

# EFFECT OF BRIGHT LIGHT ON THE COGNITIVE AND OCCUPATIONAL PERFORMANCE OF ELDERLY PEOPLE UNDERGOING HEMODIALYSIS: INITIAL DATA FROM CLINICAL TRIAL

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Maria Clara Brasileiro Barroso<sup>1</sup>  
Aldecira Uchoa Monteiro Rangel<sup>2</sup>  
Ticiania Farias Batista<sup>3</sup>  
Ana Leticia Teixeira de Oliveira<sup>4</sup>  
Larissa Keven França Aguiar<sup>5</sup>  
Elizabeth Clara Barroso<sup>6</sup>  
Geraldo Bezerra da Silva Junior<sup>7</sup>

**ABSTRACT:** INTRODUCTION: Chronic kidney disease (CKD) has no expectation of cure, therefore, the treatment is based on maintaining the chronic state of the disease, through renal replacement therapies, such as hemodialysis or kidney transplant. The CKD can compromise occupational performance, since the beginning of hemodialysis, adaptation to new life habits is required. OBJECTIVE: To analyze the effects of bright light on occupational performance of elderly people with end-stage renal disease (ESRD) on hemodialysis in the state of Ceará, aiming at its impact on the quality of life of these patients. METHOD: Randomized, placebo-controlled clinical trial with and qualitative-quantitative approach, with the use of bright light or placebo light in their homes for 30 minutes, for 4 weeks in the afternoon. From this perspective, the evaluation instruments were used before and after the light: The Dynamic Lowenstein Occupational Therapy Cognitive Assessment – for Geriatric Population (DLOTCA-G) adapted version for the Portuguese language. The sample consisted of 26 elderly people on dialysis, and the collection period comprised the months of August 2022 to May 2023. RESULTS: They were 69% (18/26) male and between 60 and 94 years old. The analysis of the impacts of such equipment on these individuals' memory, mental operations and visual-motor skills revealed that the bright light group had better results than the placebo group (linear regression,  $p < 0.001$ ). CONCLUSIONS: Bright light exposure therapy proved to be very beneficial, especially for the memory and mediation of these elderly people, thus reflecting on the improvement of their quality of life.

**KEYWORDS:** Chronic Kidney Disease; Hemodialysis; Bright Light Therapy.

<sup>1</sup> Doctor Student in Public Health by Universidade de Fortaleza (UNIFOR). Universidade Estadual de Ciências da Saúde de Alagoas (UNCISAL). E-mail: [maria.barroso@uncisal.edu.br](mailto:maria.barroso@uncisal.edu.br)

<sup>2</sup> Master in Public Health by Programa de Pós-Graduação em Saúde Coletiva. Universidade de Fortaleza (UNIFOR). E-mail: [aldeciraumrangel@gmail.com](mailto:aldeciraumrangel@gmail.com)

<sup>3</sup> Graduate Student in Medicine. Universidade de Fortaleza (UNIFOR). E-mail: [ticifariasb@edu.unifor.br](mailto:ticifariasb@edu.unifor.br)

<sup>4</sup> Graduate Student in Medicine. Universidade de Fortaleza (UNIFOR). E-mail: [analeticiat@edu.unifor.br](mailto:analeticiat@edu.unifor.br)

<sup>5</sup> Graduate Student in Medicine. Universidade de Fortaleza (UNIFOR).

E-mail: [larissaaguiar@hotmail.com](mailto:larissaaguiar@hotmail.com)

<sup>6</sup> Doctor in Medical Sciences by Universidade Federal do Ceará. Universidade de Fortaleza (UNIFOR).

E-mail: [ecbarroso@unifor.br](mailto:ecbarroso@unifor.br)

<sup>7</sup> Post-Doctor in Collective Health by Universidade Federal da Bahia. Universidade de Fortaleza (UNIFOR). E-mail: [geraldobezerra@unifor.br](mailto:geraldobezerra@unifor.br)

## EFEITO DA LUZ BRILHANTE NO DESEMPENHO COGNITIVO E OCUPACIONAL DE IDOSOS EM HEMODIÁLISE: DADOS INICIAIS DE ENSAIO CLÍNICO

**RESUMO:** INTRODUÇÃO: A doença renal crônica (DRC) não possui expectativa de cura, portanto, o tratamento baseia-se na manutenção do estado crônico da doença, por meio de terapias renais substitutivas, como a hemodiálise e transplante renal. A DRC pode comprometer o desempenho ocupacional, pois desde o início da hemodiálise é necessária a adaptação a novos hábitos de vida. OBJETIVO: Analisar os efeitos da luz brilhante no desempenho ocupacional de idosos com doença renal crônica terminal (DRCT) em hemodiálise no estado do Ceará, visando seu impacto na qualidade de vida desses pacientes. MÉTODOS: Trata-se de um ensaio clínico randomizado e controlado com placebo, com abordagem qualiquantitativa onde a coleta de dados baseou-se na aplicação do DLOTCA-G- *Dynamic Lowenstein Occupational Therapy Cognitive Assessment – for Geriatric Population* em clínicas de hemodiálise, antes e depois do fornecimento da caixa de luz brilhante ou luz placebo. A amostra consistiu em 26 pacientes distribuídos em dois grupos (luz brilhante e placebo) aleatoriamente com idade mínima de 60 e máxima de 94. RESULTADOS: 69% (18/26) eram do sexo masculino e tinham entre 60 e 94 anos. A análise dos impactos desses equipamentos sobre a memória, as operações mentais e as habilidades visuomotoras desses indivíduos revelou que o grupo luz brilhante apresentou melhores resultados do que o grupo placebo (regressão linear,  $p < 0,001$ ). CONCLUSÕES: A terapia de exposição à luz brilhante mostrou-se muito benéfica, principalmente para a memória e mediação desses idosos, refletindo na melhora de sua qualidade de vida.

**PALAVRAS-CHAVE:** Idoso; Distúrbios do Sono; Doença Renal Crônica; Hemodiálise; Luz Brilhante.

## EFECTO DE LA LUZ BRILLANTE EN EL RENDIMIENTO COGNITIVO Y OCUPACIONAL DE LAS PERSONAS MAYORES SOMETIDAS A HEMODIÁLISIS: DATOS INICIALES DE ENSAYOS CLÍNICOS

**RESUMEN:** INTRODUCCIÓN: La enfermedad renal crónica (ERC) no tiene expectativa de curación, por lo tanto, el tratamiento se basa en mantener el estado crónico de la enfermedad, a través de terapias de reemplazo renal, como la hemodiálisis o el trasplante renal. La ERC puede comprometer el rendimiento ocupacional, ya que al inicio de la hemodiálisis se requiere adaptación a nuevos hábitos de vida. OBJETIVO: Analizar los efectos de la luz brillante sobre el rendimiento laboral de ancianos con enfermedad renal terminal (ERT) en hemodiálisis en el estado de Ceará, con el objetivo de conocer su impacto en la calidad de vida de estos pacientes. MÉTODO: Ensayo clínico aleatorizado, controlado con placebo, con enfoque cualitativo-cuantitativo, con el uso de luz brillante o luz placebo en sus hogares durante 30 minutos, durante 4 semanas por la tarde. Desde esta perspectiva, se utilizaron los instrumentos de evaluación antes y después de la luz: La Evaluación Cognitiva de la Terapia Ocupacional Dinámica de Lowenstein - Población Geriátrica (DLOTCA-G) versión adaptada para el idioma portugués. La muestra estuvo conformada por 26 adultos mayores en diálisis, y el periodo de recolección comprendió los meses de agosto de 2022 a mayo de 2023. RESULTADOS: 69% (18/26) varones y entre 60 y 94 años. El análisis de los impactos de dichos equipos sobre la memoria, las operaciones mentales y las habilidades visual-motoras de estos individuos reveló que el grupo de luz brillante tuvo mejores resultados que el grupo placebo (regresión lineal,  $p < 0,001$ ). CONCLUSIONES: La terapia de exposición a la luz brillante demostró ser

muy beneficiosa, especialmente para la memoria y mediación de estas personas mayores, reflejando así la mejora de su calidad de vida.

**PALABRAS CLAVE:** Enfermedad Renal Crónica; Hemodiálisis; Terapia con Luz Brillante.

## 1. INTRODUCTION

Chronic kidney disease (CKD) is a disease that has no expectation of cure, therefore, the treatment is based on maintaining the chronic state of the disease, through renal replacement therapies, such as hemodialysis (GUANARÉ ET AL, 2016). However, hemodialysis patients are at advanced risk for cognitive impairment, mainly due to advanced age, high prevalence of cardiovascular risk factors, and cerebrovascular involvement (KARAKIZLIS *et al*, 2022)

Thus, the reduction in cognitive function potentially caused by hemodialysis greatly compromises the quality of life and decision-making capacity of individuals, which may be a risk factor for mortality in these patients (CUI, CHEN E JU, 2020).

In this context, occupational performance is the result of the interaction between the person, the environment, and the occupation, and is directly influenced by the physical, emotional, cultural, and institutional environments in which the individual is inserted (PINTO *et al*, 2020).

With this in mind, CKD can compromise occupational performance, since the beginning of hemodialysis, so adaptation to new life habits is required, such as food, routine, and family dependence (VOLTARELLI E PEREIRA, 2021).

From this perspective, it is crucial to understand the importance of non-pharmacological strategies such as occupational therapy sessions, that promote meaningful activities to improve the quality of life of individuals with CKD, and the use of bright light, as functional and cognitive performance can evolve positively with bright light therapy done in the afternoon (PONTES E POLATAJKO, 2016; BARROSO, 2014).

In this scenario, there is a need for more publications on the use of bright light therapy in elderly patients with end-stage kidney disease (ESKD) on hemodialysis, therefore, the study aimed to analyze the effects of bright light usage on the cognitive and functional performance of elderly people on hemodialysis.

## 2. METHODOLOGY

### 2.1 Design

These are the preliminary results of a randomized, placebo-controlled clinical trial with a quali-quantitative approach (MARCONI E LAKATOS, 2022).

### 2.2 Research Hypothesis

Bright light therapy is beneficial for improving occupational performance in elderly patients with ESKD on maintenance hemodialysis.

### 2.3 Participants and Study Size

The sample consisted of 26 elderly participants with a minimum age of 60 and a maximum age of 94 years, and the approach took place at the hemodialysis clinic with arbitrary randomization. The inclusion criteria were as follows: elderly aged between 60 and 94, being admitted in hemodialysis clinic for more than 1 month. About the exclusion criteria were as follows: dementia, space-time disorientation, blindness, severe visual impairment or use of photosensitizing drugs.

### 2.4 Data Collection

#### 2.4.1 The Information Form

The information form consisted of a total of nine open- and closed- ended questions about the introductory characteristics of the elderly and the pathology history.

*DLOTCA-G- Dynamic Lowenstein Occupational Therapy Cognitive Assessment – for Geriatric Population*

The DLOTCA-G is a dynamic assessment of the cognitive components of the elderly that evaluates eight areas: orientation, visual and spatial perception, praxis, visual motor construction, thinking operations, memory, and consciousness (NOVELLI, 2014). It varies from 17-124 scores, the higher value the better the result. As it is a dynamic assessment, for each activity there is a dynamic score, structured in four or five levels of mediation to aid in performance, in addition to the static score that defines the cognitive performance of the elderly ranging from 1 (severe deficit) to 4 (normal performance). This dynamic battery allows us to identify the learning potential and thinking strategies from the use of mediations (NOVELLI *et al*, 2015). The levels of mediation is shown in Table 1.

Table 1. Levels of mediation used in the DLOTCA-G battery.

Level of mediation	Mediation	Score
1.General intervention	Pay attention	1
2.General feedback	Is it equal?	2
3.Specific feedback	This part is not correct, try again	3
4.Strutured feedback	The therapist begins the activity and the client continues	4
5.Reduced amount	The therapist shows how to do the activity and then the client does	5

Source: adapted from Novelli et al (2015).

#### 2.4.2 Placebo Light versus Bright Light Therapy Intervention

The procedure was explained to the elderly, took place in three hemodialysis clinics located in a capital of northeastern Brazil. About the consent, verbal and written consent was obtained from the elderly or their guardian when necessary. The Information Form was completed by the researchers.

According to the randomization, the participants entered in the research gradually and the groups were being formed. After the application of the tests the elderly used the bright light box or placebo light box, in his/her home for four weeks, during 30 minutes every afternoon. The therapeutic lamp was a portable light box 6 × 6.5 × 1 inches in size with an array of 72 eye-optimized light-emitting diode (LED) lights. According to the manufacturer, it delivers 10,000 lux of wide-spectrum non-flickering white light to simulate natural sunlight. The placebo one delivers only 500 lux. The follow-up took place over the phone to check for possible adverse effects. After this intervention, the tests were reapplied.

## 2.5 Data Analysis

### 2.5.1 Quantitative Analysis

Firstly descriptive statistics was used to describe the participants profile. Data were evaluated the Kruskal-Wallis test, Mann-Whitney U test, one-way analysis of variance, and Tau\_b of Kendall's correlation analysis. The statistical significance level was set at  $p < 0.05$  in accordance of the test statistical type.

### 2.5.2 Qualitative Analysis

The qualitative part refers to the mediations used, in application the DLOTCA-G scale, and to the participants' speeches using Bardin's content analysis (SOUSA E SANTOS, 2020).

### 2.6 Ethical Considerations

The researchers refers to the preliminary results of a doctoral project approved by the Ethics Committee of the Proponent University under nº 4.987.780 and Certificate of Presentation for Ethical Appreciation nº 50545621.5.0000.5052. Thus, the participants agreed and signed the Informed Consent Form, by the precepts of Laws nº 466/12 and 510/2016 (BRASIL, 2012; BRASIL, 2016). Preserving anonymity and the ethical principles of scientific research with human beings. Therefore, the anonymity and ethical principles of scientific research with human beings were preserved. The study was approved too in Brazilian Registry of Clinical Trials (ReBEC) by the number RBR-8bmjpd4 .

## 3. RESULTS

Initially, it is necessary to clarify that it was decided to separate the participants into groups: CODE 1 (13 participants before using the placebo light), CODE 1.1 (13 participants after using the placebo light), CODE 2 (13 participants before using the bright light) and CODE 2.1 (13 participants after the bright light therapy).

In addition, was prepared Table 2 to facilitate understanding of the profile of the participants in this study.

Table 2: Participants profile

<b>Variables</b>	<b>Participant profile N=26 (100%)</b>
<b>Sex</b>	
Masculine	18 (68.7%)
Feminine	8 (31.3%)
<b>Age group</b>	
60-70	18 (69.2%)
71-94	8 (30.8%)
<b>Hemodialysis time</b>	
Less than 1 year	6 (23,1%)
From 2 to 3 years	11 (42.3%)

Variables	Participant profile N=26 (100%)
4 years or more	9 (34.6%)
<b>Educational level</b>	
Primary school or less	12 (46,1%)
Middle school	4 (15.9%)
Complete High school	7 (26.9%)
College degree or above	3 (11.5%)
<b>Marital status</b>	
Married	25 (93.7%)
Widow (er)	1 (6.3%)

Source: Elaborated by the authors (2023).

Starting the data analysis, the focus of this study consisted on occupational performance. Thus, the total DLOTCA-G score and its associations with age and its domains, such as memory, mental operations, visual-motor skills and RAAQ scores were analyzed in detail and correlationated with time of hemodialysis.

The first statistical analysis of the data revealed correlation between the age and cognitive performance, but this influence is weak,  $\tau = .11$  (Table 3).

Table 3: Correlation between age and total DLOTCA-G

	AGE	DLOTCA-G
Kendall's tau_b	Correlation Coefficient	<b>.11</b>
	p	.27
	N	52

\*According to Cohen correlation effect size varies from -1 to 1 and is divided in four levels: < 0.1 (No effect), 0.10 – 0.29 (Little effect), 0.30 – 0.49 (Middle effect) and 0.5 - 1 (High effect).

Source: Elaborated by the authors (2023).

Now, about the influence of the visuomotor skills, mental operations and memory in the DLOTCA-G total score, between the four groups we constructed the Table 4.

Table 4: The Influence of Bright Light in the Visuomotor Skills (VMS), Mental Operations (MO) and memory (MEM) by the total DLOTCA-G score.

DLOTCA-G				
	Type III Sum of Squares	Mean Square	F	P*
Corrected Model	5435.25	905.88	13.81	<b>&lt;.001</b>
Intercept	322.62	322.62	4.92	<b>.032</b>
VMS	1739.39	1739.39	26.51	<b>&lt;.001</b>
MO	997.06	997.06	15.20	<b>&lt;.001</b>
MEM	976.13	976.13	14.876	<b>&lt;.001</b>

\*Univariate Analysis of Variance.  
 Source: Elaborated by the authors (2023).

#### 4. DISCUSSION

The main findings of this study revealed that bright light is beneficial for elderly patients with ESKD undergoing hemodialysis. According to Huang *et al* (2015), bright light improves depressive symptoms associated with hemodialysis as well. But this study is the first to analyze the occupational performance of elderly people on hemodialysis after using bright light therapy.

In addition, the importance of memory for adherence to medication, food, and hemodialysis treatment is highlighted. Our findings are consistent with the literature.

The DLOTCA-G scale is divided into the following domains: memory, attention, visual-motor skills, visual-spatial skills, language, and verbal fluency. Correlating with our results, a significant association was noticed between memory and the total score of the DLOTCA-G (KRUG E TONETTO, 2020; CHAIBEN ET AL, 2019).

Reflecting and associating with ESRD, it was understood that cognitive impairment did not occur randomly, as there was statistical significance as shown in chart 2. Another very important domain that the DLOTCA-G scale made it possible to analyze was mediation, that is, the learning potential of the participants, considering that the dynamic battery gives the elderly the opportunity to use mediation when they are being challenged (KRUG ET AL, 2020). This detail helps both the occupational therapist to build their treatment plan and the multidisciplinary team that assists the elderly. Therefore, cognitive maintenance is an important indicator of quality of life that permeates all



occupational performance. However, this mediating variable did not obtain statistical significance.

For this reason, mediation entered the qualitative part together with content analysis qualitative. Thus, educational intervention becomes important in coping with ESRD, as it facilitates understanding the pathology and complications (CHAIBEN ET AL, 2019).

Furthermore, mediation leads to the contemplation of the clinical profile, as the patients who required more mediation consisted of the most cognitively debilitated and with the longest hemodialysis time. This finding even confirms previous studies (KRUG E TONETTO, 2020; CHAIBEN ET AL, 2019) instigates new prospective cohort studies with follow-up to understand the effects of hemodialysis on cognition and the inclusion of professional occupational therapists in hemodialysis clinics.

It was observed that hemodialysis brings numerous limitations for individuals who need this renal replacement therapy, such as worsening cognitive and occupational performance, in addition to physical limitations, which leads to an increase in the dependence of these patients and, consequently, a decrease in their quality of life, and it is necessary to resort to non-pharmacological treatments to minimize the damage caused to these people.

During the research in previous studies, it was noticed how much the strict diet increases the depressive symptoms of the patients, who often fail to participate in family get-togethers due to their limitations, a factor that also helps to decrease the quality of life (TANG E FU, 2021).

In addition, these patients' memory also suffered a decline during hemodialysis, implying greater difficulties in medication adherence, for example. Therefore, bright light must belong to the idealized treatment for the patient in this context.

## 5. CONCLUSION

Thus, the importance of including studies related to bright light becomes clearer so that this tool should be more widely used in the treatment of patients on hemodialysis, since there was a significant improvement shown by the people who were submitted to this instrument, both in the cognitive and occupational performance.

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