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Moisture in hemodialysis catheter dressings and the risk of infection: an integrative review

Umidade em curativos de cateteres de hemodiálise e o risco de infecção: revisão integrativa

Humedad en apósitos de catéteres de hemodiálisis y el riesgo de infección: una revisión integradora

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ABSTRACT

Introduction: In hemodialysis care, the nurse is involved in most care for the patient using a double-lumen central venous catheter; in this regard, it is necessary to instruct the renal patient about measures to protect venous access regarding humidity during bathing, as a wet dressing over the device insertion site increases the risk of infection. **Aims:** To identify in the literature the relationship between moisture in hemodialysis catheter dressings and the risk of infection. **Method:** Integrative review performed in MEDLINE databases via PubMed, CINAHL, Web of Science, Scopus, Cochrane, BDNF, LILACS bibliographic index and references of the articles included. The sample consisted of 10 primary studies. The results were analyzed descriptively and organized into categories. **Results:** Six (60%) addressed the humidity related to the bath, three (30%) addressed the humidity related to perspiration and one (10%) discussed the humidity related to secretions from the ostium of the hemodialysis catheter. **Implications:** Wetting the hemodialysis catheter while bathing is not the best recommendation. Moisture resulting from perspiration was associated with risk of infection.

DESCRIPTORS

Renal Dialysis; Humidity; Baths; Catheter-Related Infections.

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INTRODUCTION

Hemodialysis is performed from access to the patient's central circulation, through a venous route that allows high flow of extracorporeal blood. One of the means of access is the Double Lumen Central Venous Catheter (DLC), which consists of a device implanted in a central vein of the patient, commonly in the internal jugular, subclavian or femoral veins. Due to the complications that may arise with the use of CDL, this is an emergency method used in situations of exacerbation of chronic kidney disease, maintained until a safe and long-term access is established for the patient, such as an Arteriovenous Fistula (AVF).¹⁻²

Among the complications related to the use of DLC, there are thrombosis, obstruction, bleeding and infection, the latter being the most frequent and with the greatest potential for damage, which can lead the patient to death. It is estimated that morbidity and mortality due to infections is considerably higher in patients with DLC than in those who use AVF as a means of access.³⁻⁴

With regard to care related to the CDL, the nurse is involved in most procedures such as handling during hemodialysis for connection and disconnection; monitoring function, patency and signs of infection; performing the dressings and; it is also responsible for self-care guidelines.⁵

In this regard, the greatest doubts and questions reported by patients relate to basic survival and well-being activities performed daily, such as bathing and intimate hygiene.⁶ Thus, nursing guidelines regarding protective measures for the hemodialysis catheter during bathing are essential, as the permanence of the wet cover over the device insertion site favors increased colonization and migration of microorganisms, increasing the risk of infection.⁷

Given the above, the objective was to identify, in the literature, the relationship between

humidity in hemodialysis catheter dressings and the risk of infection.

METHOD

This is an integrative review based on the theoretical framework of Whittemore and Knafl developed in six stages: elaboration of the research question; literature search and sampling; definition of the information to be extracted from the selected studies; critical evaluation; interpretation of results; synthesis of knowledge and presentation of the review.⁸ The research question was structured using the acronym PICO (Population, Intervention, Control and Result), with the population being people with chronic kidney disease with hemodialysis catheter, the intervention moisture in dressings, did not use the control, and the result was infection related to hemodialysis catheter. Thus, the guiding question was listed: What is the relationship between humidity in hemodialysis catheter dressings and the risk of infection?

The bibliographic survey was carried out in November and December 2020, in the Medical Literature Analysis and Retrieval System online databases (MEDLINE via PubMed), Cumulative Index to Nursing and Allied Health literature (CINAHL), Web of Science, Scopus, Cochrane, Nursing Database (BDNF) and Latin American Literature of Health Sciences bibliographic index (LILACS) via Virtual Health Library.

The operationalization of the searches was carried out from the combination of controlled and uncontrolled descriptors, using the Boolean operators OR and AND. The selection of search terms occurred by consulting the Health Sciences Descriptors (DeCS), Medical Subject Headings (MeSH) and List of Headings of CINAHL Information Systems. Chart 1 presents the controlled and uncontrolled descriptors and the MEDLINE search expression via PubMed. It should be noted that the same standardization was maintained for the other databases and index consulted.

Chart 1 - Chart 1. Controlled, uncontrolled descriptors and search expression. Teresina, PI, Brazil, 2021.

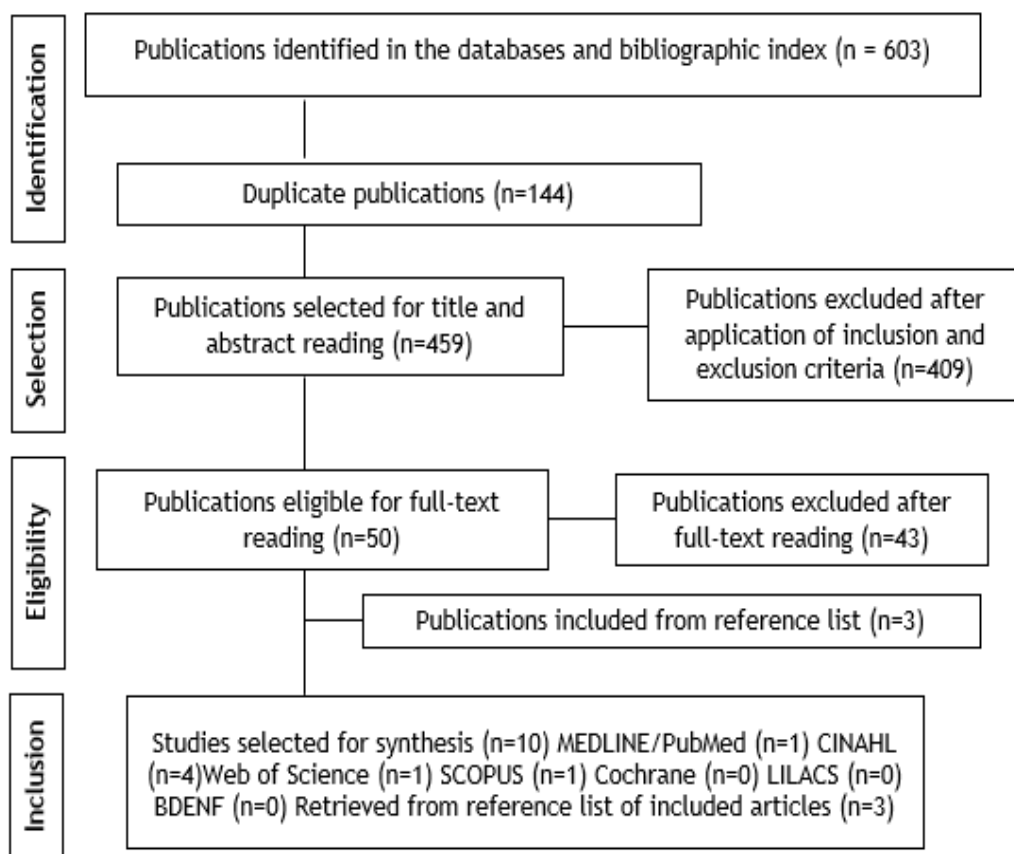
<i>MeSH</i>		
P	controlled descriptor	Catheters, renal dialysis
	uncontrolled descriptor	Catheter, hemodialysis, hemodialyses
I	controlled descriptor	Humidity, baths, bandages
	uncontrolled descriptor	Humidities, bath, bandage, dressings, dressing
C	-	-
O	controlled descriptor	Catheter-related infections
	uncontrolled descriptor	Catheter Related Infections, catheter associated infections, catheter-associated infection
PAND I AND O		
((((("catheters"[MeSH Terms]) OR ("catheter"[All Fields])) AND ("renal dialysis"[MeSH Terms])) OR ("hemodialysis"[All Fields])) OR ("hemodialyses"[All Fields])) AND ((((((("humidity"[MeSH Terms]) OR ("humidities"[All Fields])) OR ("baths"[MeSH Terms])) OR ("bath"[All Fields])) OR ("bandages"[MeSH Terms])) OR ("bandage"[All Fields])) OR ("dressings"[All Fields])) OR ("dressing"[All Fields]))) AND (((("catheter-related infections"[MeSH Terms]) OR ("catheter related infections"[All Fields])) OR ("catheter associated infections"[All Fields])) OR ("catheter related infections"[All Fields])) OR ("catheter -associated infection"))		

Source: Direct search.

Primary studies that evaluated the relationship between moisture in hemodialysis catheter dressings and the risk of infection were included, without temporal or language delimitation. Editorials, expert opinions, course completion papers, monographs, dissertations, theses and those that did not respond to the guiding question were excluded, and duplicate articles were considered only once.

The searches and selection were carried out by two reviewers, independently, in two stages. In the first, the title and abstract were read and, in the second, the full text was read. Disagreements were analyzed by a third reviewer who issued an opinion including or excluding the study. The references retrieved from the databases and bibliographic index were imported into the Rayyan QCRI application, allowing selection by pairs to occur blindly.⁹

The search expressions retrieved 603 studies, 144 of which were duplicates, leaving 459. After applying the eligibility criteria, 409 were excluded, leaving 50 for reading the full text. In the next step, 43 studies were excluded, 19 for not being primary studies and 24 for not responding to the guiding question. References to the included articles were also consulted, and thus, seven studies were retrieved from the databases and three from references, totaling a sample of ten studies. The route for identification, selection, eligibility and inclusion followed the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA),¹⁰ as shown in Figure 1.

Figure 1 - Flowchart of identification, selection, eligibility and inclusion of articles. Teresina, PI, Brazil, 2021.

Source: Direct search.

Data extraction was performed using a validated and adapted instrument, considering the following variables: study identification, main author, country of publication, year, journal, design, sample, level of evidence, main results and conclusions¹¹. The level of evidence was classified according to the model proposed by Melnyk and Fineout-Overholt.¹²

The analysis of the evidence and the synthesis of the results were carried out descriptively in three thematic categories: bath-related humidity and the risk of infection of hemodialysis catheters; moisture related to perspiration and the risk of infection of hemodialysis catheters; and humidity related to secretions from the hemodialysis catheter outlet and the relationship with the risk of infection.

RESULTS

Of the ten selected studies, four (40%) were extracted from CINAHL, one (10%) from Web of Science, one (10%) from MEDLINE via PubMed, one

(10%) from Scopus, and three (30%) were retrieved after consulting the references of the studies included in the research.

Regarding the design of the studies, four (40.0%) were randomized clinical trials, two (20%) were retrospective studies, one (10%) prospective observational, one (10%) observational and one (10%) qualitative. Regarding the level of evidence, five (50%) publications were classified as level II and five (50%) as level VI.

Of the topics addressed in the publications, six (60%) contemplated humidity related to bathing, three (30%) addressed humidity related to perspiration affected by the environment and one (10%) discussed humidity related to secretions from the catheter exit site. of hemodialysis. Of the studies that investigated the relationship between bathing and the risk of infection, two (20%) developed a device to protect the hemodialysis catheter, which

was effective in reducing the rate of infection. Chart

2 presents the ten studies included in this review.

Chart 2 - Summary of included studies addressing the relationship between humidity in hemodialysis catheters and the risk of infection. Teresina, PI, Brazil, 2021.

Main author, place and year	Journal	Design, sample and level of evidence	Main results	Conclusions
Altman, ¹³ United States of America, 2006	Dialysis Transplantation s/l	Retrospective, 29 patients, level VI	Patients wore CD-1000 secondary dressing for an average of 76.13 days, and the infection rate was 0.45 / 1000 catheter days. 96.4% patients reported effectiveness of CD-1000 in keeping the catheter and exit site dry during bathing.	The secondary dressing fulfilled the function of maintaining a dry environment for the catheter and ostium, with a high level of satisfaction and a low rate of infection.
Harwood, ¹⁴ Canada, 2008	The CANNT Journal s/l	Observational, 52 patients, level VI	The most frequent clinical features at catheter exit sites included the presence of dry crust (58%), redness (56%), and purulent exudates (33%), and none had a positive statistical association with infection.	Clinical characteristics of the catheter exit site showed no relationship with infection.
Altman, ¹⁵ United States of America, 2008	The Journal of Vascular Access	Retrospective, 209 patients, level VI	CD-1000 was 95% effective in keeping the catheter and ostium dry in the bath. Catheter infection rate dropped by 75% during the study	The CD-1000 adequately protected catheters and exit sites when patients engaged in high-risk activities, such as bathing, and reduced catheter infections.
Hughes, ¹⁶ Australia, 2011	Ren Soc Aust J.	Prospective observational, 34 patients, level VI	Incomplete dressings were associated with: femoral position of the catheter; presence of sutures; moisture; patient residence located more than 150 kilometers from the dialysis center. Although 43% of the patients had non-complete dressings, no relationship was identified between infection and dressing integrity.	Most patients lost the integrity of central venous catheter dressings between dialysis procedures, more frequently in patients who lived further away from the treatment site, who are more vulnerable to sweating situations.
Kear, ¹⁷ United States of America, 2013	Journal of Infection Prevention s/l	Qualitative, 40 patients, level VI	89% of the participants took a shower keeping the gauze dressing intact: of these, 72% reported that the gauze gets wet during the shower. Eight participants (35%) reported changing wet gauze.	It is important that the patient is informed about the care that reduces catheter-related infections, to influence their adherence to the best bathing practices in the home environment, collaborating with their autonomy, comfort, hygiene and satisfaction.
Lok, ¹⁸ Canada, 2014	Seminars in Dialysis	Prospective, longitudinal and observational, 12,122 patients, level VI	The overall rate of catheter-related sepsis was 0.47 per 1000 catheter days, but varied by season, with greater	The higher occurrence of catheter-related sepsis in the summer may be due to conditions that facilitate bacterial growth (eg,

			frequency in summer compared to winter. Increased temperature and humidity were positively associated with sepsis.	heat, sweating) and compromise protective measures.
Lawrence, ¹⁹ Canada, 2014	Nephrology Nursing Journal	Randomized controlled clinical trial, 119 patients, level II	There was no increase in infection rates in patients with a catheter that wet the dressing in the bath, compared to patients who kept the dressing dry. The overall catheter-related infection rate of study patients was 0.31 events per 1000 catheter days. The bloodstream infection rate in the “shower and no bandage” group was 0.0786 per 1000 catheter days.	The “shower and no dressing” technique seems to be a safe dressing option for hemodialysis catheters, with better quality of life and no increase in infection rates.
Evans, ²⁰ United States of America, 2014	Nephrology Nursing Journal	Randomized controlled clinical trial, 78 patients 40 participants, level II	The group that did not wet the catheter insertion site in the bath had no catheter-related infection, whereas the wetting group had a rate of 0.51 episodes of bloodstream infection per 1000 catheter days.	The bathing group had the highest rate of infection but still achieved a low level of incidence compared to other published results.
Kosa, ²¹ Canada, 2016	Kidney Int Rep	Randomized controlled clinical trial, 68 patients, level II	The catheter-related bacteremia (CRB) rate was slightly higher in the HIPPO-ST bath technique group (0.88/1000 catheter days) compared to the control group (0.68/1000 catheter days), although both were below the threshold of an acceptable CRB rate.	There are no significant additional risks of infection for the patient with a catheter who performs the bathing technique recommended in the study, and this practice increases the patient's degree of satisfaction with his self-care.
McArdle, ²² Australia, 2017	Wound Practice And Research	Controlled randomized clinical trial level II 26 patients	Infection occurred more frequently with a transparent dressing than with a non-transparent dressing.	See-through dressings with less breathability can trap moisture under the dressing and promote bacterial growth.

Source: Direct search

DISCUSSION

Bath-related humidity and the risk of infection of hemodialysis catheters

Six studies highlighted that bathing is a risk activity for infection in patients using a hemodialysis catheter, considering that the incidence of water on the catheter and dressing causes humidity and infection. These studies admitted bathing as a necessary care for the patient, contrary to guidelines

recommendations to avoid it, especially in studies in Canada and the United States of America, whose climates tend to be more cold.^{18,23}

Bathing is an inevitable activity for the patient and important for self-care. Thus, two studies aimed to test whether wetting the catheter and dressing with water followed by antiseptics carried out by the patient himself brought additional risks related to infection of the catheter.^{19,20} However, results differed regarding the risk of infection related

to the hemodialysis catheter, since in one of the studies the group of patients who wet the catheter during the bath had lower rates of bloodstream infection compared to the overall rate,¹⁹ while the other had higher bloodstream infection rates for patients who wet the catheter.²⁰

In convergence with the previous study,²⁰ three studies evaluated infection rates for patients who kept the catheter dry during bathing^{13,15,21} and identified that infection rates were lower when the catheter or site was kept free of moisture.

In this perspective, it is understood that it is fundamental to keep the insertion ostium and the catheter protected from water during the bath. The latest Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines advise that immersion of the hemodialysis catheter in water is not recommended and that bathing should be allowed if precautions are taken to reduce the likelihood of introducing microorganisms into the catheter, such as protection of the catheter and connection device with a waterproof cover.⁷

In this regard, it is important to mention the CD-1000 protection device, which was the object of study in two articles in this review and tested to protect catheters from the humidity of the bath, consisting of a removable canvas bag that covers the internal dressing and houses the catheter, protecting it from fluids. Its use showed effectiveness in protecting the catheter from humidity, lower incidence of infection and feelings of satisfaction and well-being of patients.^{13,15} Despite its effectiveness and usefulness, CD-1000 is no longer available on the market because, according to its developer, Sanford Altman, health systems do not fund this resource and most patients cannot afford it.

It is emphasized that the patients who took part in the studies discussed in this topic used a tunneled hemodialysis catheter with a healed exit site. This type of catheter, called Permcath®, has a felt cuff in its extension under the skin that serves as a barrier to the migration of microorganisms and does

not require external sutures, characteristics that reduce the risk of infection; it is commonly used in patients who cannot have an AVF and need long-term hemodialysis access.¹⁻² Unlike this material, the CDL does not have such barrier mechanisms for infection and was not the object of any of the studies that addressed the bath, limiting the analyzes to patients with tunneled catheters.

Patients who bathed freely reported a high level of satisfaction with the procedure.¹⁷ This leads us to consider that the benefits of providing the patient with a greater degree of well-being when bathing with less restrictions may be acceptable with infection rates that remain below the recommended by international entities. The KDOQI7 guideline recommends that hemodialysis services work to keep rates of catheter-related bloodstream infections below 3.5 per 1,000 catheter days, which is numerically above the results discussed.

In addition, patient skin hygiene is essential to reduce resident and transient microbial flora, which can migrate and colonize the hemodialysis catheter and cause bloodstream infection.³ For the patient using the hemodialysis catheter, the difficulty in bathing can discourage him from performing his hygiene and allows the colonization of the pericatheter skin. The nurse must guide the best hygiene practices for renal patients using a catheter and encourage them to perform this care.

Perspiration-related moisture and the risk of infection from hemodialysis catheters

Perspiration is the physiological process of water elimination (sweat) through the skin due to temperature rise.²⁴ Thus, in patients using a hemodialysis catheter, the sweat eliminated can lead to loss of adhesive bonding and the formation of wrinkles in the dressing. This in turn will allow bacteria to pass into the catheter which may increase susceptibility to infection.²⁵

Study identified a positive association between hot weather and increased rates of

septicemia in hemodialysis patients, by verifying that, in the summer, a period conducive to greater perspiration in the patient, the rates of infection increased¹⁸ Surveys carried out in Australia^{16,22} country with a warm and temperate climate favorable to perspiration,²³ did not prove the relationship between moisture resulting from perspiration and the risk of infection, but identified that excessive perspiration can cause the dressings to detach.

There are recommendations for diaphoretic patients, which indicate that the ostium of the central venous catheter should be preferably covered with a gauze dressing and sterile adhesive tape (changed every two days) instead of transparent coverings (changed every 7 days), since gauze is able to better absorb moisture. The guidelines indicate that any type of cover should be replaced immediately if it is dirty, loose or wet, as a delay in changing a dressing that has lost its integrity is associated with an increased risk of infection.⁷

Humidity related to secretions from the hemodialysis catheter outlet and the relationship with the risk of infection

A local infection or at the exit of hemodialysis catheters is identified by any one or more of the following symptoms: erythema, tenderness, skin necrosis, phlebitis, swelling, pain and exudate, including purulence.⁷ The exudate is composed of plasma proteins and leukocytes that leak from the

blood vessels and accumulate in the inflamed site; when purulent is formed by the accumulation of large numbers of neutrophils, which interact with the offending agent.²⁴

Although a prospective longitudinal study did not prove a statistical association between exudates from the exit site of hemodialysis catheters and positive local cultures, it should be taken into account that purulent exudate is the result of a local inflammatory and/or infectious reaction, and this type secretion is often associated with infections at the hemodialysis catheter exit site.^{7,18} Research with central venous catheters showed that local signs at the exit site were clearly associated with infections, with redness and purulent and non-purulent secretions.²⁶

CONCLUSION

In view of the above, it was identified that wetting the hemodialysis catheter during the bath is not the best recommendation, as it contributes to an increased risk of infection. Thus, alternatives that provide safe and less complicated hygiene care should be studied and disseminated, such as catheter protection devices, so that chronic renal patients, using a hemodialysis catheter, feel encouraged to perform their hygiene and bathing self-care, providing well-being and reducing contamination of the pericatheter skin.

RESUMO

Introdução: Nos cuidados de hemodiálise, o enfermeiro está envolvido na maioria dos cuidados ao paciente que utiliza um cateter venoso central de duplo lúmen; nesse sentido, é necessário orientar o paciente renal sobre as medidas de proteção do acesso venoso quanto à umidade durante o banho, pois um curativo úmido sobre o local de inserção do dispositivo aumenta o risco de infecção. **Objetivo:** Identificar na literatura a relação da umidade em curativos de cateteres de hemodiálise com o risco de infecção. **Método:** Revisão integrativa realizada nas bases de dados MEDLINE via PubMed, CINAHL, Web of Science, Scopus, Cochrane, BDNF, índice bibliográfico LILACS e referências dos artigos incluídos. A amostra foi composta de 10 estudos primários. Os resultados foram analisados de forma descritiva e organizados em categorias. **Resultados:** Seis (60%) contemplavam a umidade relacionada ao banho, três (30%) abordaram a umidade relacionada à transpiração e um (10%) discutia a umidade relacionada a secreções do óstio do cateter de hemodiálise. **Implicações:** Molhar o cateter de hemodiálise durante o banho não é a melhor recomendação. A umidade decorrente da transpiração apresentou associação com risco de infecção. A umidade relacionada a exsudatos não confirmou relação com infecção em sítios de cateteres de hemodiálise.

DESCRITORES

Diálise Renal; Umidade; Banhos; Infecções Relacionadas a Cateter.

RESUMEN

Introducción: En la atención de hemodiálisis, el enfermero participa en la mayoría de los cuidados de los pacientes que utilizan un catéter venoso central de doble luz; en ese sentido, es necesario orientar al paciente renal sobre las medidas para proteger el acceso venoso contra la humedad durante el baño, ya que un vendaje húmedo sobre el sitio de inserción del dispositivo aumenta el riesgo de infección. **Objetivo:** Identificar en la literatura la relación entre la humedad en los apósitos de catéteres de hemodiálisis y el riesgo de infección. **Delineación:** Revisión integrativa realizada en bases de datos MEDLINE vía PubMed, CINAHL, Web of Science, Scopus, Cochrane, BDNF, índice bibliográfico LILACS y referencias de artículos incluidos. La muestra estuvo compuesta por 10 estudios primarios. Los resultados fueron analizados descriptivamente y organizados en categorías. **Resultados:** Seis (60%) abordaron la humedad relacionada con el baño, tres (30%) abordaron la humedad relacionada con la transpiración y uno (10%) discutieron la humedad relacionada con las secreciones del ostium del catéter de hemodiálisis. **Implicaciones:** Mojar el catéter de hemodiálisis mientras se baña no es la mejor recomendación. La humedad resultante de la transpiración se asoció con el riesgo de infección. La humedad relacionada con los exudados no confirmó una relación con la infección en los sitios de los catéteres de hemodiálisis.

DESCRIPTORES

Diálisis Renal; Humedad; Baños; Infecciones Relacionadas con Catéteres.

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COLLABORATIONS

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Data available upon request from the main author.

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CONFLICTS OF INTEREST

There are no conflicts of interest to declare.