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IN THIS ISSUE

CANNT|ACITN
Canadian Association of Nephrology Nurses and Technologists
l'Association canadienne des infirmières et infirmiers et des technologues de néphrologie


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SAVE THE Date
OCTOBER 26-28, 2023
CHARTLOTTETOWN, PEI
CANNT STOP, WON'T STOP
FINDING CREATIVE WAYS TO BRIDGE THE GAP
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Letter from the Editors

A warm hello to our CANNT colleagues! We hope there is minimal to no concern for an air quality advisory in your neck of the woods because of the multiple wildfires raging in Western and Central Canada. We hope these fires will soon be tempered by the valiant efforts of all firefighters at home and from abroad amidst favourable weather. As nurses, we have become inured to the various natural or man-made disasters that have beset us. The resulting poor air quality does not bode well for individuals with respiratory compromise, and kidney failure further complicates this scenario. We salute nurses who have been providing the best patient care possible under these challenging and dangerous circumstances.

At the time of publication, the International Council of Nurses (ICN) and Canadian Nurses Association (CNA) will have just co-hosted the ICN Congress 2023 at the Palais des congrès de Montréal on July 1–5. The theme of the congress was *Nurses together: A force for global health*. As a first-time attendee at this premier nursing event, I (JB) felt awed by the sheer number of initiatives that nurses across the globe are undertaking, yet attendees were also reminded about the gaps in care in low- and middle-income countries. The Canadian healthcare system is not perfect, but it provides for its citizens, which cannot be said for many countries, including developed countries. For example, in certain parts of the world, the advanced practice nurse (APN) role, which comprises nurse practitioners (NP) and clinical nurse specialists (CNS) in Canada, has not yet been fully or optimally implemented. This underscores the gains that have been championed and achieved by the Canadian pioneers in the field. Issues that we face in caring for people receiving dialysis in Canada are similarly felt in other parts of the world. I (JB) struck up a conversation with a nurse delegate from Qatar who submitted two abstracts on the management of missing treatments and of anemia in the hemodialysis population, and just like that – a connection was made. Momentarily putting our nephrology hats aside, ICN is for all nurses worldwide. The Finnish Nurses Association (FNA) and the ICN will co-host the next ICN Congress 2025 in Helsinki, Finland. For those all nurses working in nephrology, this would be a great opportunity to share your experiences and learn from others about providing care at the frontline and advancing issues unique to nephrology nursing at the policy level. It would be great to see representation from nephrology nursing in Canada at all levels of care – from the dialysis chairside or bedside to the NPs directing the care, to management and policy makers, and everyone in between!

In this issue, we present the manuscript *Effect of a yoga intervention on depression, anxiety, and sleep in patients on hemodialysis – A pilot study* by Kauric-Klein (2023). Kauric-Klein reports on the effect of chair yoga on psychological outcomes such as depression, within the context of an explanatory theoretical framework. Although the study was not powered to achieve generalizability, it does give us a glimpse of the potential means of ensuring the psychological fitness of our patients. It is also emblematic of the need to conduct optimal randomized clinical trials on interventions that are outside of the box, so to speak.

In our CE article offering, *Hyperphosphatemia and vascular calcification in chronic kidney disease*, Ogunrinde et al. (2023) describe the pathophysiology of hyperphosphatemia and the implications for vascular calcification in individuals with chronic kidney disease. Management of hyperphosphatemia is one of the mainstays of patient care in dialysis, and there is always something evolving in the therapy toolkit, which is why this topic is perennial. We hope the topics in these articles will resonate with you and your practice.

As always, we are looking for budding and seasoned writers in nephrology nursing and technological practice who have something to share with the CANNT community and the nephrology community at large. We publish observational studies, clinical trials, case reports, solutions to clinical bedside problems, and quality improvement projects to advance nephrology nursing and technological practice. We do not have a shortage of talented writers in the Canadian nephrology scene, and we need to harness this talent in order to share the knowledge and expertise with the rest of the nephrology community across the country. We are gearing up for the upcoming national conference in Prince Edward Island on October 26–28, 2023. We will be hosting a writing workshop during the conference. It is our hope that we will see you at the workshop.

Have a wonderful rest of the summer.

Sincerely from your *CANNT Journal* co-editors,

Jovina Bachynski
MN-NP Adult, RN(EC), CNeph(C), PhD Student

Rosa M. Marticorena
CNS, CNeph(C), DClinEpi, PhD

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Message des rédactrices en chef

Un beau bonjour à tous les collègues de l'ACITN! Nous espérons que votre région n'est pas visée par les avis de mauvaise qualité d'air en raison des feux de forêt qui sévissent dans le centre et l'ouest du Canada ou que l'air est à tout le moins respirable. Souhaitons que ces incendies soient bientôt maîtrisés grâce aux efforts de tous les valeureux pompiers, d'ici et d'ailleurs, et des conditions météorologiques favorables. En tant qu'infirmières, nous sommes habituées aux conséquences des catastrophes naturelles ou de celles causées par l'homme. La mauvaise qualité d'air qui résulte de la situation actuelle n'est pas de bon augure pour les personnes qui ont des problèmes respiratoires, et l'insuffisance rénale vient davantage compliquer les choses. Nous saluons toutes les infirmières qui prodiguent les meilleurs soins possibles aux patients dans ces circonstances difficiles et dangereuses.

Au moment de publier ce numéro, le Conseil International des Infirmières (CII) et l'Association des infirmières et infirmiers du Canada viendront tout juste de tenir le Congrès du CII de 2023 au Palais des congrès de Montréal, du 1er au 5 juillet. Le thème du congrès était *Les infirmières ensemble : une force pour la santé mondiale*. Il s'agissait pour moi (JB) d'une première participation à cet événement d'envergure et j'ai été impressionnée par le nombre d'initiatives menées par les infirmières dans le monde entier. Néanmoins, les participants se sont également vu rappeler les lacunes en matière de soins dans les pays à faibles et moyens revenus. Le système de santé canadien n'est pas parfait, mais on doit reconnaître qu'il offre beaucoup aux citoyens, ce qui n'est pas le cas dans tous les pays, en particulier ceux en voie de développement. Par exemple, dans certaines parties du monde, la pratique infirmière en soins avancés, qui comprend les infirmières praticiennes (IP) et les infirmières cliniciennes spécialisées (ICS) au Canada, n'a pas encore été mise en œuvre de manière intégrale ou optimale. Cela met en lumière les progrès réalisés par les pionniers canadiens en ce sens. Les difficultés que nous rencontrons dans les soins aux personnes sous dialyse au Canada s'observent également dans d'autres parties du monde. J'ai (JB) discuté avec une infirmière déléguée du Qatar qui avait soumis deux résumés sur la gestion des traitements manqués et la prise en charge de l'anémie chez les patients sous hémodialyse, et la connexion s'est faite tout naturellement! En mettant temporairement nos chapeaux d'infirmières en néphrologie de côté, on s'aperçoit que le CII s'adresse aux infirmières du monde entier. La Finnish Nurses Association (FNA) et le CII coorganiseront le Congrès du CII de 2025, qui aura lieu à Helsinki, en Finlande. Il s'agit d'une excellente occasion pour toutes les infirmières qui travaillent en néphrologie de parler de leur expérience et d'apprendre de leurs collègues dans le contexte des soins de première ligne, et de faire avancer les politiques de soins infirmiers en néphrologie. Il serait agréable que l'ensemble des professionnels canadiens en néphrologie soient représentés, que ce soit l'infirmière qui accompagne le patient lors de sa dialyse, l'IP qui dirige les soins ou les gestionnaires et décideurs du secteur, et tous les autres!

Dans ce numéro, nous présentons l'article *Effect of a yoga intervention on depression, anxiety, and sleep in patients on hemodialysis – A pilot study* de Kauric-Klein (2023). L'auteur examine, dans un contexte théorique, les bienfaits éventuels du yoga sur chaise pour les patients atteints de divers troubles psychologiques, comme la dépression. Même si cette étude n'a pas été conçue de façon à permettre d'en généraliser les conclusions, elle nous permet de jeter un coup d'œil sur les moyens potentiels d'assurer le bien-être psychologique de nos patients. Elle est également représentative de la nécessité de mener des études cliniques à répartition aléatoire optimales portant sur des interventions

en quelque sorte non orthodoxes. Dans notre article d'éducation continue *Hyperphosphatemia and vascular calcification in chronic kidney disease*, Ogunrinde et ses collaborateurs (2023) décrivent la physiopathologie de l'hyperphosphatémie et son rôle dans la calcification vasculaire chez les personnes atteintes d'insuffisance rénale chronique. La prise en charge de l'hyperphosphatémie est l'un des piliers des soins aux patients sous dialyse, et l'arsenal thérapeutique qui est consacré est en constante évolution, ce qui en fait un sujet toujours d'actualité. Nous espérons que vous pourrez établir des liens entre ces articles et votre pratique.

Comme toujours, nous sommes à la recherche de rédacteurs en herbe ou chevronnés qui souhaitent transmettre aux membres de l'ACITN, ainsi qu'à l'ensemble de la communauté en néphrologie, leur expérience des soins infirmiers ou des pratiques technologiques en néphrologie. Nous publions des articles sur des études observationnelles, des essais cliniques, des études de cas, des solutions à des problèmes cliniques et des projets d'amélioration de la qualité afin de faire avancer les soins infirmiers et les pratiques technologiques en néphrologie. Heureusement, nous avons une pépinière de rédacteurs canadiens talentueux dans le domaine de la néphrologie et nous souhaitons en tirer le meilleur parti afin de transmettre les connaissances et l'expertise au reste du milieu de la néphrologie. Nous nous préparons à notre prochain Congrès national qui se tiendra à l'Île-du-Prince-Édouard, du 26 au 28 octobre 2023. Durant ce congrès, nous proposerons un atelier sur la rédaction d'articles. Au plaisir de vous y voir!

Meilleurs vœux pour le reste de la saison estivale!

Salutations cordiales de la part des rédactrices de la *Revue de l'ACITN*,

Jovina Bachynski
Sc. inf., IP (adulte), inf. aut. (catégorie spécialisée), CNeph(C), doctorante

Rosa M. Marticorena
ICS, CNeph(C), D.E.S. Épidémiologie clinique, Ph. D.

President's Message

Summer has arrived! The warm weather and extreme drought, however, have prompted the worst wildfires in Canadian history. This climate change crisis has led to hundreds of wildfires spreading across Canada, causing mass evacuations and burning millions of acres. At CANNT, we are sending our prayers to our colleagues and patients who have been forced to evacuate and have had their homes and livelihoods destroyed. We would also like to acknowledge our Canadian generosity shown by so many of you who have sheltered those evacuated in your own homes and have donated your time and money to care for your neighbours.

CANNT sends a warm thank-you to firefighters from Canada and abroad who have come to help in this effort. This is truly a global crisis, as we witness vast portions of our country and certain areas of the American Northeast region covered in smoke and haze. We have all heard the air quality warnings extending far into the United States and as far away as Norway. Our nephrology populations are at risk for the greatest potential health impacts of these severe levels of air pollution. It is important to educate our patients and families and help develop an emergency plan for those most at risk. We must all do our part and act now to fight climate change before things get worse. Please visit our website to see how your unit can participate in a greener dialysis.

On a more positive note, I want to extend congratulations to all those nurses who committed your time and energy to preparing and writing the nephrology certification examination in May. We wish you the best of luck and know you will be successful in your professional pursuits. For those who are planning to write in the fall, remember you can apply from now until September 30, 2023, to write on November 1–15, 2023. CANNT will also support you by providing resource material on our website and offering a workshop at this year's conference with helpful tips and hints. We are also working with the Canadian Association of Registered Nurses to explore the development of certification examination for our registered practical nurse members. This is very exciting news, and we will keep you updated as things progress.

Our annual CANNT Conference is only months away and our planning committee has been busy to ensure we provide the most informative and current educational sessions. Please consider coming to Prince Edward Island, October 26–28, 2023, to our "CANNT stop, won't stop – Finding creative ways to bridge the gap" national conference. This will be an excellent opportunity to connect with your colleagues and our industry partners, as we learn and grow together. Thank you to all those who have submitted abstracts. I would urge you to consider writing a manuscript for our journal. Please see our website for further assistance and guidance.

On behalf of CANNT, I wish you a safe and most enjoyable summer, filled with good times with family and friends.

Respectfully submitted,

Cathy Cake, M.Ed., BN, RN, CNeph(C)
CANNT President 2021–2023

President's Message

L'été est arrivé! Toutefois, les températures chaudes et la sécheresse extrême ont déclenché les pires feux de forêt dans l'histoire du Canada. Cette crise issue des changements climatiques a donné lieu à des centaines de feux de forêt qui sévissent partout au Canada, causant des évacuations de masses et consumant des millions d'acres de territoire. L'ACITN est de tout cœur avec les collègues et les patients qui ont été forcés de quitter leur domicile et ont perdu leur gagne-pain. Nous souhaitons aussi souligner la générosité des Canadiennes et Canadiens qui ont accueilli les personnes évacuées et ont donné de leur temps et de leur argent pour s'occuper des gens de leur voisinage.

L'ACITN envoie un merci retentissant aux pompiers du Canada et d'ailleurs qui participent à la lutte. C'est là une crise générale réelle; on peut voir de vastes étendues de notre pays et certaines régions du nord-est des États-Unis aux prises avec la fumée et le smog. Nous avons tous eu connaissance d'avertissements relatifs à la qualité de l'air qui s'étendent chez nos voisins du sud et aussi loin qu'en Norvège. Nos populations en néphrologie courent le risque de subir les plus graves séquelles à la suite des niveaux élevés de pollution de l'air. Il importe d'éduquer nos patients et leurs familles et de les aider à établir un plan d'urgence pour les personnes les plus à risque. Nous devons tous faire notre part et agir immédiatement pour lutter contre les changements climatiques avant que la situation se détériore davantage. Nous vous prions de visiter notre site Web pour découvrir comment votre unité peut participer à une dialyse plus écoresponsable.

Sur une note plus joyeuse, je veux exprimer toutes mes félicitations à toutes les infirmières et tous les infirmiers qui ont investi temps et énergie pour se préparer à l'examen d'agrément en néphrologie et le passer en mai dernier. Nous vous souhaitons bonne chance et sommes convaincus que vous atteindrez vos aspirations professionnelles. Pour les personnes qui planifient passer l'examen à l'automne, vous pouvez vous inscrire dès maintenant et jusqu'au 30 septembre; l'examen aura lieu du 1er au 15 novembre 2023. L'ACITN vous épaulera également en fournissant la documentation depuis son site Web et en offrant, dans le cadre du congrès de cette année, un atelier où vous pourrez puiser des astuces et des conseils pour réussir. Nous collaborons par ailleurs avec l'Association des infirmières et infirmiers du Canada pour étudier la possibilité de créer une épreuve d'agrément à l'intention de nos membres qui sont aussi des infirmières et infirmiers praticiens. C'est là une excellente nouvelle, et nous vous tiendrons au courant des progrès.

Notre congrès de l'ACITN aura lieu dans quelques mois et notre comité de planification s'affaire depuis un certain temps déjà à préparer des séances des plus informatives et actuelles. Envisagez de vous joindre à nous à l'Île-du-Prince-Édouard, du 26 au 28 octobre prochain pour notre congrès national intitulé *CANNT stop, won't stop – Finding creative ways to bridge the gap* (L'ACITN en action – Trouvons des moyens créatifs de combler l'écart). Ce sera une excellente occasion d'échanger avec vos collègues et nos partenaires commerciaux dans une ambiance d'apprentissage et de croissance. Merci à toutes les personnes qui ont soumis des abrégés. Je vous encourage à rédiger un article pour notre revue. Consultez notre site Web pour obtenir de l'aide et des conseils à cet égard.

Au nom de l'ACITN, je vous souhaite un été joyeux et sécuritaire, rempli de bons moments en compagnie de parents et d'amis.

Avec respect,

Cathy Cake, M. Éd., BN, infirmière, CNéph(C)
Présidente de l'ACITN, 2021-2023

Your Board in Action

It always is a pleasure to write to you as your President-Elect/Treasurer for CANNT-ACITN. I continue to express my sincere and deep appreciation for your unrelenting perseverance and dedication.

I am continually inspired by the aptitude, talent, and devotion exhibited by nephrology practitioners across Canada. Thank you for all that you do to advance nephrology nursing care. CANNT-ACITN recognizes and appreciates your efforts, and we are committed to promoting the nephrology nursing profession and reaching new heights in making Canada a healthier, better country.

CANNT-ACITN also welcomes you to join us in Charlottetown, PEI, on October 26–28, 2023, for the CANNT National Conference 2023, entitled "CANNT stop, won't stop – Finding creative ways to bridge the gap."

Your conference committee has worked diligently to **develop an original and engaging program to address the needs of nephrology professionals at all levels of practice, from novice to advanced.** The CANNT-ACITN national conference will provide opportunities to:

- Develop your understanding of the latest issues and advances within nephrology care
- Increase your expertise and advance your professional practice
- Network and collaborate with nephrology colleagues and industry partners
- Join the CANNT-ACITN community of health professionals who share your commitment to quality care.

Looking forward to seeing you in Charlottetown, PEI on October 26–28, 2023.

Again, I want to express my heartfelt gratitude for your commitment to CANNT. **Remember you have a unique opportunity to enhance the quality of care provided to individuals with kidney disease**. I cannot wait to see, hear, and experience all of the wonderful things we'll be able to accomplish together.

Regards,

Alicia Moonesar

Dr. Alicia Moonesar, DNP, MScN, NP-PHC (she/her)
CANNT President-Elect/ Treasurer 2021–2023

Votre conseil d'administration à l'œuvre

À titre de présidente désignée et trésorière de la CANNT-ACITN, c'est toujours pour moi un grand plaisir de vous écrire. Une fois de plus, je tiens à vous exprimer ma sincère et profonde reconnaissance pour votre persévérance et votre dévouement continus.

Je suis continuellement inspirée par la qualité, le talent et le dévouement déployés par les praticiens de la néphrologie au Canada. Merci à vous tous pour votre contribution aux progrès des soins infirmiers en néphrologie. CANNT-ACITN reconnaît et valorise vos efforts; nous sommes déterminés à promouvoir la profession des infirmières et infirmiers en néphrologie et à atteindre de nouveaux sommets pour faire du Canada un pays en meilleure santé.

CANNT-ACITN espère aussi vous accueillir à Charlottetown, Î.-P.-É., du 26 au 28 octobre 2023 dans le cadre du congrès national intitulé *CANNT stop, won't stop – Finding creative ways to bridge the gap* (L'ACITN en action – Trouvons des moyens créatifs de combler l'écart).

Votre comité du congrès a travaillé sans relâche pour concevoir une programmation répondant aux besoins des professionnels en néphrologie dans tous les volets du milieu, des novices aux plus chevronnés. Le congrès national du CANNT-ACITN permettra aux participants :

- de mieux comprendre les enjeux de l'heure et les avancées en matière de soins en néphrologie;
- d'accroître leur expertise et de progresser dans leur pratique professionnelle;
- d'échanger et de collaborer avec des collègues en néphrologie et des partenaires commerciaux;
- de se joindre à la communauté des professionnels de la santé ayant le même engagement envers la qualité des soins au sein de la CANNT-ACITN.

Nous avons hâte de vous rencontrer à Charlottetown, Î.-P.-É, du 26 au 28 octobre 2023.

Encore une fois, je tiens à vous exprimer ma sincère gratitude pour votre engagement envers l'ACITN. **N'oubliez pas que vous avez une occasion unique d'améliorer la qualité des soins prodigués aux personnes atteintes de maladies du rein**. Je suis impatiente de voir, d'entendre et de vivre toutes les merveilleuses choses que nous arriverons à accomplir ensemble.

Cordialement,

Alicia Moonesar

Dre Alicia Moonesar, DPI, M. Sc. Inf., IPSPL (elle)
Présidente désignée et trésorière de l'ACITN 2021–2023

NOTICE BOARD

- Canadian Nurses Association (CNA) Exam Timeline. **https://www.cna-aiic.ca/en/certification/about-certification**

	Spring 2023	**Fall 2023**
Initial exam or renewal by exam application window	January 11–March 31, 2023	June 5–September 30, 2023
Certification exam window	May 1–15, 2023	November 1–15, 2023
Renewal by continuous learning application window	January 11–December 16, 2023	

- **September 20, 2023.** Nephrology Health Care Professionals' Day (celebrated every third Wednesday of September annually)
- **October 14–17, 2023.** 51st EDTNA/ERCA International Conference, Vilnius, Lithuania. **https://www.edtnaerca.org/conferences/conferences-vilnius-2023**
- **October 26–28, 2023.** CANNT National Conference - *CANNT Stop, Won't Stop – Finding Creative Ways to Bridge the Gap*, Charlottetown, PEI.
- **November 2–5, 2023.** American Society of Nephrology (ASN) 2023 Kidney Week. Pennsylvania Convention Center, Philadelphia, PA. **https://www.asn-online.org/education/kidneyweek/**
- **November 9–10, 2023.** BC Kidney Days, Vancouver, BC, **http://www.bcrenal.ca/learning-events/bc-kidney-days**
- **September 26–29, 2024.** International Society for Peritoneal Dialysis (ISPD) Congress (ISPD 40th Anniversary). Dubai World Trade Center, Dubai, UAE. **www.ispd.org/dubai2024**

Nephrology Certification Registration Status Report 2022

Initial and Renewal by Exam to Renew in 2022	Renewal by Continuous Learning (CL) Hours	Total of Initials and Renewals	Due
41	80	121	191

Effect of a yoga intervention on depression, anxiety, and sleep in patients on hemodialysis – A pilot study

By Zorica Kauric-Klein

ABSTRACT

Background: *Patients on hemodialysis (HD) suffer from poor psychological outcomes including depression, anxiety disorders, poor sleep quality, and decreased quality of life. Yoga has been found to have a positive effect on psychological outcomes in the general population, however, few studies have been conducted with the HD population.*

Purpose: *The two major aims of this study are: (1) to report the findings of the effect of a chair yoga intervention on psychological outcomes (anxiety, depression, and sleep quality) in a pilot study of 31 patients on HD, and (2) to explain the underlying theoretical framework that guides the study.*

Methods: *A quasi-experimental prospective pilot study was conducted in 31 participants from four HD units in the American Midwest. Participants in the intervention group were instructed to participate in a prerecorded 20-minute chair yoga session three times weekly for four weeks. The Patient Health Questionnaire (PHQ-9), Generalized Anxiety Disorder (GAD-7), and Pittsburgh Sleep Quality Index (PSQI) were used to measure depression, anxiety, and sleep at baseline and four weeks.*

Results: *The majority of the sample were males (n = 10, 52%), Caucasian (n = 12, 63%), and the average age was 65 years (SD = 14.43). The attrition rate in the chair yoga intervention was 53% (n = 10) and 17% (n = 2) in the standard care group. There was a significant decrease in depression scores in the intervention group compared to the control group $F(1, 17) = 6.21$, $p = .023$. Although non-significant, there was also a trend towards an improvement in anxiety and sleep quality scores in the intervention group compared to the control group.*

Conclusion: *Yoga can be used as a complementary intervention to help improve depression, anxiety, and sleep quality in patients receiving chronic HD. Findings from this study lend support for The Systems Network Model of Yoga for Optimizing Self-Regulation. Further studies are warranted to validate findings.*

Keywords: yoga, depression, anxiety, sleep quality, hemodialysis

AUTHOR NOTE

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INTRODUCTION

Patients on hemodialysis (HD) suffer from many poor psychological outcomes including depression, anxiety disorders, poor sleep quality, and decreased quality of life (Al Naamani et al., 2021). The dialysis procedure can be quite stressful due to the dependence on a dialysis machine to sustain life, dietary and fluid restrictions, and vascular access problems (Painter & Marcus, 2013). Patients receiving chronic HD are frequently unable to continue working and they lose their sense of identity and self-esteem. They also have many comorbid diseases and require multiple drug therapies. Depression and anxiety are the two most prevalent psychiatric disorders associated with HD. Major therapy for these disorders includes antidepressants and psychotherapy, which can further complicate their HD medication regimen. In addition, poor sleep quality is very prevalent in patients on HD (Mehrabi et al., 2017). Mood disorders and being on HD are major risk factors for poor sleep quality in patients on HD (Al Naamani et al., 2021). A possible nonpharmacologic intervention to help manage depression, anxiety, and sleep disturbances in this population is yoga therapy.

LITERATURE REVIEW

There is increasing evidence that society is turning to yoga as a mind-body practice to improve wellbeing and help manage a variety of health conditions. Several systematic reviews have confirmed the positive effects that yoga can have on depression (Bridges & Sharma, 2017; Brinsley et al., 2021; Cramer et al., 2013), anxiety (Pascoe & Bauer, 2015; Sharma & Haider, 2013; Yin et al., 2021) and sleep quality (Neuendorf et al., 2015). However, to date, few studies have investigated the effect of a yoga intervention on psychological variables in patients receiving HD. Kalita (2021) conducted a quasi-experimental study to investigate the effect of a yoga Nidra intervention in a sample of 30 participants with chronic kidney disease (CKD) and found a significant improvement in stress, anxiety, and depression in the yoga intervention group compared to the control group. Pandey and colleagues (2017) conducted a randomized clinical trial in 50 patients with CKD and found that a six-month yoga intervention significantly improved the psychological domain of quality-of-life scores in the yoga intervention group compared to the control group. In an integrative review conducted by Kauric-Klein (2019), yoga was found to improve quality of life, fatigue, and sleep quality in patients receiving chronic HD. Limitations of the studies conducted

included small sample sizes and weak research designs. To date, not one study has specifically examined the effect of yoga in patients receiving HD on the psychological variables of depression, anxiety, and sleep quality. Thus, further well-designed studies need to be conducted to investigate the effect of yoga on psychological variables of depression, anxiety, and sleep in patients on HD. In this study, the following hypotheses were tested:

- A chair yoga intervention will decrease depression scores in a sample of patients receiving HD compared to standard care.
- A chair yoga intervention will decrease anxiety scores in a sample of patients receiving chronic HD compared to standard care.
- A chair yoga intervention will improve sleep quality in a sample of patients receiving chronic HD compared to standard care.

The two major aims of this study are: (1) to report the findings of the effect of a chair yoga intervention on psychological outcomes (depression, anxiety, and sleep quality) in a pilot study of 31 patients receiving HD; and (2) to explain the underlying theoretical framework that guides the study.

THEORY

Despite the evidence about the positive effects of yoga on an individual's mental and physical health, explanatory frameworks as to how yoga really works are lacking. An explanatory framework identifies key concepts and relationships between concepts that can develop a translation of yoga therapy in today's present healthcare and research settings. The Systems Network Model of Yoga for Optimizing Self-Regulation offers an excellent framework to understand how yoga can improve psychological and physical wellbeing in terms of self-regulation (Gard et al., 2014), and it was used to guide the development of this study.

According to Gard et al. (2014), pathophysiological processes with negative psychopathological effects may occur under the following prolonged conditions: prolonged release of neuroendocrine mediators during a stress-related physiological challenge, failure to adjust to repeated stress-related challenges, or failure to create an adequate response to a stressor. Patients receiving chronic HD encounter many physiological and stress-related challenges including dependence on HD for life, fluid and dietary restrictions, vascular access complications, and multiple comorbidities and medications. The foundational (initial) principle of yoga encourages the individual to move away from a focus on the medical diagnosis to experiences of relaxation and happiness, which can be very beneficial in the population with CKD (Gard et al., 2014). Yoga may also support changes in chronic illness schema by challenging a person's beliefs about one's physical body limitations. Individuals with CKD may come to realize they may have more mobility in their bodies than they previously thought.

Gard et al. (2014) proposed "The Systems Network Model of Yoga for Optimizing Self-Regulation" where yoga can be broken down into a skillset of four tools for self-regulation: (1) ethical precepts; (2) sustained postures; (3) breath regulation; and (4) meditation techniques. In this study, only three major self-regulation tools were operationalized for the yoga intervention: sustained postures, breath regulation, and meditation techniques. It is postulated that breathing and postures influence parasympathetic activation which, in turn, will lead to improvement in an individual's psychological and physical states. In addition, the theoretical model also suggests that yoga practice may have beneficial effects on the self-regulation of cognition, emotions, and behaviours through several different pathways resulting in improved physical and psychological functioning (Gard et al., 2014). In this study, psychological states were operationalized into the following variables: anxiety, depression, and sleep quality.

The model proposes that yoga facilitates bidirectional feedback and improves integration and efficiency of high-level and low-level brain networks along with viscerosomatic, musculoskeletal, cardiac, respiratory, and sensory information coming from the periphery (Gard et al., 2014). According to the model, yoga practice helps extinguish maladaptive cognitive, emotional, and behavioral output (e.g., negative appraisal, emotional reactivity, rumination), as well as physiological output initiated by lower-level brain systems (e.g., sympathetic related vasoconstriction and pulmonary constriction, inflammation, muscle pain/tension), which can improve homeostatic conditions across the cardiovascular, neuroendocrine, and musculoskeletal systems (Gard et al., 2014). Thus, in this model, it is expected that through repeated yoga practice, there is an optimization of autonomic control in response to stressors during and outside of yoga practice.

METHODS

Study Design

A quasi-experimental study was conducted with patients receiving chronic HD. The initial proposed design for this study was a randomized control study to be conducted over 12 weeks. Due to the difficulty in recruiting participants, participants were assigned to groups according to patient preference, and the duration of the study was decreased to four weeks.

Setting and Sample

As this was a pilot study, the initial goal for recruitment was 12 to 15 participants per group. Participants were recruited from four HD units in the American Midwest that had approximately 280 patients who undergo HD. Inclusion criteria to participate in the study included: (1) being older than 18 years of age, (2) receiving chronic HD for longer than three months, and (3) and ability to understand, speak, and write English. Exclusion criteria included: (1) unstable cardiac disease, (2) chronic lung disease requiring oxygen supplementation, (3) history of major stroke, and (4) cognitive impairment. The study was explained, and questions were answered by the author (primary investigator [PI]) to any potential participant who was interested in participating in the study. Those who met the inclusion/exclusion criteria and wanted to participate signed an informed consent.

Data Collection Instruments: The Baseline Data Collection survey, The Patient Health Questionnaire (PHQ-9), Generalized Anxiety Disorder (GAD-7), and Pittsburg Sleep Quality Scale (PSQI) were used to measure baseline demographic variables, depression, anxiety, and sleep quality.

Baseline Data Collection Survey: This investigator-developed survey was used to collect the following data: age, sex, race, medical history, and medications.

Patient Health Questionnaire (PHQ-9): The PHQ-9 is a five-minute, nine-item, self-report survey used to measure depression. Scores of greater than 10 had a 92% sensitivity and 92% specificity for diagnosing depression (Watnick et al., 2005).

Generalized Anxiety Disorder (GAD-7): The GAD-7 is a five-minute, seven-item, self-report survey that was used to measure generalized anxiety disorders (Spitzer et al., 2006). The tool has been found to have good reliability ($\alpha = 0.89$) and validity ($r = .64$) in the general population (Löwe et al., 2008).

Pittsburgh Sleep Quality Index (PSQI): The PSQI is a 10-minute, 19-item, self-report scale that was used to measure sleep quality (Buysse et al., 1989). The scale has been found to be reliable ($\alpha = .70$ to .83) and valid ($r = .072$ to 0.80) in a variety of clinical and non-clinical settings (Mollayeva et al., 2016).

Data Collection

Baseline demographic data were collected by the PI using the Baseline Data Collection Survey. The PHQ-9, GAD-7, and PSQI surveys were administered at baseline and at the completion of the study at four weeks. The surveys were completed by participants either electronically through Qualtrics or within the HD units. When completed in the HD unit, the surveys were administered by the PI and completed by paper and pen format. For those participants who preferred to complete the surveys online, an electronic weblink was sent to the participant's email with instructions on how to complete the survey. The PI was the only individual who had access to the data.

Data Analysis

Descriptive statistics were conducted to analyze all study variables. Demographic data were compared between groups at baseline and no significant differences in demographic variables were found between the intervention and control groups. Mixed model analysis of variance (ANOVA) with one within-subject factor (time) and one between subjects' factor (group) was conducted to determine whether there were significant differences between groups in depression, anxiety and sleep quality based on an alpha level of 0.05. Assumptions of normality and homoscedasticity were met for all outcome study variables. Intellectus (2019) software was used to conduct data analysis. As treated analyses were conducted on study data.

Intervention

The original intent of the study was to conduct the yoga intervention in the HD unit during HD sessions. However, the dialysis organization where the study was conducted would not allow the yoga intervention to be conducted during HD sessions due to the fear of possible adverse effects. As a result, the format of the chair yoga intervention was changed to an online Zoom class. Participation in the chair yoga class was very poor, with only one to three participants attending per class. As a result, the online Zoom class was cancelled after four classes. The reasons given by the participants for not attending classes were that the time of the class did not work for participants' schedule, and technical difficulties with computers and logging into the Zoom class. Other participants struggled with audio difficulties and hearing the yoga instructor during the session. Other participants wanted to drop out as they indicated that the original 12-week duration of the study was too long to commit to.

Based on participant feedback, the intervention was changed again to a prerecorded 20-minute chair yoga class developed by a certified yoga instructor. The chair yoga session consisted of awareness practice, breathing techniques, gentle physical movement, yoga hand gestures, and relaxation practice. To further promote recruitment and retention, the duration of the study was decreased from 12 weeks to four weeks. A YouTube™ weblink containing the prerecorded yoga class was sent electronically to participants' email by the PI. The prerecorded yoga class could be accessed through a YouTube™ weblink on the participant's phone or computer. Participants were instructed to participate in the chair yoga session three times weekly for four weeks in their homes. As a token for their participation in the study, participants received two Amazon gift cards totaling $50 for completing all study components.

Ethical Principles of the Study

Ethics approval was obtained from the dialysis organization and Oakland University's (Michigan) Institutional Review Boards. Informed consent was obtained from all participants prior to the initiation of the study. The PI was the only individual who had access to the data, and all the data were kept confidential.

RESULTS

Few eligible participants indicated interest in participating in yoga or the study. Reasons given for not participating in the study included lack of time to commit to intervention, lack of access to electronic devices, and lack of interest in yoga. Interestingly, several participants indicated they would agree to participate if the yoga sessions were offered in the HD unit.

Thirty-one (11%) of a potential 280 participants were interested and met the criteria to participate in the study. Data related to how many participants were ineligible verses declined to participate was not collected by the PI. Nineteen of the original 31 participants agreed to participate in the yoga intervention, and 12 participants agreed to participate in the standard care group. Nine of the initial 19 participants (47%) in the yoga intervention group completed the study, and 10 of the 12 participants (83%). Reasons for attrition from the intervention group included: hospitalization ($n = 3$), received a kidney transplant ($n = 1$), death in family

(n = 1), lack of interest in yoga (n = 4), technical computer issues (n = 1), and unable to participate (n = 1). Reasons for attrition from the control group included: transfer to another HD facility (n = 1) and not completing post study surveys (n = 1). As the intervention was conducted unsupervised by the participant at home, data related to treatment adherence is missing. Analytic data indicated that the video was viewed 189 times; however, specific information as to how often each participant participated in the intervention was not available.

Descriptive Data

Males made up 52.6% (n = 10) of the sample. In terms of race, Caucasians made up most of the sample (n = 12, 63.1%) followed by African Americans (n = 7, 36.8%). The average age of the sample was 65.32 years (SD = 14.43). There were no significant differences between groups in age, sex, and race. There was no significant relationship between baseline demographic factors and outcome variables.

Psychological Variables

Depression (PHQ-9): A mixed method ANOVA was conducted to determine within and between differences in depression scores at baseline and at the completion of the study. The overall Baseline PHQ-9 score for the sample was 4.26 (SD = 3.02) indicating a mild level of depression with scores ranging from 0 to 10. The average mean PHQ-9 score in the intervention group was (M = 4.0, SD = 3.46) with scores ranging from 0 to 12. The average mean PHQ-9 score in the standard care group was (M = 4.50, SD = 2.76) with scores ranging from zero to nine. There were no significant differences in baseline PHQ-9 scores between the two groups. The main effect for group was not significant, $F(1, 17) = 3.32$, $p = .086$, indicating that there was no significant difference between groups in PHQ-9 scores at baseline and completion of the study. The main effect for the within-subjects factor between baseline PHQ-9 and post-study PHQ-9 was not significant, $F(1, 17) = 3.95$, $p = .063$, indicating there were no significant differences within groups in PHQ-9 scores from baseline to completion of the study. However, the interaction effect between the within-subjects factor and group was significant, $F(1, 17) = 6.21$, $p = .023$, indicating that the relationship between baseline PHQ-9 and post-study PHQ-9 differed significantly between the two groups (Figure 1). Tukey comparisons were conducted to test the differences in the estimated marginal means for each combination of between-subject and within-subject effects. In the yoga intervention group, baseline average PHQ - 9 scores (M = 4.00, SD = 3.46) were significantly greater than post study PHQ – 9 scores (M = 1.33, SD = 1.41), ($t(17) = 3.09$, $p = .007$).

Anxiety (GAD-7): A mixed method ANOVA was conducted to determine within and between differences in anxiety scores at baseline and at the completion of the study. The overall GAD-7 mean score was 4.22 (SD = 3.78) with scores ranging from 0 to 12. A score of five or less indicates mild anxiety and six to 10 indicates moderate anxiety. The main effect for group was significant, $F(1, 17) = 5.69$, $p = .029$, indicating that there were significant differences in baseline and post-study GAD-7 scores between groups. At baseline, there were no significant differences in GAD- 7 scores between the treatment group (M = 2.67, SD = 4.18) and the standard care group (M = 5.30, SD = 2.98) ($p = .130$); however, there was a significant difference in GAD-7 scores between the intervention group (M = 1.67, SD = 2.35) and standard care group (M = 5.20, SD = 2.97) ($t = 2.85$, $p = .011$) groups at study completion (Figure 2). The main effect for the within-subjects factor was not significant, $F(1, 17) = 0.65$, $p = .430$, indicating there were no significant differences within group in GAD- 7 scores between baseline and completion of the study. The interaction effect between the within-subjects factor and group was not significant, $F(1, 17) = 0.44$, $p = .517$, indicating that the relationship between baseline GAD-7 and post-study GAD-7 scores were similar between the two groups.

Figure 1

The Means of Baseline PHQ-9 and Post Study PHQ-9 with 95% CI Error Bars

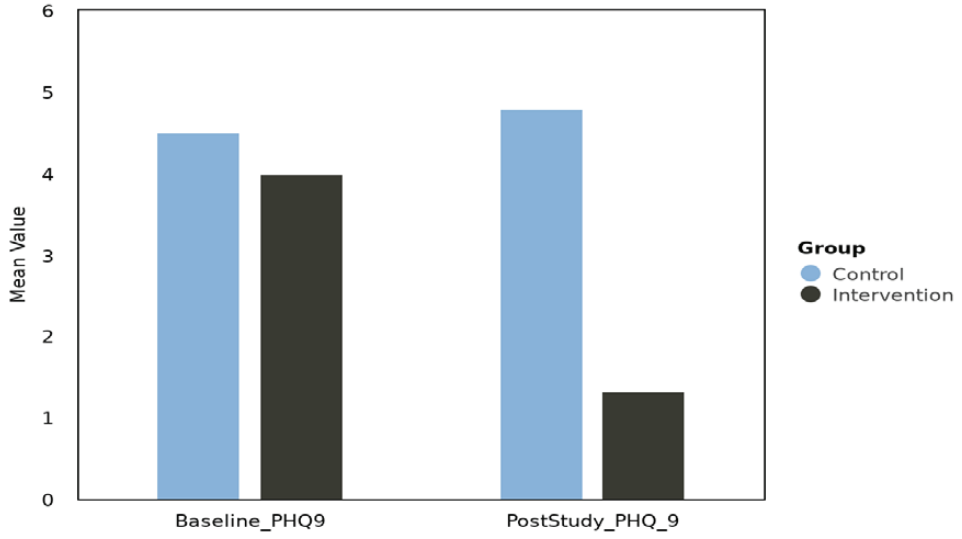
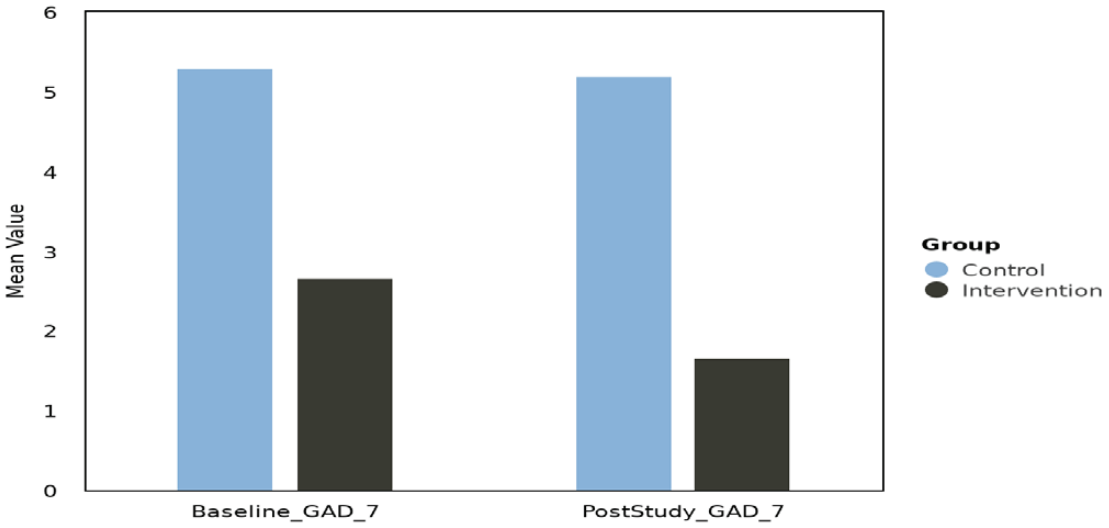


Figure 2

The Means of Baseline GAD-7 and Post Study GAD-7 with 95% CI Error Bars

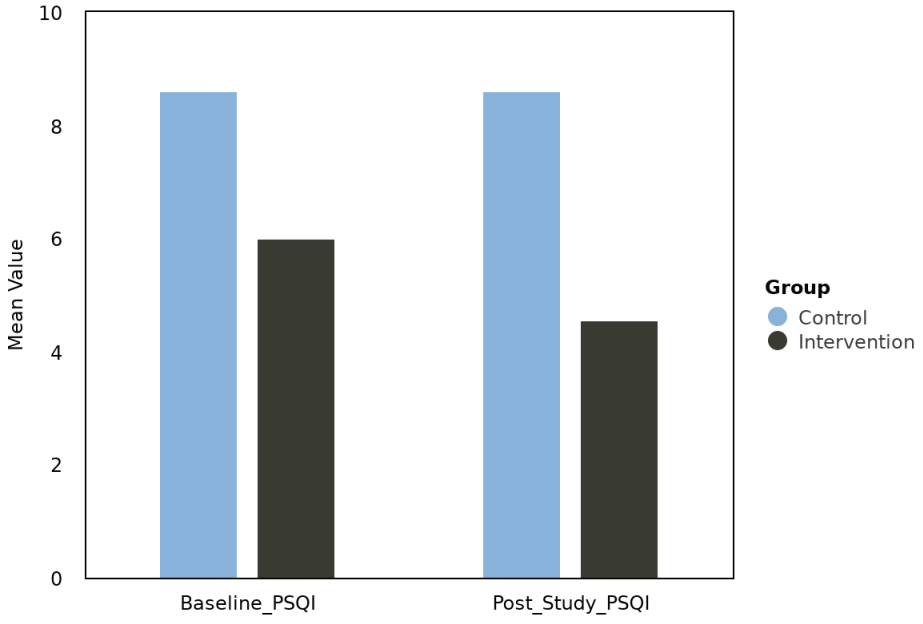


Sleep (PSQI)

A mixed method ANOVA was conducted to determine within and between differences in sleep quality scores at baseline and at the completion of the study. The overall average PSQI score at baseline was 7.37 (*SD* = 4.50) with scores ranging from 0 to 15. A score of greater than or equal to five indicates poor sleep quality. The main effect for group was not significant, $F(1, 17) = 3.20$, $p = .092$, indicating there were no significant differences between groups in PSQI scores at baseline and post-study. The main effect for the within-subjects factor was not significant, $F(1, 17) = 1.86$, $p = .190$, indicating there were no significant differences in PSQI scores within groups between baseline and study completion. The interaction effect between the within-subjects factor and group was not significant, $F(1, 17) = 1.86$, $p = .190$, indicating that the relationship between baseline PSQI and post-study PSQ1 scores was similar between the two groups. Although not significant, there was a trend towards a decrease in PSQI scores in the intervention group from baseline (*M* = 6.0, *SD* = 4.56) to post-intervention (M = 4.56, *SD* = 4.25), whereas the PSQI score remained unchanged in the standard care group from baseline (*M* = 8.6, *SD* = 4.3) to post-intervention (*M* = 8.6, *SD* = 3.7) (Figure 3).

Figure 3

The Means of Baseline PSQI and Post Study PSQI with 95% CI Error Bars



DISCUSSION

Findings from this small pilot study clearly indicate the difficulty in recruitment of participants and adherence to the chair yoga intervention. Participation in the study was poor despite allowing participants to choose the group they wanted to participate in, offering flexibility in the days that subjects could participate in the chair yoga sessions, and decreasing the duration of the study from 12 weeks to four weeks.

A possible solution to this finding is to offer yoga sessions during HD. During recruitment, several potential participants had indicated they would have been interested in participating in the intervention, if it was offered during HD. A recent study conducted by Herron et al. (2023) supported this recommendation. Herron et al. conducted a study in 69 patients on HD comparing intradialytic yoga to education. Adherence to the yoga sessions was 90%. There were five adverse events, of which none was attributed to the act of practicing yoga. Findings from the study did not show any improvement in physical function between groups; however, similar to the findings in this study, mental health indicators had a statistically non-significant improvement in the yoga intervention group and were noted to be decreased in the education group.

Despite the difficulty in recruitment of participants and adherence, the chair yoga intervention appeared to have a positive effect on psychological outcomes in this sample. There was a significant decrease in depression scores in the intervention group compared to the control group. Similar findings exploring the relationship between yoga and depression have been found in other studies (Bridges & Sharma, 2017; Brinsley et al., 2021; Cramer et al., 2013). Although non-significant, there was also a trend toward an improvement in anxiety and sleep quality scores in the intervention group compared to the control group. Other studies have also found a relationship between the effects of yoga on decreasing anxiety (Pascoe et al., 2015; Sharma & Haider, 2013; Yin et al., 2021). In addition, Neuendorf et al., (2015) found a relationship between participation in yoga and improved sleep quality.

Findings from this study lend support for The Systems Network Model of Yoga for Optimizing Self-Regulation (Gard et al., 2014). According to the model, yoga practice may help extinguish maladaptive cognitive, emotional, and behavioral output such as negative appraisal, emotional reactivity, and rumination, which may have resulted in improvement in depression, anxiety, and sleep quality scores. It is postulated that breathing and postures influence parasympathetic activation which, in turn, leads to improvement in an individual's psychological outcomes such as anxiety, depression, and sleep quality.

Limitations of this study included a small sample size, which caused the study to be underpowered and likely affected nonsignificant findings. Another limitation was the lack of randomization of the participants. As it was difficult to recruit participants for the study, randomization was not possible and patient preferences were used to assign participants to groups, which may have resulted in selection bias. The study was also conducted during COVID, which may have also negatively affected participation in the study and the report of psychological variables. Other limitations included the evaluation of outcomes using self-report, which may have resulted in social desirability bias and the short duration of the study. Another limitation was that no treatment adherence data were collected.

Future randomized controlled studies should be conducted in HD units to further assess feasibility, recruitment, and adherence to the yoga intervention, as well as further validate findings. Studies should also be conducted over longer time periods to determine the changes in psychological variables over time. Further studies should be conducted in Canada, as no studies have been conducted to date. Additional studies assessing physiological as well as psychological variables should be conducted in order to determine if there is a relationship between the physiological and psychological outcome variables, which would further lend support for the Systems Network Model of Yoga for Optimizing Self-Regulation (Gard et al., 2014).

CONCLUSION

Yoga can be a complementary intervention to help improve depression, anxiety, and sleep quality in patients on chronic hemodialysis. Findings from this study lend support for The Systems Network Model of Yoga for Optimizing Self-Regulation. Further studies are warranted to validate the findings in this study.

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Hyperphosphatemia and vascular calcification in chronic kidney disease

By Oluwakonyinsolami Ogunrinde, Joy A. Gatmaitan, Simerdeep Chouhan, Hitesh Mehta, and Rosa M. Marticorena

LEARNING OBJECTIVES

By the end of this article, readers should be able to:

1. Describe the pathophysiology of hyperphosphatemia in renal disease.
2. Describe the vascular calcification in renal disease.
3. Describe current approaches to managing hyperphosphatemia and opportunities to improve the management of hyperphosphatemia in hemodialysis.

INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of death in patients with chronic kidney disease (CKD) and is present in more than 50% of patients receiving dialysis (Doshi & Wish, 2022). The risk of death from CVD is 20 times higher in these patients compared to the general population. (Jankowski et al., 2021). Risk factors for cardiovascular mortality in CKD and end-stage renal disease (ESRD) can be broadly categorized as traditional (diabetes, hypertension, and dyslipidemia) and non-traditional risk factors (vascular calcification and inflammation) (Jankowski et al., 2021). The ability of the kidneys to maintain mineral homeostasis progressively declines with the loss of renal function. Mineral metabolism imbalance is characterized by an increase in serum concentration of phosphate, calcium, and parathyroid hormone (PTH) levels, and decrease in serum levels of vitamin D, parathyroid vitamin D receptors, and parathyroid calcium receptors, often seen with glomerular filtration rates (GFR) of 30mL/min or lower (Zhou et al., 2021; Jankowski et al., 2021).

Hyperphosphatemia (HP) has been identified as an independent risk factor for the development of bone mineral disease and vascular disease including vascular calcification, and metastatic calcification of the heart valves and soft tissues prevalent in the dialysis population (Doshi & Wish, 2022; KDIGO Working Group [KDIGO], 2017; Jankowski et al., 2021). Epidemiological data from the Dialysis Outcomes Practice Patterns Study (DOPPS) showed that HP is a strong predictor of cardiovascular (CV) mortality in dialysis patients, with the lower death rates in patients with phosphate levels closer to normal ranges sustained over a period of six months (Lopes et al., 2020). Strict control of HP has been shown to delay the progression for coronary artery calcification in HD patients (Isaka et al., 2021). This paper focuses on the development of vascular calcification related to HP in patients receiving HD and current therapy options to control HP.

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PHOSPHATE REGULATION AND HYPERPHOSPHATEMIA

Phosphate is an abundant mineral in the human body and an important component of genetic material, lipids on cell membranes, and adenosine triphosphate (ATP); it is tightly regulated through dietary absorption, bone flux, and renal excretion. (Zhou et al., 2021). Normal serum phosphate levels range from 0.81 to 1.58 mmol/L with HP defined as a serum phosphate level greater than 1.58 mmol/L (Zhou et al., 2021). HP due to decreased GFR can induce hypertension, vascular calcification, cardiac vascular calcification, atherosclerosis, left ventricular hypertrophy (LVH), and myocardial fibrosis (Zhou et al., 2021). It can also cause hypocalcemia, hyperparathyroidism, metabolic bone disease, and adverse cardiovascular events. The kidneys excrete about 90% of the phosphate intake in the body and the gastrointestinal tract excretes the rest; however, phosphate does not bind to albumin, and it is

usually filtered through the glomerulus with 75% of filtered phosphate being reabsorbed in the proximal tubule, approximately 10% in the distal tubule, and 15% lost in the urine. Phosphate homeostasis is under the direct hormonal influence of calcitriol, PTH, Vitamin D receptors, calcium-sensing receptors (CaSR), and phosphatonins including fibroblast growth factor (FGF) 23 (Goyal & Jialal, 2021). Serum phosphate level is maintained through a complex interaction between intestinal phosphate absorption, renal phosphate handling, and phosphate transcellular movement between intracellular fluid and bone storage pool (Goyal & Jialal, 2021).

Effects of hyperphosphatemia on the vascular and cardiac systems

HP is an important factor in the development of adverse cardiac events that result from hypertension, vascular calcification, cardiovascular calcification, atherosclerosis, LVH, and myocardial fibrosis (Cozzolino et al., 2018). Vascular calcifications can increase the incidence of arrhythmia, sudden cardiac death, stroke, and mortality. This is because it can lead to ischaemic CVD and increases in pulse pressure and pulse wave velocity, resulting in the reduction of diastolic coronary perfusion and LVH. Vascular calcification also results in aortic stenosis, which causes an increase in cardiac afterload (Jankowski et al.2021). In HD patients, calcification of the lower part of the abdominal aorta appeared to be most predictive of CV events and mortality (NasrAllah, 2016). Abdominal radiographs are recommended as part of screening for vascular calcification in patients with HP and GFR categories G3a to G5 (i.e., GFR less than 60 mL/min/1.73 m^2) (KDIGO, 2017).

Mechanism of vascular calcification

Blood vessels (aside from the capillaries) are made of three layers. The inner layer or *tunica intima* consists of an endothelial lining that provides a frictionless pathway for the movement of blood. The middle layer or *tunica media* is composed of elastic and muscular tissue that regulates the internal diameter of the vessel. Finally, the outer layer or *tunica adventitia* provides structural support and shape to the vessel (Tucker et. al., 2022).

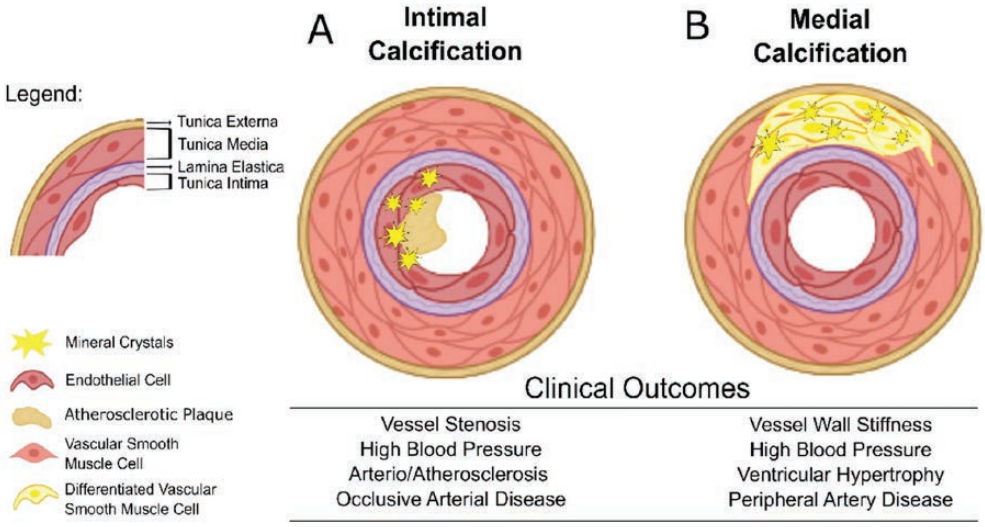
Vascular calcification is an active process driven partly by smooth muscle cells in the media of the vascular wall (Vahed et al., 2020). Vascular smooth muscle cells (VSMC) are cellular components of the medial layer that can switch from a contractile phenotype to a synthetic phenotype in response to injury (Jankowski et al., 2021). VSMC can undergo trans-differentiation to osteoblast-like cells and extrude matrix vesicles containing proteins that resemble osteoblastic vesicles (Durham et al., 2018). The excretion of these proteins creates an osteogenic environment that results in vascular calcification (Lee et al., 2020). In essence, the vascular wall converts into bone. Smooth muscle cells are highly sensitive to the increased levels of phosphate, calcium, and PTH, which trigger cell transformation from a contractile cell type to an osteoblastic/chondrogenic cell type (Vahed et al., 2020).

Vascular calcification occurs in both the intimal and medial layers of the arteries (Figure 1). Intimal calcification has been linked to arterial obstruction and atherosclerotic plaque rupture, whereas medial calcification has been linked to vessel stiffness, systolic hypertension, and increased pulse wave velocity resulting in increased diastolic dysfunction

Figure 1

Intimal and Medial Calcification

(A) Intimal calcification is confined to the lumen of the endothelium of the vessel mainly associated with atherosclerosis, contributing to vessel stenosis, lumen narrowing and increased BP. (B) Medial calcification affects the medial layer of the vessel wall mainly composed of vascular smooth muscle cells, leading to increased vessel wall stiffness with compromised blood pumping and compliance, reflecting in high BP, peripheral artery disease or even ventricular hypertrophy.



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and heart failure (Vahed et al., 2020; Lee et al., 2020). Coronary artery calcification, prevalent in HD patients, is associated with hyperphosphatemia and increased mortality rate in this population. In patients receiving dialysis, reduction of phosphate level to closer to normal level is associated with a slower progression of coronary artery calcification (Isaka et al., 2021).

Management of hyperphosphatemia

There are three main therapies to combat hyperphosphatemia: phosphate binders, diet regulation, and dialysis (Fishbane & Nigwekar, 2021). However, studies have shown that 77% of dialysis patients struggle with maintaining a phosphate level of less than or equal to 1.58 mmol/L. Fishbane and Nigwekar (2021) found that dialysis patients, on average, are prescribed 10.8 phosphate binders daily, accounting for approximately 50% of their daily medication pill burden. Some phosphate binders cause unpleasant gastrointestinal symptoms such as nausea, vomiting, abdominal pain, and constipation. The calcium-based phosphate binders have been found to increase calcium levels and contribute to vascular calcification, further worsening the situation (Fishbane & Nigwekar, 2021).

Dietary changes are the first line of treatment when caring for patients with hyperphosphatemia (Goyal & Jialal, 2021). Patients are encouraged to reduce their consumption of foods with high phosphate content, but it is very difficult to do so when there is a large amount of food products that contain phosphate hidden in chemicals used to preserve packaged food. Still, this line of intervention does not show a marked reduction in phosphate levels for patients receiving dialysis (Floege, 2019). In addition, concerns about the dietary phosphate restriction include the potential to reduce protein intake and risk protein malnutrition (Floege, 2019). A recent meta-analysis of randomized trials comparing various dietary interventions in addition to phosphate binder therapy showed a 0.02 mmol/L decline in serum phosphate levels in dialysis patients over six months of therapy, and the effect seemed to disappear with discontinuation of the dietary intervention (St. Jules et al., 2021).

The main aim of standard therapies is to help reduce the phosphate level to an acceptable range close to the norm (Goyal & Jialal, 2021). Medication options for phosphate binders largely fall into the following categories of binders: aluminum-based, calcium-based, non-calcium-based, and iron-based (Chan et al., 2017). Aluminium-based binders (aluminum hydroxide or Amphojel) are very effective, but their use is no longer popular due to concerns about aluminum toxicity. Their use is restricted to controlled short-term therapy when the levels of phosphate are extremely high, and control needs to be achieved with urgency (Liu & Pemas, 2021; KDIGO, 2017).

Calcium-based binders such as calcium carbonate (TUMS) replaced aluminum binders and are currently the first choice of therapy due to their low cost. However, large doses are required to be taken with meals above the recommended daily amount (Frazão & Adragão, 2012). Doses over two grams per day increase the risk of calcium overload and hypercalcemia, which have been linked to vascular calcification (Hutchison, 2009; KDIGO, 2017). Non-calcium-based binders such as lanthanum carbonate (Fosrenol) and sevelamer hydrochloride (Renagel) are currently being used due to their ability to reduce phosphate levels at a rate similar to the calcium-based binders while eliminating the risk of calcium overload (Frazão & Adragão, 2012; Ogata et al., 2021). Lanthanum carbonate is a chewable tablet that is also available in powder form. Sevelamer hydrochloride is a polymeric amine non-absorbed, binder approved for use in reducing phosphate levels.

Iron-based phosphate binders such as sucroferric oxyhydroxide (Velphoro) are formulated as chewable berry-flavoured tablets approved for use in patients undergoing dialysis, that have the added advantage of requiring a lower number of tablets, thus decreasing pill burden in these patients (Ketteler et al., 2019; Frazão & Adragão, 2012). Tenapanor hydrochoride is a treatment used for irritable bowel syndrome and has been studied as a new non-binding therapy to control hyperphosphatemia. It inhibits phosphate absorption in the GI tract. It has been shown to lead to good results in controlling serum levels of phosphate; however, the long-term effects of this drug are currently under evaluation (Pergola, et al., 2021). It is not approved in Canada to be used to treat HP in CKD.

IMPLICATIONS FOR NURSING PRACTICE

Hyperphosphatemia has far-reaching effects extending to vascular calcification. Treatment of hyperphosphatemia is complex, it requires diet control, use of phosphate lowering medications and HD. Management of HP requires a multipronged approach requiring intervention and counselling from multiple disciplines, particularly from nurses at the bedside. Knowledge of the pathophysiology of vascular calcification as a sequela of hyperphosphatemia is an important component of hemodialysis nursing practice. Nephrology nurses play a pivotal role in providing continuous education and reinforcement to patients regarding the importance of adherence to therapy to prevent complications. Nephrology nurses are best positioned to provide consistent guidance and support to these patients during their HD sessions. Important consideration needs to be given to the side-effects of phosphate binders such as gastrointestinal upset, nausea, and other symptoms that could contribute to suboptimal adherence to HP management. Having an honest discussion with patients and providing continuous education to inform them of available options for treatment are just as crucial as being able to engage patients in their own medical care. Advocating for patients in this regard is not the sole domain of nurses. Nephrologists and the renal allied health team comprising dietitians, pharmacists, and social workers can all similarly engage in advocacy by working together to expedite the sometimes-complex process of procuring access to medications that are not covered by provincial drug plans. Such a collaborative interdisciplinary approach to care that puts patients front and centre is pivotal in the management of hyperphosphatemia that would mitigate serious complications such as vascular calcification.

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CONTINUING EDUCATION STUDY QUESTIONS

CONTACT HOUR: 2.0 HRS

Hyperphosphatemia and vascular calcification in chronic kidney disease

By Oluwakonyinsolami Ogunrinde, Joy A. Gatmaitan, Simerdeep Chouhan, Hitesh Mehta, and Rosa M. Marticorena

1. Cardiovascular disease (CVD) is the leading cause of death in patients with chronic kidney disease (CKD).
   a) True
   b) False

2. Epidemiological data by Dialysis Outcomes Practice Patterns Study (DOPPS) showed that patients with CKD and hyperphosphatemia who have maintained their phosphate level close to normal for _____ months have lower mortality levels.
   a) 2 months
   b) 4 months
   c) 6 months
   d) 8 months

3. What is the normal range for serum phosphate?
   a) 135–145 mmol/L
   b) 0.81–1.58 mmol/L
   c) 35–45 mmol/L
   d) 10–20 mmol/L

4. Which of these play a role in phosphate homeostasis?
   a) Calcitriol
   b) PTH
   c) Fibroblast growth factor 23
   d) All of the above

5. Which of these processes do not play a role in phosphate maintenance?
   a) Hepatic clearance
   b) Renal handling
   c) Intestinal absorption
   d) Transcellular movement between intracellular fluid and bone storage pool

6. Calcification in what area most indicates risk of cardiovascular events and mortality in hemodialysis (HD) patients?
   a) Descending aorta
   b) Upper part of the abdominal aorta
   c) Lower part of the abdominal aorta
   d) Aortic arch

7. What is the criterion recommended by the KDIGO Working Group as screening for vascular calcification in patients?
   a) Hyperphosphatemia and a GFR > 90
   b) Hypercalcemia and a GFR > 60
   c) Hyperphosphatemia and a GFR < 60
   d) Hypophosphatemia and a GFR > 90

8. Vascular calcification is a(n) ____ process that is driven partly by ____ cells, which are sensitive to changes in _____.
   a) Active; cardiac muscle; T3, T4, and TSH
   b) Active; smooth muscle; phosphate, calcium, and PTH
   c) Passive; smooth muscle; phosphate, calcium, and PTH
   d) Passive; cardiac muscle; TSH, calcium, and insulin

9. Vascular calcification essentially turns the walls of blood vessels into bone.
   a) True
   b) False

10. According to the literature, what percentage of patients struggle with maintaining their phosphate level below 1.58 mmol/L?
    a) 50%
    b) 30%
    c) 77%
    d) 34%

11. According to the literature, on average, dialysis patients take _____ phosphate binders daily.
    a) 2.5
    b) 6.8
    c) 10.8
    d) 12.5

12. Which of these phosphate binders creates an environment conducive to the development of vascular calcification?
    a) Sevelamer hydrochloride
    b) Lanthanum carbonate
    c) Sucroferric oxyhydroxide
    d) Calcium carbonate

CONTINUING EDUCATION STUDY ANSWER FORM

CE: 2.0 HRS CONTINUING EDUCATION

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By Oluwakonyinsolami Ogunrinde, Joy A. Gatmaitan, Simerdeep Chouhan, Hitesh Mehta, and Rosa M. Marticorena

Volume 33, Number 1

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At the time of manuscript submission, authors should disclose any potential sources of conflict of interest, which includes any financial interest or relationship that might be perceived as influencing the authors' objectivity. The existence of a conflict of interest does not preclude publication. Authors must also declare if they have no conflict of interest to declare. Sources of funding should be included on the title page under the heading "Conflicts of Interest and Source of Funding." Each author must complete and submit the journal's copyright transfer agreement, which includes a section on the disclosure of potential conflicts of interest.

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At the time of submission, the submitting author will be presented with the copyright transfer and conflict of interest form. Co-authors will receive an email with instructions to also complete the form in order to proceed with the review process.

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Lignes directrices pour la soumission des manuscrits au *Journal ACITN*

DESCRIPTION

Le *Journal ACITN* est une revue publiée trimestriellement qui met en valeur l'excellence des écrits sur les soins infirmiers et les technologies en néphrologie par le biais d'articles évalués par des pairs qui examinent les questions et les tendances actuelles de la pratique, de la formation et de la recherche dans ce domaine. Le *Journal ACITN* est la revue officielle de l'Association canadienne des infirmières et infirmiers et des technologues de néphrologie et soutient la mission de l'association pour servir ses membres en perfectionnant le développement des connaissances en matière de soins infirmiers et de technologies en néphrologie. La revue est référencée dans les bases de données MEDLINE et CINAHL.

POLITIQUES RÉDACTIONNELLES

Le *Journal ACITN* accepte les manuscrits portant sur la formation, la pratique, la recherche sur les soins infirmiers et les technologies de néphrologie ou la politique en matière de santé. Le manuscrit doit être la propriété intellectuelle unique des auteurs. Une fois acceptés, les manuscrits deviennent la propriété permanente du *Journal ACITN* et ne peuvent être reproduits ailleurs sans l'autorisation écrite de l'éditeur.

Nous préférons les manuscrits qui présentent de l'information clinique nouvelle ou qui abordent des problématiques d'intérêt particulier pour les infirmières et infirmiers et les technologues en néphrologie. Plus précisément, nous recherchons :

- Rapports de recherche originaux;
- Articles cliniques pertinents;
- Rapports sur des approches innovatrices en matière d'amélioration de la qualité;
- Textes narratifs relatant une expérience de pratique infirmière ou technologique;
- Textes sous forme de questions et de réponses sur la pratique interdisciplinaire;
- Revues de littérature ou revues systématiques.

Nous encourageons également les tribunes libres sous forme de courrier des lecteurs comme moyen de promouvoir le dialogue et des perspectives de rechange aux articles publiés dans le *Journal ACITN*. Veuillez choisir « Courrier des lecteurs » dans le menu déroulant de la Section sur la page des soumissions.

DÉCLARATION RELATIVE À LA SOUMISSION

La soumission de l'article laisse entendre que l'œuvre décrite n'a pas été diffusée autre part (sauf sous la forme d'un résumé ou d'une présentation orale publiée), qu'elle n'est pas à l'étude pour publication ailleurs, que sa publication est approuvée par tous les auteurs et les autorités responsables où la recherche a été réalisée, et que, si elle est acceptée, elle ne sera pas publiée ailleurs sous la même forme sans le consentement écrit du titulaire du droit d'auteur. À l'acceptation du document soumis, le ou les auteurs devront transférer la propriété du droit d'auteur au *Journal ACITN*. Les déclarations et les opinions contenues dans l'œuvre demeurent la responsabilité de l'auteur ou des auteurs.

ÉVALUATION PAR LES PAIRS

Le *Journal ACITN* fonctionne selon un processus d'évaluation par les pairs à double insu. Les noms des évaluateurs ne seront pas divulgués à l'auteur ou aux auteurs qui auront soumis le manuscrit, de même que le ou les noms des auteurs ne seront pas divulgués aux évaluateurs.

Toutes les contributions seront initialement évaluées par les rédactrices en chef pour leur pertinence à la revue. Les manuscrits réputés acceptables sont envoyés à deux experts indépendants qui en évalueront la qualité. Un manuscrit ne sera envoyé pour évaluation que si les rédactrices en chef déterminent que le manuscrit répond aux exigences de qualité et de pertinence appropriées, conformément à l'objectif et au champ d'application particuliers du *Journal ACITN*.

Les rédactrices sont responsables de la décision définitive en ce qui a trait à l'acceptation ou au rejet du manuscrit. Les rédactrices en chef n'interviennent pas dans les décisions relatives aux articles qu'elles-mêmes ont rédigés ou que des proches ou des collègues ont écrits ou encore qui portent sur des produits ou services pour lesquels elles sont en conflit d'intérêts. Toutes les soumissions de manuscrit font l'objet du processus habituel d'évaluation par les pairs indépendants de la revue.

Les critères d'acceptation de tous les manuscrits comprennent la qualité et l'originalité de la recherche ou du matériel intellectuel, son importance ou son attrait pour le lectorat de la revue et le style d'écriture en général.

PRÉPARATION DE LA SOUMISSION

Les éléments suivants sont requis pour toutes les soumissions. Les manuscrits qui ne répondent pas à ces exigences seront renvoyés à l'auteur-ressource en vue de révisions techniques avant d'être soumis à l'évaluation par les pairs.

Le manuscrit doit être soumis en fichiers séparés dans cet ordre : page titre; résumé avec mots clés; corps du texte incluant les références; et les figures ou les tableaux. Une lettre de présentation peut être fournie à la discrétion des auteurs.

Page titre

Inclure :

- Titre du manuscrit (concis et descriptif)
- Titre court comptant moins de 40 caractères
- Nom complet, diplôme de plus haut grade et affiliations de tous les auteurs, adresse courriel et numéros de téléphone/télécopieur de l'auteur-ressource
- Affiliations institutionnelles des auteurs (département, établissement, ville, pays) où les travaux de recherche ont été réalisés
- Tous les remerciements (y compris la divulgation du financement), les crédits ou les avertissements, un énoncé de conflit d'intérêts pour tous les auteurs

Résumé avec mots clés

Soumettre un résumé structuré ou succinct de 250 mots au maximum. La limite de mots inclut les en-têtes dans un résumé structuré (p. ex., *contexte*, *objet*, *méthode*, *résultats* et *discussion*).

Le résumé doit être une description succincte de la question, du problème ou du sujet principal abordé dans le manuscrit, ainsi que les résultats ou conclusions présentés. Il ne doit pas reproduire le corps du texte. Il ne doit pas contenir de sous-titres, d'abréviations ou de citations de référence.

Fournir jusqu'à huit mots clés qui décrivent le contenu du manuscrit.

Corps du texte (manuscrit, liste de référence)

Corps du texte :

- Longueur maximum de 15 à 20 pages, à double interligne
- Se servir du guide de style *Publication Manual of the American Psychological Association* (APA), 7e édition (droit d'auteur 2020) pour les lignes directrices en matière de style et de format
- Comme les manuscrits font l'objet d'une évaluation par des pairs à double insu, le corps du texte ne doit inclure aucune information pouvant servir à identifier les auteurs. Par conséquent, il ne faut pas inclure de renseignements d'identification (p. ex., noms des auteurs)
- Paginer sans interruption dans le coin supérieur droit
- Citer les tableaux ou les figures à la suite
- S'assurer d'approuver ou d'éliminer toutes les modifications de suivi de votre document Word avant le téléversement

Références :

- N'utiliser que des sources publiées dignes de foi et de qualité
- À double interligne à la fin du manuscrit
- La liste de citations et de références doit être conforme au guide de style de l'APA, 7e édition (droit d'auteur 2020)
- Fournir les adresses URL pour toutes les références, le cas échéant
- S'assurer que toutes les références citées dans le texte figurent dans la liste de référence (et vice versa)

Tableaux ou figures

- Soumettre chaque tableau ou figure dans un fichier séparé, sous forme modifiable et non sous forme d'image
- Préparer les tableaux ou les figures selon le guide de style de l'APA, 7e édition (droit d'auteur 2020)
- Citer les tableaux ou les figures à la suite dans le texte et les numéroter dans cet ordre. Ne pas incorporer les tableaux ou les figures dans le fichier texte du manuscrit
- Numéroter les tableaux et les figures à la suite selon leur apparition dans le texte et positionner le titre du tableau ou de la figure et toute note connexe sous le corps du tableau ou de la figure
- Utiliser les tableaux avec retenue et s'assurer que les données qui y sont présentées clarifient et complètent les résultats décrits dans le corps du texte, sans toutefois les reproduire. Seuls les tableaux sur 3 pages de manuscrit ou moins seront acceptés aux fins de publication dans l'article.
- Les auteurs qui utilisent des tableaux ou des figures précédemment publiés doivent inclure l'autorisation écrite de l'éditeur original. Cette autorisation doit être jointe au manuscrit soumis.

SOUMISSION DU MANUSCRIT

Après avoir préparé le matériel de soumission conformément aux directives indiquées dans la rubrique « Préparation de la soumission » ci-dessus, les manuscrits doivent être soumis en ligne à cette adresse : **https://cannt-acitn.ca/journal/ojs/index.php/canntj**

Les nouveaux utilisateurs doivent cliquer sur « Register » (S'inscrire) dans le coin supérieur droit de la page. Une fois inscrit, sélectionner « Submissions » (Soumissions) du menu déroulant « About » (À propos de).

APRÈS LA SOUMISSION

L'examen du manuscrit se déroule en trois étapes avant que la décision ultime soit prise sur le statut de l'article aux fins de publication.

Examen préliminaire

Examen préliminaire par les rédactrices en chef afin de déterminer la pertinence de l'article aux fins d'évaluation par les pairs. Les rédactrices en chef examinent toutes les exigences de présentation de manuscrits, notamment le style et le format du manuscrit.

Évaluation rédactionnelle par les pairs

Le processus d'évaluation par les pairs détermine la valeur scientifique de l'article. Tous les manuscrits sont évalués par deux membres du comité d'évaluation rédactionnelle. Les critères d'acceptation pour tous les textes reposent sur la qualité et l'originalité de l'œuvre et sur son importance aux yeux du lectorat de la revue. Les manuscrits sont envoyés aux évaluateurs uniquement si les rédactrices en chef décident que le texte mérite un examen plus approfondi.

Détermination de l'admissibilité aux fins de publication

Après l'évaluation par les pairs, les rédactrices en chef prennent une décision concernant l'admissibilité de l'article à la sélection en se fondant sur les commentaires et les recommandations des évaluateurs. Selon l'évaluation par les pairs, les rédactrices en chef prennent l'une des décisions suivantes :

- Accepter le manuscrit sans modifications
- Accepter le manuscrit une fois les modifications mineures apportées
- Soumettre de nouveau le manuscrit une fois les modifications majeures apportées – réévaluation par les évaluateurs d'origine
- Rejeter le manuscrit

APRÈS L'ACCEPTATION

Les auteurs-ressources recevront une épreuve en format PDF de l'article. L'épreuve d'imposition doit être soigneusement relue afin de détecter toute erreur d'édition ou de composition. Il incombe aux auteurs de s'assurer que les épreuves sont exemptes d'erreurs. Les auteurs doivent également s'assurer que les tableaux, les figures ou les références renumérotés correspondent aux citations du texte et que les légendes des figures correspondent aux citations du texte et aux figures réelles. Les épreuves doivent être renvoyées dans le délai précisé par les rédactrices en chef.

Les modifications apportées à l'épreuve qui vont au-delà de ce qui est nécessaire pour corriger des erreurs ou pour répondre à des questions ou qui constituent un remaniement du matériel précédemment accepté **ne** seront **pas** permises. Les rédactrices en chef se réservent le droit de rejeter toute modification qui n'influe pas sur l'exactitude du contenu.

APRÈS LA PUBLICATION

L'auteur-ressource recevra une copie papier du numéro de la revue ainsi qu'une copie PDF de l'article.

S'il est accepté, votre article ne doit pas être publié nulle part ailleurs sous une forme similaire, en toute autre langue, sans le consentement de l'éditeur. Vous ne pouvez pas publier le fichier PDF de votre article révisé ou de votre article définitif publié dans un service d'archives ou sur un site de médias sociaux en ligne.

OPTION D'ACCÈS LIBRE

Les auteurs d'articles acceptés dans le cadre d'une évaluation par les pairs peuvent choisir de payer une redevance pour permettre aux lecteurs du monde entier d'accéder en ligne à leur article publié, sans restriction et à perpétuité, dès sa publication. Cette option n'a aucune influence sur le processus d'évaluation par les pairs. Tous les manuscrits font l'objet d'un processus standard d'évaluation par les pairs à double insu et seront acceptés ou refusés en fonction de leur propre valeur.

Des frais de traitement de l'article de 250,00 $ sont facturés à l'acceptation du manuscrit et doivent être payés dans les cinq (5) jours par le ou les auteurs. Le paiement doit être traité pour que l'article soit publié en accès libre.

CONFLITS D'INTÉRÊTS ET SOURCE DE FINANCEMENT

Au moment de la soumission du manuscrit, les auteurs doivent divulguer toute source potentielle de conflit d'intérêts, ce qui inclut toute relation ou tout intérêt financier qui pourrait être perçu comme influençant leur objectivité. La présence d'un conflit d'intérêts n'empêche pas la publication. Les auteurs doivent également déclarer qu'ils n'ont aucun conflit d'intérêts à déclarer. Les sources de financement doivent figurer sur la page titre sous la rubrique « Conflits d'intérêts et source de financement ». Chaque auteur doit remplir et soumettre le formulaire d'entente de transfert du droit d'auteur de la revue, lequel comprend une section sur la déclaration de conflits d'intérêts potentiels.

ENTENTE DE TRANSFERT DU DROIT D'AUTEUR

Au moment de la soumission, l'auteur qui soumet un manuscrit recevra un formulaire d'entente de transfert du droit d'auteur et de déclaration de conflits d'intérêts. Les coauteurs recevront des directives par courriel pour aussi remplir le formulaire afin d'amorcer le processus d'évaluation.

COORDONNÉES DU BUREAU DE LA RÉDACTION

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