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Relationship between Expenses on Nutritional Therapy and Mortality Rate in Public Hospitals in Salvador, Bahia: An Ecological Study

Relação entre os gastos com terapia nutricional e taxa de mortalidade em hospitais públicos de Salvador, Bahia: Um estudo ecológico

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Abstract

Nutritional therapy (NT) is a set of procedures that maintain or recover the nutritional status. In hospitals, there is a prevalence of 15% to 60% of cases of malnourishment. Malnutrition is related to an increase in infections, immune system dysfunction, longer hospital length of stay and higher mortality. Therefore, a multidisciplinary nutrition therapy team (MNTT) is indispensable. There are gaps regarding the impact of these procedures. The present study aims to analyze the relationship between the expenses on NT and the mortality rate in public hospitals in the city of Salvador, Bahia, Brazil. The present is an ecological study, and data were collected from the Computer Sciences Department of the Brazilian Unified Health System (DATASUS, in Portuguese), regarding the expenses on enteral nutritional therapy (ENT) and parenteral nutritional therapy (PNT) and the mortality rate in public hospitals, from January 2008 to December 2018. The analyses were developed to enable the determination of the exposure associated with the health indicator studied through the adjustment of the curves. The expenses on NT correlated with the mortality rate were represented as a geometric regression curve, revealing a negative β coefficient (-0.3648), showing an inversely proportional relationship ($p = 0.0096$). For the expenses on ENT, a geometric regression was evidenced, revealing a negative β coefficient (-1.8790), demonstrating an inversely proportional relationship ($p = 0.0034$). The expenses on PNT evidenced a logarithmic regression, revealing a negative β coefficient (-9824,7295), but with no statistical significance ($p = 0.4767$). Hospitals that do not provide NT have shown a growth tendency regarding the mortality rate. We concluded that the implementation of a MNTT in public hospitals seems to reduce the mortality rate in the hospital.

Keywords
- nutrition therapy
- health expenses
- public hospitals
- mortality

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Resumo

A terapia nutricional (TN) é um conjunto de procedimentos que mantém ou recupera o estado nutricional. Nos hospitais, há prevalência de 15 a 60% de desnutridos. A desnutrição está relacionada ao aumento de infecções, disfunção do sistema imunológico, maior permanência hospitalar e mortalidade. Por isso, uma equipe multidisciplinar de terapia nutricional (EMTN) é indispensável. Existem ainda lacunas em relação ao impacto desses procedimentos. Este estudo tem como objetivo analisar a relação entre os gastos com TN e a taxa de mortalidade em hospitais públicos de Salvador, Bahia, Brasil. Trata-se de um estudo ecológico e os dados foram coletados do Departamento de Informática do Sistema Único de Saúde (DATASUS), referente às despesas com Terapia Nutricional Enteral (TNE) e Parenteral (TNP) e à taxa de mortalidade dos hospitais públicos, de janeiro de 2008 a dezembro de 2018. As análises foram desenvolvidas para permitir a determinação da exposição associada ao indicador de saúde estudado por meio do ajustamento de curvas. O gasto com TN correlacionado com a taxa de mortalidade foi representado como uma curva de regressão geométrica, revelando um coeficiente β negativo (−0,3648), mostrando uma relação inversamente proporcional ($p = 0,0096$). Para o gasto com TNE, foi evidenciada uma regressão geométrica, revelando um coeficiente β negativo (−1,8790), demonstrando uma relação inversamente proporcional ($p = 0,0034$). Os gastos com TNP evidenciaram uma regressão logarítmica, revelando um coeficiente β negativo (−9824.7295), mas sem significância estatística ($p = 0,4767$). Os hospitais não habilitados para realização de TN mostraram uma tendência de crescimento da taxa de mortalidade. Concluiu-se que a implantação da EMTN em hospitais públicos parece reduzir a taxa de mortalidade hospitalar.

Palavras-chave

- terapia nutricional
- gastos em saúde
- hospitais públicos
- mortalidade

Introduction

Nutritional therapy (NT) can be understood as a set of therapeutic procedures that aim to maintain or recover the patient's nutritional status through enteral or parenteral nutrition.[1] This therapy is chosen according to individual conditions, such as integrity of the gastrointestinal tract, psychological status, symptoms, and nutritional or clinical status.[2] Nutritional screening tools should be used to identify and track needs, which can reveal nutritional risks or, in some cases, malnutrition itself.[3]

In the hospital population, there is a prevalence of $\sim$ 15% to 60% of malnourishment.[4] However, in many health institutions, there is still an inefficiency to recognize and treat patients in this condition,[5] who end up having unfavorable outcomes. This delay in diagnosis leads to intense depletion of macro and micronutrients in these individuals.[6]

Malnutrition is directly related to an increased incidence of infections and postoperative complications,[3] immune system dysfunction, elevated production of free radicals,[6] longer hospital length of stay, and higher mortality. These consequences have proportional repercussions on increased medical and hospital costs, representing an increment of 19% to 29%.[7]

In this scenario, the presence of the clinical nutrition physician and a multidisciplinary team is indispensable, especially for the malnourished patient. These professionals could easily identify individuals at nutritional risk and treat them according to their needs.[8] In addition, they can institute NT earlier,[3] starting whenever possible by the most physiological route.[9] Besides, a multidisciplinary nutritional therapy team (MNTT) may provide permanent education for other health professionals regarding the prevention and treatment of patients with malnutrition.[10]

For this purpose, in Brazil, the government issued ordinance number 131, on March 8th, 2005, which instituted high-complexity NT hospital units. This ordinance also determined some criteria for the accreditation of these institutions regarding the proper performance of the NT procedures.[11]

Despite the notorious importance of NT, there are still some gaps regarding the impact that these procedures and their costs may have on the most diverse outcomes of patient care. There are also scarce data that contribute for public funding managers to choose to implement an MNTT in their hospitals.[7] Thus, the present study aims to analyze the relationship between the expenses on NT and the mortality outcome in public hospitals in the city of Salvador, Bahia, Brazil.

Methods

The present is an ecological study. Data were collected in October 2019 from the Hospital Information System (SIH, in Portuguese) of the Computer Sciences Department of the Brazilian Unified Health System (DATASUS, in Portuguese) regarding expenses on enteral nutritional therapy (ENT) and parenteral nutritional therapy (PNT) and the mortality rate of public hospitals in Salvador, Bahia, from January 2008 to December 2018. We included the data from health facilities

whose information on NT costs and mortality rate were available for the established period. Hospitals that had incomplete data published in the SIH/SUS were excluded.

The hospitals that had information about the NT-related transfer of funds from the Brazilian Federal Government were grouped as "NT-enabled hospitals." Those that did not have these data were classified as "non-NT-enabled hospitals."

An epidemiological analysis was developed according to an evolutionary process, in stages, to enable the determination of the exposure associated with the health indicator studied. This process subsequently involved the following activities: 1) descriptive analysis of the indicator for hospitals that were grouped together; 2) adjustment of curves to determine the correct type of regression analysis between the expense of the total resources for NT, as well as the expenses stratified by type of procedure (enteral or parenteral) versus the epidemiological indicator "mortality rate," "one by one," to evaluate the relationship between this epidemiological indicator (dependent variable) and the cost of the NT (independent variable). A significance level of 5% was adopted.

No ethics committee approval was needed for the present study, because the data used was obtained from a public-use dataset.

For the data analysis, we used the statistical package BioEstat 5.3, Instituto Bioestatístico de Ciência e Tecnologia, Belém, Pará, Brazil.

Results

Through the collection of data available in the SIH, nine hospitals in Salvador received funding for NT. We excluded those units that had incomplete information. The collected data are summarized in ►**Table 1**.

With the data collected, when processing the adjustment of the curves and the regression analysis for the expenses with NT in the qualified hospitals correlated with the indicator "mortality rate," a geometric regression curve was presented, revealing a negative β coefficient (-0.3648), showing an inversely proportional relationship ($p = 0.0096$). Thus, as the expenses with the NT procedures in these units increase, the mortality rate decreases (►**Fig. 1**).

For the specific expenses with ENT in these hospitals in relation to the indicator "mortality rate," a geometric regression was again evidenced, also revealing a negative β coefficient (-1.8790), demonstrating an inversely proportional relationship between the variables ($p = 0.0034$). Therefore, as the amount of enteral nutrition in these units increases, the mortality rate decreases (►**Fig. 2**).

On the other hand, the specific expenses on PNT in the qualified hospitals correlated with the indicator "mortality rate" evidenced a tendency towards a logarithmic regression,

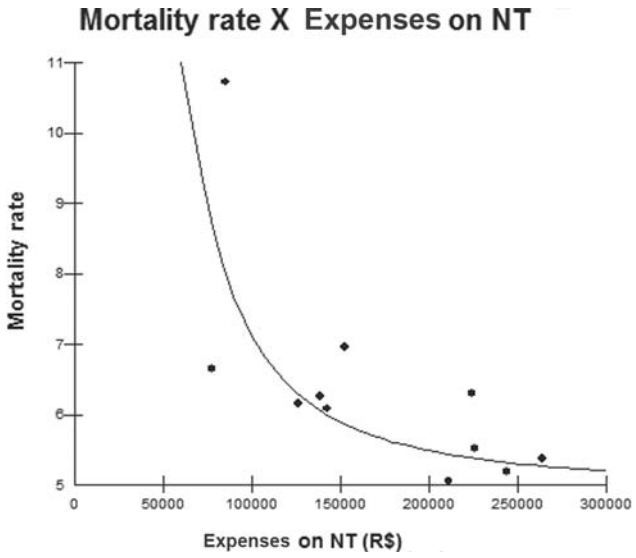

Fig. 1 Geometric regression regarding the expenses on NT in qualified hospitals and the mortality rate in these units in Salvador, Bahia.

Table 1 Summary of the data collected in the Hospital Information System of the Brazilian Unified Health Service (SIH/SUS, in Portuguese)

	Expenses of NT-enabled hospitals (R$)			Mortality rate (n/1000)	
Year	Total	Enteral	Parenteral	NT-enabled hospitals	Non-NT -enabled hospitals
2008	85,453.13	52,993.13	32,460.00	10.73	6.95
2009	167,555.36	118,722.86	48,832.50	6.96	2.95
2010	77,735.63	57,920.63	19,815.00	6.65	3.05
2011	126,488.57	100,992.86	25,495.71	6.15	2.83
2012	138,923.57	107,633.57	31,290.00	6.26	2.98
2013	142,674.38	111,440.63	31,233.75	6.08	5.15
2014	224,356.88	182,641.88	41,715.00	6.30	5.16
2015	225,993.75	186,300.00	39,693.75	5.51	5.58
2016	244,057.50	200,793.75	43,263.75	5.19	6.08
2017	264,033.75	224,265.00	39,768.75	5.37	5.07
2018	211,390.71	172,506.43	38,884.29	5.05	4.79

Abbreviation: NT, nutritional therapy.

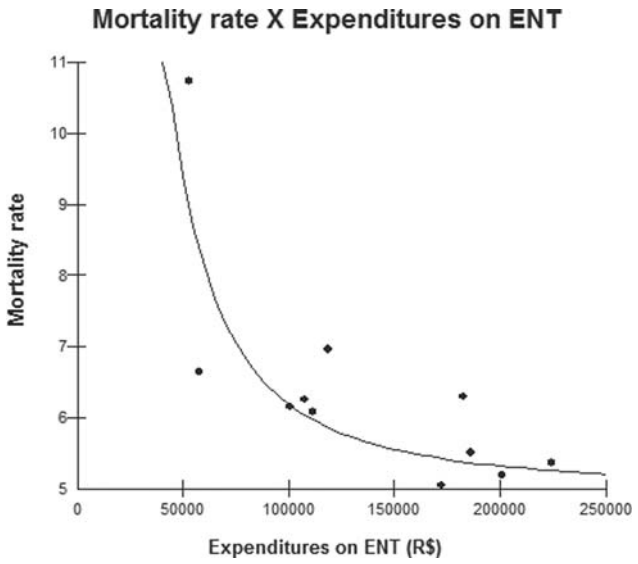

Fig. 2 Geometric regression regarding the expenses on ENT in qualified hospitals and the mortality rate in these units in Salvador, Bahia.

also revealing a negative β coefficient (-9824,7295). Despite the inversely proportional relationship between the variables, there was no statistical significance ($p = 0.4767$). The curve is represented in ►**Fig. 3**.

►**Figire 4** shows the graphs the total expenses on NT, as well as the expenses on ENT and PNT, from 2008 to 2018 correlated with the decreasing mortality-rate curve in the qualified hospitals during the same period. We observed that, over the years, the expenses on NT grew, while the mortality rate decreased.

Analyzing the mortality-rate curve over the period studied, unlike what happens in the NT-enabled hospitals, non-NT-enabled hospitals have shown a growth tendency of this variable. ►**Figure 5** demonstrates the difference between the mortality rate curves from 2008 to 2018.

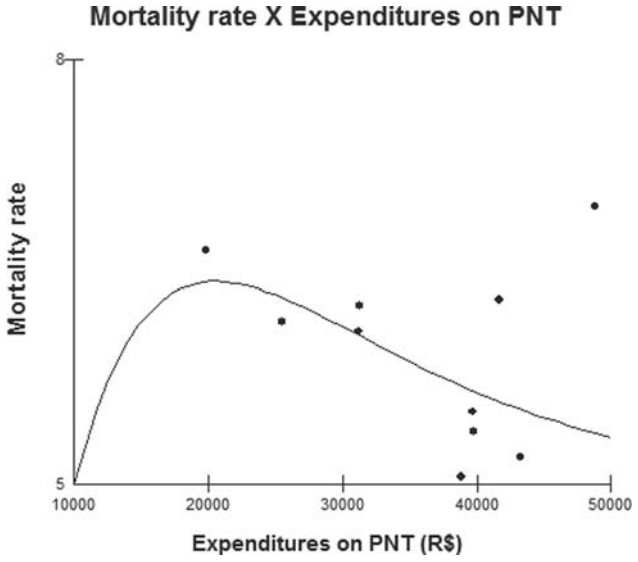

Fig. 3 Logarithmic regression regarding the expenses on PNT in qualified hospitals and the mortality rate in these units in Salvador, Bahia.

Discussion

Considering that malnutrition is a frequent condition in the hospital environment and that it results in debilitating consequences to the patient, its contribution to the increase in hospital costs is undeniable. This is due to the higher drug costs, the longer hospital length of stay, the greater patient dependence, and the greater clinical complications.[12]

A study[13] conducted at a university hospital in Singapore compared data on length of stay, readmission and mortality within three years of discharge among patients. Those who were malnourished had worse outcomes, regardless of characteristics such as gender, age and race. On the other hand, the costs of the hospitalization of these patients were three times higher than the expenses of the nursing members.[13] In the present study, a similar situation could be evidenced. The results demonstrate that, as the expenses on NT increase, there is a tendency towards a decrease in the mortality rate, regardless of the type of therapy instituted.

Since the 1980s, MNTTs have been considered the gold standard for the nutritional care of patients. These teams optimize the efficacy and safety of the NT, improve the patients' clinical condition, and reduce hospital expenses compared with individual caregivers.[14] A study[15] conducted at a hospital in Pennsylvania analyzed 136 patients who received enteral nutritional support for at least 24 hours. These individuals were randomized into two groups, one accompanied by a nutritional support team, and the other, not. The results revealed that in the first group there was a 23% reduction in mortality.[15] That seems to be the scenario found in the present work as well. The hospitals that receive government funding for NT are those that have MNTTs. Thus, the results found show that the presence of this team and the expenses on nutritional procedures suggest that there is a significant reduction in the mortality rates of the patients assisted.

Another research,[16] performed at a hospital in Spain, analyzed diagnoses and nutritional procedures, observing malnutrition related to disease. The authors concluded that hiring specialists for the care of patients who needed NT was cost-effective. In addition, the researchers identified that economic losses could reach 10% of the total care cost for patients when the nutritional needs were not well corrected.[16] Despite this evidence, to reduce costs, in recent years there has been a decline in the number of MNTTs in the world (65% of hospitals in 1995 to 42% in 2008). This reveals a contradiction, even though the beneficial results of the team's presence in the hospital environment is already well known.[14]

Analyzing the state of São Paulo, Brazil, in 1997, 20% of the hospitals had MNTTs. In 2008, that number doubled. Still, the numbers remain unsatisfactory if we consider what is necessary and established by Brazilian law. Moreover, most of these teams are concentrated in medium and large private hospitals, not reaching the same proportion in public hospitals.[17]

To show the cost-benefit ratio of NT, a research[18] involving 19 hospitals showed that quality care in this field with the

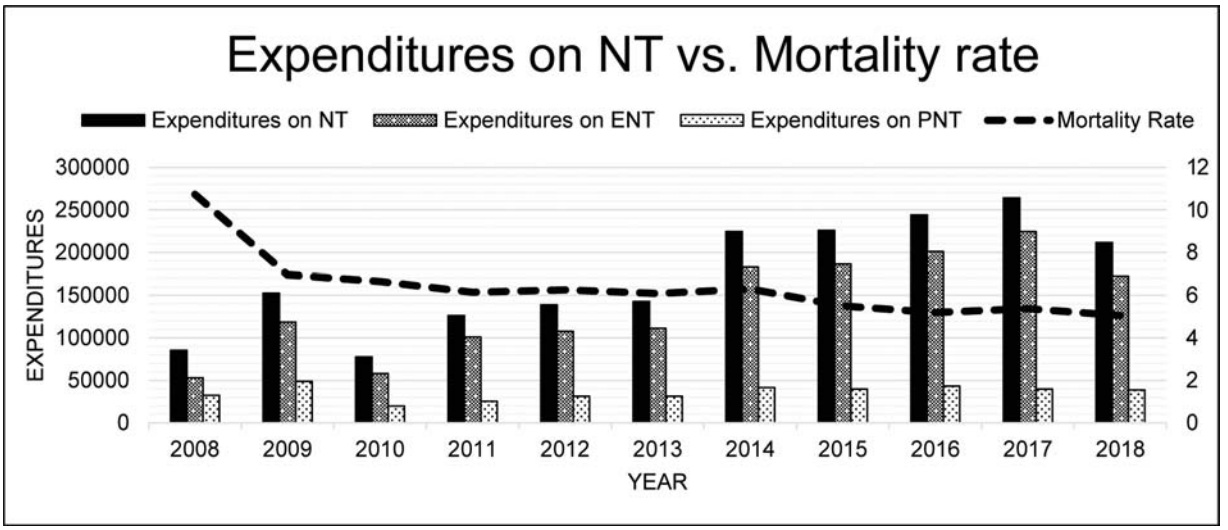

Fig. 4 Graph of NT expenses over the years related to the mortality rate curve of the NT-enabled hospitals in Salvador, Bahia.

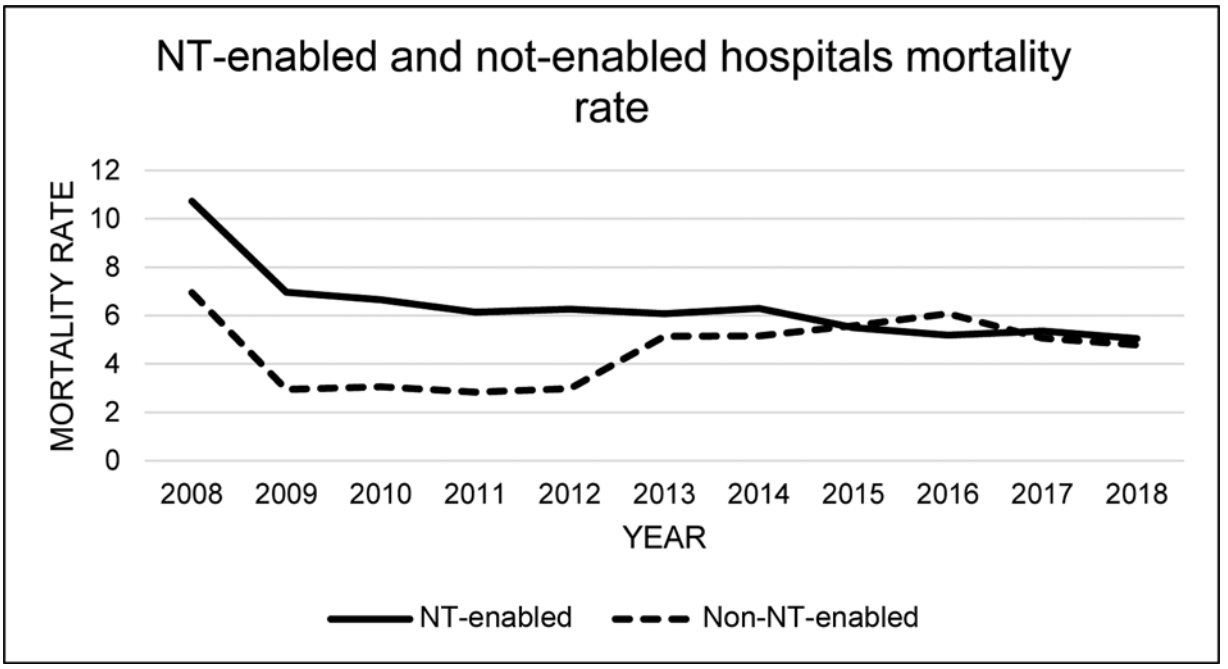

Fig. 5 Mortality rate curves for the NT-enabled and non-NT-enabled hospitals in Salvador, Bahia.

rational use of specialized nutritional products could reduce the costs by US$ 1,064.00 per patient in a health facility.[18] Another study[17] showed that if all malnourished patients (around 50% of all hospitalized patients) were assisted with NT, there would be a 300% increase in the costs. However, the overall health costs would not increase, considering the shorter length of hospital stay of these patients. Thus, for every dollar invested in NT, US$ 4.00 could be saved in the total health costs.[17] This explains the potential good cost-benefit ratio of such procedures.

The analysis of the cost-effectiveness is not only related to monetary issues; it is primarily about avoiding cases of disease, preventing mortality, providing better quality of life etc. And both relationships bring a positive balance to the implementation of NT.[19]

A systematic review conducted by Cangelosi et al[20] demonstrated that ENT would be able to reduce the risk of potentially fatal infections by 42%, thereby reducing mortality by 30%.[20] This information corroborates the data obtained in the present study, since it reveals that the cost of NT, especially of ENT, seems to be inversely proportional to the mortality rate in hospitals.

It is understood that the best route for nutrition is the oral route, because it is the most physiological. If this is not possible, ENT should be chosen, because it is more economical and has a lower risk of complications. That is the reason why the highest NT costs are related to the enteral-route nutrition. This is supported by a study that analyzed health insurance hospital invoices in southern Brazil.[7] The present work was also able to verify that in public hospitals

capable of performing NT, ENT represents the greatest expenses.

It is important to point out that not only the nutritional condition of the patient determines the mortality rate, but also the length of hospitalization and other factors such as the clinical profile, the procedures offered in the hospital environment, the availability of specialties and the complexity of the site.[7] In the present study, it was not possible to stratify, isolate or correlate other factors influencing the mortality rate in the hospitals studied, which is a bias. The main limitation of the present study was the impossibility of analyzing other information about the individuals who used NT, since in the DATASUS there is only data on the amount of money spent on this procedure.

Finally, we concluded that the implementation of an MNTT in public hospitals seems to be of paramount importance. Whether due to the possibility of reducing the mortality rates in hospitals, which was evidenced in the present study, or by the possible good cost-benefit ratio reported by other studies, the increase in NT expenses, when well applied, is justified.

Conflict of Interests

The authors have no conflict of interests to declare.

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