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# Assessment of the adequacy of copper and zinc intake in burn patients

Evaluación de la adecuación del consumo de cobre y zinc en pacientes quemados

Avaliação da adequação do consumo de cobre e zinco de pacientes queimados

## ABSTRACT

Objective: To assess the probability of adequacy of copper and zinc intake by burned patients hospitalized in Fortaleza, Ceará. Method: This is a prospective, descriptive, quantitative study, carried out between April and May 2017. A 24-hour food record was applied on three non-consecutive days. The declared consumption was converted into nutrient values and assessed for the likelihood of adequacy. Certificate of Presentation and Ethical Appreciation n° 60526116.9.0000.5047. Result: 21 patients hospitalized in a burn treatment center participated, 61.9% male and 38.1% female, aged 19 to 48 years. A greater distribution of the sample was identified in the range greater than 85% of probability of adequacy nutrient intake, being at this level or above 85.71% of the total population in the adequate intake of copper and 90.47% of the total population for the adequate intake of zinc. Conclusion: It was possible to identify a high prevalence of probability of adequacy of copper and zinc intake.

**DESCRIPTORS:** Burns; Copper; Food Consumption; Zinc.

## RESUMEN

Objetivo: Evaluar la probabilidad de adecuación del consumo de cobre y zinc de pacientes quemados hospitalizados en la ciudad de Fortaleza, Ceará. Método: Se trata de un estudio prospectivo, descriptivo, cuantitativo, realizado entre abril y mayo de 2017. Se aplicó un registro alimentario de 24 horas en tres días no consecutivos. El consumo declarado se convirtió en valores de nutrientes y se evaluó la probabilidad de adecuación. Certificado de Presentación y Reconocimiento Ético n° 60526116.9.0000.5047. Resultado: participaron 21 pacientes hospitalizados en un centro de tratamiento de quemados, 61,9% hombres y 38,1% mujeres, de 19 a 48 años. Se identificó una mayor distribución de la muestra en el rango por encima del 85% de probabilidad de adecuación del consumo observado, estando en este nivel o por encima del 85,71% de la población total en el consumo adecuado de cobre y el 90,47% de la población total para el consumo adecuado de zinc. Conclusión: fue posible identificar una alta prevalencia de probabilidad de adecuación del consumo de cobre y zinc.

**DESCRIPTORES:** Cobre; Consumo de alimentos, Quemaduras; Zinc.

## RESUMO

Objetivo: Avaliar a probabilidade de adequação do consumo alimentar de cobre e zinco de pacientes queimados hospitalizados na cidade de Fortaleza, Ceará. Método: Trata-se de um estudo prospectivo, descritivo, quantitativo, realizado entre abril e maio de 2017. Foi aplicado recordatório alimentar de 24 horas em três dias não consecutivos. O consumo declarado foi convertido em valores de nutrientes e avaliado quanto à probabilidade de adequação. Certificado de Apresentação de Apreciação Ética n° 60526116.9.0000.5047. Resultado: Participaram 21 pacientes hospitalizados em um centro de tratamento de queimados, sendo 61,9% do sexo masculino e 38,1% do sexo feminino, com faixa etária de 19 a 48 anos. Identificou-se maior distribuição da amostra na faixa superior a 85% de probabilidade de adequação do consumo observado, estando nesse nível ou acima 85,71% da população total no consumo adequado de cobre e 90,47% da população total para o consumo adequado de zinco. Conclusão: Foi possível identificar alta prevalência de probabilidade de adequação do consumo de cobre e zinco.

**DESCRIPTORES:** Cobre; Consumo de Alimentos; Zinco; Queimadura.

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## INTRODUCTION

**B**urns are tissue injuries resulting from exposure to agents of thermal, chemical, electrical, mechanical or radioactive origin. The action of these elements on the tissues of the human body causes injuries that culminate in partial or integral deterioration of the affected region. It is a dynamic trauma associated with a sequence of responses, which start immediately and can reach all organs, cause local and systemic reactions, and dysfunctions according to the severity of the injury.<sup>1,2</sup>

It is a predominant trauma in adults (52,45%), with a prevalence of males (63%). In 60,65% of cases, injuries occur accidentally, with thermal etiological agents being 63,11% the most frequent.<sup>3</sup>

The increased need for trace elements copper and zinc, nutrients needed in small quantities, in burned patients is due to physiological changes in trauma and the loss of skin integrity, a factor related to the leakage of inflammatory cutaneous exudate that compromises the reserves of copper and zinc.<sup>4,5</sup>

The use of trace elements copper and zinc in the diet is a therapeutic resource highly recommended for the prevention of classic clinical complications of burns, and is justified by the probability of developing nutritional deficiencies related to injuries and hospitalization. Nutritional therapy specializing in copper and zinc can promote organic replacement and restore serum levels of these trace elements, and should be administered early after trauma. The doses and route of administration of these components of the diet are constantly reviewed, with a focus on observing the joint action of copper and zinc in biological processes, a mutual antagonism relationship, understanding the effects of supplementation and risks, and the interaction between other nutrients offered.<sup>6,7,8,9</sup>

Studies and advances in treatment methods for faster recovery from injuries, better aesthetic and functional results, require that there is a constant

update on the management of burn patients.<sup>10,11</sup>

Quantitative assessment of food consumption using data from dietary surveys is an indirect method for observing an individual's nutritional intake. Although it does not provide a health diagnosis in isolation, evaluations of this nature are important for the elaboration and evaluation of dietary and supplementation plans, the development of strategies with a greater chance of adherence on the part of the populations, and may indicate the probability of nutrient intake is adequate to favor the maintenance or recovery of the health of a population.<sup>12,13</sup>

Knowing that burn is an important depleting pathology, and considering the importance and evidence on specialized nutritional therapy for the prevention of clinical complications, and improving the prognosis of burned patients, the present study seeks to assess the adequacy of food consumption of the elements copper and zinc in burned patients.

## METHOD

This is a prospective, descriptive, quantitative study, with an inclusion criterion delimited in addressing subjects of both genders aged between 19 and 50 years old, affected by burns of any origin, hospitalized in Plastic Surgery Units of a Nursing Center. Burn Treatment in Fortaleza, Ceará.

Pregnant and lactating patients, consuming enteral and parenteral diets, amputated and with cognitive impairment were excluded for the purpose of this study.

The screening of subjects for the research took place by consulting the occupational census and medical records of the Burns Treatment Center. For the identification, inclusion or exclusion of individuals, in this set of documents the variables age, sex, and cognitive deficit status were verified. After this stage, the approach of patients in bed was initiated, in which after presentation of the research of the Free and Informed Consent

Term and acceptance of the invitation for voluntary participation, a data collection form consisting of fields for identification and history was applied. of the patient, history of trauma, and characteristics of the diet consumed.

A 24-hour food record was applied on three non-consecutive days for each participant, and the portions ingested reported in a homemade measure were converted into grams according to the Table for Evaluation of Food Consumption in Homemade Measures.<sup>14</sup> The gram quantity obtained was converted into nutrient values with the help of the Brazilian Food Composition Table.<sup>15</sup> The copper and zinc consumption data were cut out, the simple arithmetic mean of the individual daily intake of the selected nutrients was calculated, and the average values obtained for copper and zinc were applied in a parametric method proposed by the Institute of Medicine (IOM), to calculate the probability of adequacy of the observed intake.<sup>16</sup>

The proposed method consists of an equation, " $D/DPd = (y-EAR)/DPnec + (Dpint/n)$ ", in which  $y$  is replaced by the simple individual arithmetic mean of  $n$  days of ingestion of the nutrients copper and zinc, being  $n$  corresponding to the three days of application of a food survey.<sup>16</sup> For estimated average requirement (EAR) for copper and zinc, IOM values were used<sup>17</sup>, namely, 700 $\mu$ g of copper for both sexes, 6,8mg and 9,4mg of zinc for women and men respectively. The variance of the estimated average demand for copper and zinc ( $Vnec$ ) pre-set was 10% according to IOM.<sup>16</sup> Copper intrapersonal variance ( $Vint$ ) values provided by IOM were used 16, the values being 0,6 for women and 0,7 for men. For intrapersonal zinc variance, values provided by Marchioni were consulted 18, 5,35 for women and 6,00 for men, obtained in a study carried out with the Brazilian population. Observing the coefficient of variation (CV%) values below 70% considered adequate by IOM<sup>16</sup> for use in assessing nutrient intake.

Following a methodological model,

the results of the equation were evaluated according to the Snedecor and Cochran table 19 adapted by IOM<sup>16</sup>, for qualitative classification of the adequacy of the observed intake, and the corresponding probability of correct conclusion.

The research was conducted by a nutrition scholar under the supervision of a nutritionist, from April to May 2017, in compliance with the biosafety and access rules of the Burns Treatment Center, and in accordance with Resolution No. 466/2012 of National Health Council and complementary rules.

Registered and approved by the CEP/ CONEP system with Presentation Certificate for Ethical Appreciation number 60526116.9.0000.5047.

## RESULT

The age group of males was 19 to 41 years old, and females were 22 to 48 years old. Injury agents of the electrical type had a higher percentage of occurrence and were related to the classification of patients with multiple trauma. However, the sum of the harmful agents of the

thermal type reached a higher percentage (61,90%) than the electrical type in the total population.

Although injuries in the domestic environment stood out in the total population, accidents in the workplace were greater in men. It is also observed that the majority of men had a low level of education.

Assessing copper consumption (Table 2), the male gender had a higher population concentration in the D/DPd > 1.00 criterion range, which represents adequate intake with 85% probability of

TABLE 1 - Characterization of the patient and the trauma of burned individuals, aged 19 to 48 years, of both sexes, hospitalized in Fortaleza, Ceará, 2017.

VARIABLES	CLASSIFICATION	GENDER		
		Men	Women	Total population
Age	Average	61,9% (n=13)	38,1% (n=8)	100% (n=21)
Education	Elementary level	31,31 (±7,8)	37,63 (±7,73)	33,71 (±8,36)
	High School	92,31%	75%	85,71%
Burn type	Thermal	7,69%	25%	14,29%
	Electric	53,85%	75%	61,9%
Injury classification	Third degree	46,15%	25%	38,1%
	Second degree	53,85%	37,5%	47,62%
	Multiple trauma	23,08%	50%	33,33%
	Surgical wound dehiscence	0%	0%	14,29%
Etiological agent	Electricity	46,15%	25%	38,1%
	Heated liquid	15,38%	50%	28,57%
	Flammable liquid and explosion	23,08%	12,5%	19,05%
	Open flame	15,38%	12,5%	14,29%
Occurrence environment	Domestic	46,15%	75%	57,14%
	Labor	46,15%	25%	38,1%
	Public	7,69%	0%	4,76%

Source: Prepared by the author.

TABLE 2 - Probability of adequacy of copper consumption of burned patients aged 19 to 48 years, of both sexes, hospitalized in Fortaleza, Ceará, 2017.

D/DPd Criterion	Classification	Probability of correct conclusion	GENDER		
			Men	Women	Total population
>2,00	Adequate Intake	98%	15,38%	87,5%	42,86%
>1,65	Adequate Intake	95%	7,69%	0%	4,76%
>1,50	Adequate Intake	93%	15,38%	0%	9,52%

>1,00	Adequate Intake	85%	46,15%	0%	28,57%
>0,50	Adequate Intake	70%	15,38%	0%	9,52%
>0,00	Adequate Intake	50%	0%	12,5%	4,76%

Source: Adapted from Snedecor and Cochran<sup>19</sup>.

TABLE 3 - Probability of adequacy of zinc consumption of burned patients aged 19 to 48 years, of both sexes, hospitalized in Fortaleza, Ceará, 2017.

D/DPd Criterion	Classification	Probability of correct conclusion	GENDER		
			Men	Women	Total population
>2,00	Adequate Intake	98%	92,31%	62,5%	80,95%
>1,50	Adequate Intake	93%	0%	12,5%	4,76%
>1,00	Adequate Intake	85%	0%	12,5%	4,76%
>0,50	Adequate Intake	70%	7,69%	12,5%	9,52%

Source: Adapted from Snedecor and Cochran<sup>19</sup>.

correct conclusion, while most individuals in the female gender was classified in the criterion D/DPd > 2,00, which represents adequate intake with 98% probability of correct conclusion. It is also noteworthy in relation to women, the occurrence of 12,5% (n=1) of observed intake classified in 50% probability of correct conclusion on adequacy, related to copper consumption below the recommended dietary allowance (RDA) of this nutrient, however with consumption above the estimated average requirement (EAR). The analysis of the total population showed that the criteria D/DPd > 2,00 and > 1,00 group the highest percentages of individuals.

In relation to the assessment of zinc consumption (Table 3), the highest population concentration was observed in the classification of criterion D/DPd >

2.00, being for this criterion, 98% probability for correct conclusion on adequate intake.

By consolidating the information contained in tables 2 and 3, where the quantitative and qualitative classification criteria and the distribution by gender and total population are exposed, it is possible to identify through the criteria D/DPd > 1,00 to > 2,00, the majority of individuals in qualitative adequacy classification, with corresponding probability greater than 85%, being at that level or above, the percentage of 85,71% of the total population regarding adequate consumption related to copper and 90,47% of the total population for consumption suitable for zinc.

Based on table 4, the most important findings are related to the average intake of copper, 2,38 ( $\pm$  0,69), and zinc,

19,29 ( $\pm$  3,55), of women classified in the age range. 98% probability of correct conclusion about adequate intake, while for men, the intake values classified in the range of 85% probability of adequacy for copper, corresponding to 1,22mg ( $\pm$  0,06), and 98% probability of adequacy for zinc, 22,54mg ( $\pm$  4,37) of average intake.

No participating individual had consumption averages below the estimated average requirement (EAR) or higher than the upper tolerable upper intake level (UL) of copper or zinc (Table 4). It is also noteworthy that the consumption of copper and zinc was above the recommended dietary allowance (RDA) in all males, and in women, with only one exception regarding the consumption of copper below the recommended dietary allowance (RDA).<sup>17</sup>

TABLE 4 – Average values of copper and zinc intake according to the level of probability of adequacy in burned patients according to gender, 2017.

	PROBABILITY OF ADEQUACY BY GENDER AND NUTRIENT									
	Women					Men				
	50%	70%	85%	95%	98%	70%	85%	93%	95%	98%
	N=1	N=1	N=0	N=0	N=6	N=2	N=6	N=2	N=1	N=2
Copper (mg)	0,86	1,54	0	0	2,38 ( $\pm$ 0,69)	1,00 ( $\pm$ 0,4)	1,22 ( $\pm$ 0,06)	1,32 ( $\pm$ 0,01)	1,43	1,88 ( $\pm$ 0,04)
	N=0	N=1	N=1	N=1	N=5	N=1	N=0	N=0	N=0	N=12
Zinc (mg)	0	9,91	11,31	13,51	19,29 ( $\pm$ 3,55)	12,84	0	0	0	22,54 ( $\pm$ 4,37)

Source: Adapted from Snedecor and Cochran<sup>19</sup>.

## DISCUSSION

The predominant characteristics of patients and trauma observed in this study regarding the prevalence of third-degree burns, thermal etiologic agent and the male sex as the largest portion of burn victims, present values similar to those observed in other publications.<sup>3,20</sup>

The low level of education identified in the total population is observed in other studies of the burned population. This factor raises the question of how this characteristic can condition or determine the type of bond, whether formal or informal work to which the individual is inserted, the perception of the use and availability of adequate equipment in risk environments for burns, and exposure to precarious social and work conditions, factors referenced in relation to occupational traumas.<sup>21,22,23</sup>

Although injuries in the total population stood out in the total population, injuries in the workplace were significant in males. According to the Labor Health and Safety Observatory of the Public Ministry of Labor, between 2012 and 2018, 119.046 occupational accidents and more than 309 deaths in the workplace related to burns, scalding and chemical burns were reported.<sup>24</sup>

The recommendations for zinc intake for the burned population indicated in the literature can reach values of up to 50mg and 4mg for copper daily, values considered safe and that promoted an increase in immune cells and a reduction in inflammatory mediators.<sup>25,26,27</sup> These con-

sumption values were not observed in the sample of the present study.

A survey on food consumption of 25 burned patients hospitalized in the Northern region of Brazil, identified an average daily consumption of zinc of 30,20 mg. The consumption of these nutrients was classified as below the recommended according to the references used in production.<sup>28</sup> The divergence of conclusions in relation to the present study is due to the use of different methodological paths.

## In a study that compared the consumption of copper, zinc and other micronutrients to the recommended dietary intake (RDA)

In the case of the present study, which found lower values of copper and zinc food consumption, the variation between

the surveys may be related to the characteristics of the eating habits of populations in different regions.<sup>29</sup>

In a study that compared the consumption of copper, zinc and other micronutrients to the recommended dietary intake (RDA), it was found that 52,5% and 12,5% of the individuals had an inadequate consumption of zinc and copper. Positive results were observed in wound healing in patients with adequate consumption of vitamins A and E and Zinc, lesser notification of infections among patients with adequate amounts of vitamins A and C and Zinc, but similar results were not observed in patients with adequacy of vitamin E, copper and selenium consumption.<sup>30</sup>

In general, the proper administration of trace elements in the management of burn patients is recognized as a therapeutic resource with positive clinical effects, however, further research is still necessary in order to determine safe reference values for ingestion of trace elements in burns in different life cycles.<sup>31,32,33</sup>

## CONCLUSION

It was possible to identify a high prevalence of probability of adequacy of the observed intake. However, it is suggested that the values obtained through the assessment of the probability of adequacy performed, be associated with other predictive methods for assessing individuals and populations, mainly for use in clinical practice, where individualized assessment is imperative for diagnoses and treatments. ■

## REFERENCES

1. Piccolo NS, Serra MCVF, Leonardi DF, Lima Jr EM, Novaes FN, Correa MD, et al. Queimaduras: Diagnóstico e Tratamento Inicial. Sociedade Brasileira de Cirurgia Plástica - Projeto Diretriz. Associação Médica Brasileira e Conselho Federal de Medicina. 2008;1-14. [Acesso: 24 Jun2014]. Disponível em: [http://www.projetodiretrizes.org.br/projeto\\_diretrizes/083.pdf](http://www.projetodiretrizes.org.br/projeto_diretrizes/083.pdf)
2. Serra MCVF, Gomes DR, Crisostomo MR. Fisiologia e fisiopatologia. In: Lima Junior EM, ed. Tratado de queimaduras: Sao Paulo: Atheneu; 2004. p.37-42.
3. Luz SSA, Rodrigues JE. Perfis epidemiológicos e clínicos dos pacientes atendidos no centro de tratamento de queimados em Alagoas. Rev Bras Queimaduras 2014;13(4):245-250
4. Berger MM, Cavadini C, Bart A, Mansourian R, Guinchard S, Bartholdi I et al. Cutaneous copper and zinc losses in burns. Burns 1992; 18: 373-380
5. Berger MM, Cavadini C, Chiolo R, Dirren H. Copper, selenium, and zinc status and balances after major trauma. J Trauma 1996; 40: 103-109.

## REFERENCES

6. Al-Jawad FH, Sahib AS, Al-Kaisy AA. Role of antioxidants in the treatment of burn lesions. *Ann Burns Fire Disasters* [Internet]. 2008 Dec 31;21(4):186–91. Available from: <https://pubmed.ncbi.nlm.nih.gov/21991135>
7. Berger MM, Cavadini C, Chioloro R, Guinchard S, Krupp S, Dirren H. Influence of large intakes of trace elements on recovery after major burns. *Nutrition*. 1994;10(4):327–34.
8. Cozzolino SMF. Biodisponibilidade de nutrientes. Editora Manole; 2005.
9. Pochon JP. Zinc-and copper-replacement therapy--a must in burns and scalds in children? *Prog Pediatr Surg*. 1981;14:151.
10. Alves APNN, Verde MEQL, Ferreira Júnior AEC, Silva PGB, Feitosa VP, Lima Júnior EM, et al. Avaliação microscópica, estudo histoquímico e análise de propriedades tensiométricas da pele de tilápia do Nilo. *Rev Bras Queimaduras* 2015;14(3):203-210
11. Ferreira MC, Paggiaro AO, Isaac C, Teixeira Neto N, Santos GB dos. Substitutos cutâneos: conceitos atuais e proposta de classificação. *Rev Bras Cir Plástica*. 2011;26(4):696–702.
12. Cavalcante AAM, Priore SE, Franceschini S do CC. Estudos de consumo alimentar: aspectos metodológicos gerais e o seu emprego na avaliação de crianças e adolescentes. *Rev Bras Saúde Matern Infant*. 2004;4(3):229–40.
13. Organização Mundial de Saúde. Elementos traço na nutrição e saúde humana. São Paulo: Roca; 1998. p.63-91.
14. Pinheiro A BV, Lacerda EMDA, Benzecry EH, Gomes MCDS, Costa VMD. Tabela para Avaliação de Consumo Alimentar em Medidas Caseiras. 5. ed. São Paulo: Atheneu, 2008.
15. Núcleo de Estudos e Pesquisas em Alimentação. Universidade Estadual de Campinas (UNICAMP). Tabela Brasileira Composição dos Alimentos. 2011;4.
16. Institute of Medicine. Dietary reference intakes: applications in dietary assessment. Washington (DC): National Academy Press; 2000.
17. Institute of Medicine, Food and Nutrition Board. Dietary reference intakes for vitamin A, vitamin K, arsenic, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium, and zinc: a report of the panel on micronutrients, Subcommittees on Upper Reference Levels of Nutrients and of Interpretation and Uses of Dietary Reference Intakes, and the Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. Washington (DC): National Academy Press; 2001.
18. Marchioni DML, Verly Junior E, Cesar CLG, Fisberg RM. Avaliação da adequação da ingestão de nutrientes na prática clínica. *Rev Nutr*. 2011;24(6):825–32.
19. Snedecor GW, Cochran WG. 1980. *Statistical Methods*, 7th edition. Ames, Iowa: Iowa State University Press.
20. Silva JAC, Lima AVM, Borborema CLP, Cunha LM, Martins MM, Pantoja MS. Perfil dos pacientes queimados atendidos em um centro de referência na região metropolitana de Belém do Pará. *Rev Bras Queimaduras* 2016;15(3):153-157
21. Martins CL, Jacondino MB, Antonioli L, Braz DL, Bazzan JS, Guanilo MEE. Equipamentos de proteção individual na perspectiva de trabalhadores que sofreram queimaduras no trabalho. *Rev Enferm da UFSM*. 2013;3:668–78.
22. Gawryszewski VP, Bernal RTI, Silva NN da, Morais Neto OL de, Silva MMA da, Mascarenhas MDM, et al. Atendimentos decorrentes de queimaduras em serviços públicos de emergência no Brasil, 2009. *Cad Saude Publica*. 2012;28:629–40.
23. Franco T, Druck G, Seligmann-Silva E. As novas relações de trabalho, o desgaste mental do trabalhador e os transtornos mentais no trabalho precarizado. *Rev Bras saúde Ocup*. 2010;35(122):229–48.
24. MINISTÉRIO PÚBLICO DO TRABALHO [observatoriosst.mpt.mp.br]. MINISTÉRIO PÚBLICO DA UNIÃO. Observatório Digital de Saúde e Segurança no Trabalho: Smartlab de Trabalho Decente MPT - OIT. 2021 [Acesso em: 20 de janeiro de 2021]. Disponível em: [observatoriosst.mpt.mp.br](http://observatoriosst.mpt.mp.br)
25. Berger MM, Shenkin A. Trace element requirements in critically ill burned patients. *Journal of Trace Elements in Medicine and Biology*. 2007; 21 Suppl 1:44-8
26. Silva APA, Freitas BJ, Oliveira FLC, Piovacari SMF, Nóbrega FJ. Terapia nutricional em queimaduras: uma revisão . *Rev Bras Queimaduras* 2012;11(3):135-141
27. Prelack K, Sheridan RL. Micronutrient supplementation in the critically ill patient: strategies for clinical practice. *The Journal of Trauma*. 2001 Sep;51(3):601-620. DOI: 10.1097/00005373-200109000-00037.
28. Braga MS, Pantoja LD, Scerni FM, Vasconcelos FC. Análise do consumo alimentar e das alterações bioquímicas de pacientes queimados internados em hospital de referência. *Rev Bras Queimaduras* 2015;14(2):125-132
29. Araujo MC, Bezerra IN, Barbosa FS, Junger WL, Yokoo EM, Pereira RA et al. Consumo de macronutrientes e ingestão inadequada de micronutrientes em adultos. *Rev. Saúde Pública* [Internet]. 2013 Feb [citado 2021 Jan 14]; 47(Suppl 1): 177s-189s. Disponível em: [http://www.scielo.br/scielo.php?script=sci\\_arttext&pid=S0034-89102013000700004&lng=pt](http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0034-89102013000700004&lng=pt). <https://doi.org/10.1590/S0034-89102013000700004>.
30. Adjepong M, Agbenorku P, Brown P, Oduro I. The effect of dietary intake of antioxidant micronutrients on burn wound healing: a study in a tertiary health institution in a developing country. *Burn trauma*. 2015;3:1–7.
31. Adjepong M, Agbenorku P, Brown P, Oduro I. The role of antioxidant micronutrients in the rate of recovery of burn patients: a systematic review. *Burn trauma*. 2016;4:1–7.
32. Jafari P, Thomas A, Haselbach D, Watfa W, Pantet O, Michetti M, et al. Trace element intakes should be revisited in burn nutrition protocols: A cohort study. *Clin Nutr*. 2018;37(3):958–64.
33. Kurmis R, Greenwood J, Aromataris E. Trace element supplementation following severe burn injury: a systematic review and meta-analysis. *J Burn Care Res*. 2016;37(3):143–59.