36,39-41). Older hemodialysis patients, whom are expected to be more conservative and have a more structured lifestyle are able to adhere to the treatment regimen of hemodialysis, especially in terms of dietary restriction. Besides, younger patients always lead a more active and busy social life than older person and they tend to perceive themselves as less vulnerable to negative consequences of dietary non-compliance (8, 42-43). This finding is in accordance with previous local study (2) but was not in-line with others (39). Unequal distribution on these variables among patients as well as methodological issues such as sample size may as well influence the discrepancies and the difficulty to have significant levels result. This study found that higher knowledge did not indicate better compliance which was parallel with other studies (2,44-45) but were inconsistent with Durose et al. (11). We have no concrete answer for this, but it could be possible that patients with good knowledge level on phosphate control may forget the information, especially when the information is conveyed verbally without written copies. Besides, patients may find it difficult to cut down on food-rich in phosphorus acknowledging the harmful consequences to the body, portraying intentional non-compliance (2,11,43). It is possible that knowledge might be a prerequisite for adherence behaviour but knowledge alone may be insufficient for such behaviour changes (46).

There were significant correlations between clinical factors and serum phosphate level. Patients with longer duration of dialysis and presence of comorbid diseases had higher serum phosphate level. This finding echoed earlier studies (47-48). The actual mechanism between serum phosphate level and comorbid diseases such as diabetes mellitus is unclear. It was proposed that there might be a unique diabetic milieu' that leads to enhanced phosphate absorption among dialysis patients with diabetes (49). On the other hand, several medications used for the treatment of diabetes mellitus may contain highly bioavailable inorganic phosphorus as an additive (50). More works are warrant in this aspect. As expected, adequate dialysis dose was associated with lower serum phosphate level. Dialysis is the cornerstone of homoeostatic electrolyte management for ESRD patients. However, as the three-times weekly conventional hemodialysis sessions can only remove approximately 600 to 1200 mg of phosphorous per session (51), the currently available dialysis techniques hamper ability to attain the targeted serum phosphate levels in ESRD population (52), without the good adherence of patients on dietary control and phosphate binders.

Higher perceived social support from family was associated with lower serum phosphate levels. This finding was in congruent with other studies (8,33,53) but was inconsistent with Fincham & Moosa (44). Consistent encouragement and useful advice from social support network can facilitate changes on individual's lifestyle (15), which in turn may improve patients' adherence to treatment regimen. Social support may also enhance quality of life through various mechanisms for example

increasing patients' satisfaction from the provided care, improving adherence to the therapeutic regimen which includes diet and fluid restrictions, thus improving laboratory results (lower phosphate and potassium) and lead to better clinical outcomes (8, 54).

Higher dietary phosphorus intake was correlated with higher serum phosphate among this study cohort, regardless on dialysis or non-dialysis day, signify the need for hemodialysis patients to watch their food intakes, especially considering the high prevalence of excessive dietary phosphorus intake among them. Despite our findings echo earlier study (7), inconsistencies exist. The divergent results may be attributed by the incomplete database to capture phosphorus content in most population especially the inorganic phosphorus which nutrition labelling is not a mandatory. The extra-phosphate load attributed to the widely use of inorganic phosphorus as food additives for various reasons in processed meat, poultry, and fish products is usually unavailable. On the other hand, the use of complex names or ingredients on food labels may obscure the presence of inorganic phosphorus in foods. In light of increased serum phosphate level attributed to excessive intake of dietary phosphorus additives had been shown to induce increased carotid intima-media thickness (55), which is a known risk factor for cardiovascular diseases, more effective strategies are needed to improve the dietary phosphorus intake of the renal community. The addition information of phosphorus content to nutrition labels would be of substantial benefit to the chronic kidney disease population, which has been called for many years, but receive little attention.

There are few limitations in this study. Firstly, cross-sectional study had limited finding which only estimated the presence and strength of correlations between variables. Causal relationship between variables could not be identified. Therefore, cohort studies should be taken into consideration in future studies to produce more valuable findings. Besides, this study was only conducted in three dialysis centres in Selangor, thus the study outcomes could not represent the whole hemodialysis population in Malaysia. Study with extended coverage might be needed to generalize the outcomes which favour phosphate compliance among hemodialysis patients. The current sample size limits the ability to perform more advance statistical analysis including multilinear regression. It is highly recommend to extend the sample size in the future study. By using interviewer-administered questionnaire, study outcomes may depend on honesty of the patients as well as interviewer's skills and techniques in acquiring the accurate information. Moreover, patients might have the tendency to give answers with the intention to impress the interviewers, leading to potential bias.

CONCLUSION

This study confirmed that hyperphosphatemia was prevalent among hemodialysis patients with more than half of the patients exhibited poor phosphate compliance. As younger patients are more likely to develop hyperphosphatemia, health care professionals including dietitians should perform regular nutritional screening and counselling among young patients. Besides, it is beneficial to note that half of the patients had low level of knowledge regarding optimal control of serum phosphate. Although there were no significant association found between knowledge with serum phosphate, further rigorous and concrete studies may be needed to confirm these results. Results of this study also attract our attention to the role of dietary phosphorus intake in managing hyperphosphatemia. Intervention program that educate on protein-phosphorus ratio should be recommended as the antecedents to improve phosphorus compliance while minimizing risk of protein energy malnutrition. Healthcare professionals should play their role in providing proper dietary phosphorus management especially on 'hidden phosphorus' in daily life. Other than that, raising awareness among knowledgeable hemodialysis patients with poor phosphate compliance, particularly on the harmful consequences of hyperphosphatemia is important to correct their intentional non-compliance dietary phosphorus restrictions. Despite limitations present, this study highlighted several findings that require further studies for confirmation apart from filling the existing research gaps.

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