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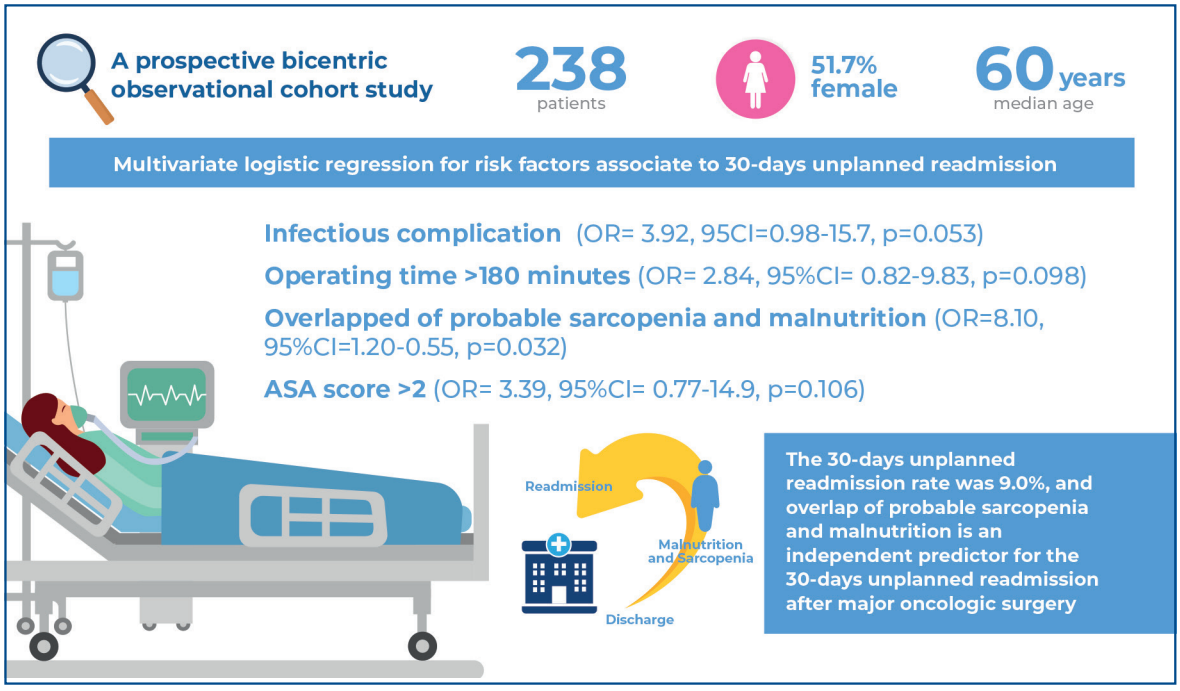
ORIGINAL ARTICLE

The 30-day readmission rate of patients with an overlap of probable sarcopenia and malnutrition undergoing major oncological surgery



Authors

Hadassa Hillary Novaes Pereira Rodrigues, Kathyelli Thaynara Pimenta de Araujo, José Eduardo de Aguilar-Nascimento, Diana Borges Dock-Nascimento

Correspondence

E-mail: dianadock@hotmail.com

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In Brief

Overlapping sarcopenia and malnutrition may increase the risk of readmission in surgical oncology. Overlapping probable sarcopenia/malnutrition was found in 4.6% of 238 patients and the 30-day unplanned readmission rate was 9.0%. In multivariate analysis, the overlap of probable sarcopenia and malnutrition was a significant predictor for the 30-day unplanned readmission (OR= 8.10, 95%CI= 1.20–0.55; p=0.032).

Highlights

- Probable sarcopenia plus malnutrition was significantly associated with unplanned readmission.
- Overlap of probable sarcopenia and malnutrition was an independent risk factor for readmission.
- Certification of whether the patient is malnourished and/or sarcopenic preoperatively is necessary.
- SARC-F and subjective global assessment can effectively and easily assess sarcopenia and malnutrition at admission.

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ORIGINAL ARTICLE

The 30-day readmission rate of patients with an overlap of probable sarcopenia and malnutrition undergoing major oncological surgery

Hadassa Hillary Novaes Pereira Rodrigues[1], Kathyelli Thaynara Pimenta de Araujo[1], José Eduardo de Aguilar-Nascimento[2,3], Diana Borges Dock-Nascimento[2,4]

[1] Health Sciences by the Graduate Program in Health Sciences, Universidade Federal de Mato Grosso, Cuiabá, MT, Brazil.
[2] Postgraduate Program in Health Sciences, Universidade Federal de Mato Grosso, Cuiabá, MT, Brazil.
[3] Centro Universitário de Várzea Grande, Várzea Grande, MT, Brazil.
[4] Faculdade de Nutrição, Universidade Federal de Mato Grosso, Cuiabá, MT, Brazil.

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ABSTRACT

Objective: To assess the 30-day unplanned readmission rate and its association with overlapping probable sarcopenia and malnutrition after major oncological surgery. **Methods:** A prospective bicentric observational cohort study performed with adult oncological patients undergoing major surgery. The primary outcome was unplanned readmission within 30 days after discharge and the association with probable sarcopenia and malnutrition. Nutritional status and probable sarcopenia were assessed just prior to surgery. Patients classified using subjective global assessment, as B and C were malnourished. Probable sarcopenia was defined using SARC-F (strength, assistance with walking, rise from a chair, climb stairs, falls) questionnaire ≥4 points and low HGS (handgrip strength) <27kg for males and <16kg for females. **Results:** Two hundred and thirty-eight patients (51.7% female) with a median age of 60 years were included. The 30-day readmission rate was 9.0% (n=20). Univariate analysis showed an association of malnutrition (odds ratio (OR) = 4.84; p=0.024) and probable sarcopenia (OR = 4.94; p=0.049) with 30-day readmission. Furthermore, when both conditions were present, the patient was almost nine times more likely to be readmitted (OR = 8.9; p=0.017). Multivariable logistic regression analysis showed that overlapping probable sarcopenia and malnutrition was an independent predictor of 30-day unplanned readmission (OR = 8.10, 95% confidence interval (95%CI) 1.20-0.55; p=0.032). **Conclusion:** The 30-day unplanned readmission rate was 9.0%, and the overlap of probable sarcopenia and malnutrition is an independent predictor for the 30-day unplanned readmission after major oncologic surgery.

Keywords: Sarcopenia; Malnutrition; Nutritional status; Patient readmission; Surgical oncology; Postoperative complications

INTRODUCTION

Unplanned hospital readmission is more frequent in the first three days after discharge.[1,2] Among surgical patients, the most frequent causes of unplanned readmission are postoperative complications and inadequate nutrition.[3-5] Additionally, readmissions are associated with increased in-hospital morbidity and mortality,[4] such that their reduction is an important metric of quality care.[6] In patients with cancer undergoing gastrointestinal surgery, such as colorectal and gastric cancer, the readmission rate is 7.5-16.7%.[7-9] Furthermore, patients undergoing oncology surgery usually have weight loss and skeletal muscle damage, which may result in sarcopenia and malnutrition.[10-13]

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Associate Editor:
Maria Carolina Santos Mendes
Faculdade de Ciências Médicas, Universidade Estadual de Campinas, Campinas, SP, Brazil
ORCID: https://orcid.org/0000-0002-2442-1956

Corresponding author:
Diana Borges Dock-Nascimento
Rodovia Arquiteto Helder Cândia 2755, condomínio Country casa 15 - Bairro Ribeirão do Lipa
Zip code: 78048-150 – Cuiabá, MT, Brazil
Phone: (55 65) 99972-1177
E-mail: dianadock@hotmail.com

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Recently, sarcopenia has received increasing scientific attention owing to its association with postoperative complications. Sarcopenia is a syndrome characterized by dependence, the main alteration of which is the progressive and generalized loss of function, muscle mass, and performance.[14,15] In a recent meta-analysis with patients operated on for digestive carcinoma, the sarcopenia range was 11.6-33% and sarcopenia were associated with total complications, infections and readmission.[16] This muscular condition, is commonly used as a criterion for diagnosing sarcopenia and hospital malnutrition[17-19] and can increase the risk of complications[19,20] and readmissions.[21] Sarcopenia and malnutrition, may occur within a wide range of diseases, and their presence is associated with poorer health outcomes in patients.[21] The potential for misdiagnosis is high because they share certain characteristics and overlap in some of their criteria; however, their physiopathology, etiology, and prognosis differ widely, as do the diagnostic and therapeutic approaches.[17,19] Nevertheless, both syndromes share similar etiological factors to different extents, including inflammation, hormonal changes, increased energy requirements and reduced physical activity. Owing to these similarities in etiology and definitions, the syndromes partly overlap and can be present in the same patient.[22] Further, readmissions after surgical procedures lead to increased healthcare costs worldwide.[23] By understanding the factors associated with unplanned readmission, such as sarcopenia and malnutrition, strategies can be designed to reduce costs and improve postoperative results. We hypothesized in this study that overlapping probable sarcopenia and malnutrition increases the risk of unplanned readmission.

OBJECTIVE

The aim of this study was to assess the 30-day unplanned readmission rate and its association with overlapped probable sarcopenia and malnutrition after major oncological surgery.

METHODS

This was an original prospective bicentric observational cohort study. Overall, 352 patients on the *Sistema Único de Saúde* (SUS-Brazil), with cancer who were scheduled for surgery from July 2018 to November 2020 at *Santa Casa de Misericórdia e Hospital do Câncer de Mato Grosso* (Cuiabá-MT Brazil) were potentially eligible. The study was approved by the Research Ethics Committee of *Universidade Federal de Mato Grosso* (CAAE: 89216318.8.0000.8124; #2.666.168) and written informed consent was obtained from all patients. This study was performed in accordance with the ethical standards established in the 1964 Declaration of Helsinki and its later amendments.

Inclusion and exclusion criteria

Major surgery was defined as a surgery lasting at least 2 hours.[24] Patients with non-melanoma skin cancer or advanced disease (metastatic cancer or palliative care) were excluded. Patients with missing recorded data (such as: ASA Score, age, operation description, and others) and those who had surgeries suspended or transferred before the surgery were excluded.

Variables and measurements

The primary outcome was unplanned readmission within 30 days after discharge and an association with probable sarcopenia and malnutrition. Readmission was defined as unplanned if the patient returned to the hospital within 30 days after discharge and stayed for a minimum of 48 hours. Based on the data recorded in the database, patient demographics, physiological status as defined by the American Society of Anesthesiologists (ASA Score), type of oncological surgery, operating time (minutes) post-operative length of stay (days), post-operative infection complications,[25] Clavien-Dindo (surgical complication scale)[13] classifications, and mortality were recorded. Nutritional status (subjective global assessment-SGA)[26] and probable sarcopenia were assessed just prior to surgery. Probable sarcopenia was defined using the SARC-F questionnaire as ≥4 points (strength, assistance with walking, rise from a chair, climb stairs, falls)[27] and a low handgrip strength (HGS-kg) <27kg for males and <16kg for females.[15] Sarcopenia risk was defined using the SARC-F questionnaire as ≥4 points.[28]

Statistical analysis

The Kolmogorov-Smirnov test was initially applied to determine the normality of the data. Continuous data were presented as the mean (M) and standard deviation (±SD) if they were normally distributed; otherwise, they were presented as the median (MD) and interquartile range (IQR) where appropriate. The categorical variables data are presented as number and percentage. For statistical analysis, patients classified as moderate and severely malnourished (SGA = B and C) were categorized as malnourished.[25] Student's

t-test or Mann-Whitney test was performed to compare quantitative variables. Chi-square or Fisher's exact tests were used to assess the association between the 30-day unplanned readmission and outcome-specific variables. Odds ratio (OR) was reported with 95% confidence intervals (95%CI).

Multivariate logistic regression models were constructed to explore whether or not risk factors were independently predictive of the 30-day unplanned readmission. The variables associated with $p<0.20$ in the univariate comparison were inserted into a multivariate logistic regression model (stepwise automatic model). To prevent the collinearity of data, only diagnoses of malnutrition (SGA = B and C) and overlapping probable sarcopenia and malnutrition were considered in the multivariate regression. Further, to avoid collinearity with infectious complications, the Clavien-Dindo Score was not used in the multivariate model. A $p<0.05$ indicated statistical significance. All statistical analyses were performed using the SPSS 20.0 software (SPSS Statistics; IBM, Armonk, NY, USA).

RESULTS

Initially, 352 patients were eligible. However, 14 patients with skin cancer types other than melanoma, 17 with advanced disease, 13 with missing data, and 70 with suspended surgeries were excluded. Therefore, 238 patients with a median age of 60 (49-68) years and including 123 (51.7%) females were included in the study. An overlap of probable sarcopenia and malnutrition was found in 4.6% of the patients (Table 1). The 30-day unplanned readmission rate was 9.0% (n=20). There was no difference between age (MD/IQR; Mann Whitney test) (61 [52-71] *versus* 59 [48-68] years; p=0.122); HGS (M±SD; Student *t*-test) (31.1±11.6 *versus* 31.5±11.2kg; p=0.905), and post-operative length of stay (MD/IQR; Mann Whitney test) (5 [2.5-9] *versus* 3 [2-6] days; p=0.078) between the readmitted and non-readmitted patients. Figure 1 shows the oncological operation performed.

Table 1. Demographic data and characteristics of the patients

Variables	p value
Age (years; MD/IQR)	60 (49-68)
Sex, n (%)	
Male	123 (51.7)
Female	115 (48.3)
Nutritional status, n (%)	
Nourished (SGA = A)	73 (30.7)
Moderate malnourished (SGA = B)	121 (50.8)
Severe malnourished (SGA = C)	44 (18.5)
Malnourished (SGA = B and C)	165 (69.3)
Sarcopenia risk (SARC-F ≥4 points), n (%)	44 (18.5)
Low HGS, n (%)	27 (11.4)
Probable sarcopenia, n (%)	14 (5.9)
Overlap of probable sarcopenia and malnutrition, n (%)	11 (4.6)
HGS (M ± SD;kg)	31.4±11.2
ASA Score, n (%)	
I and II	212 (91.8)
Clavien–Dindo, n (%)	
I and II	61 (25.6)
>II	26 (10.1)
Infectious complications, n (%)	36 (15.1)
Operating time (minutes; MD/IQR)	125 (90-200)
Post-operative length of stay (days; MD/IQR)	3 (2-7)
Mortality, n (%)	15 (6.3)

Data are expressed as median (MD) and interquartile range (IQR), mean (M) and standard deviation (± SD).
SGA: subjective global assessment; SARC-F: strength, assistance with walking, rise from a chair, climb stairs, falls; HGS: handgrip strength; ASA: American Society of Anesthesiologists.

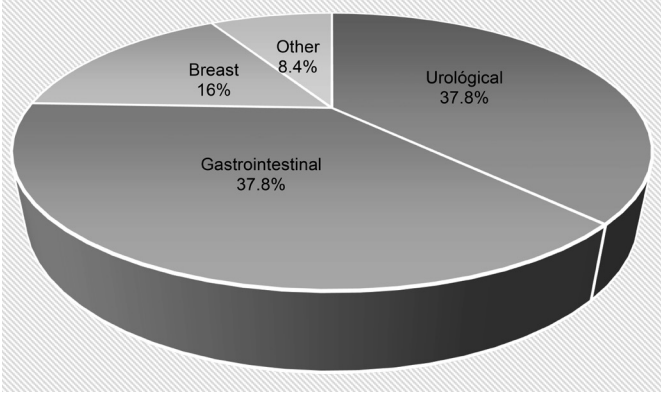

Figure 1. Oncological operations performed

Factors associated with 30-day readmission rates

A univariate analysis was performed to evaluate several parameters that may be associated with the 30-day hospital readmission. Patients with an ASA Score >2 (p=0.049), malnourished (SGA = B and C) (p=0.024), with probable sarcopenia (p=0.049), and those with both diagnoses were more likely to be readmitted within 30 days compared to those without these conditions. Further, patients with operating time >180 minutes (p=0.001), those who had postoperative Clavien-Dindo Scores >2 (p=0.015), and infection complications (p<0.001) had a greater chance of 30 day-readmission compared to that in patients without these outcomes (Table 2).

Table 2. Univariate analysis according to the experience of the 30-day unplanned readmissions

Characteristics	30-day unplanned readmission		OR 95%CI	p value
	Yes (n=20)	No (n=218)		
Female, n (%)	9 (45)	110 (54.2)	0.69 (0.27–1.74)	0.432
ASA Score >2, n (%)	4 (22.2)	14 (7.1)	3.75 (1.09–12.9)	0.049
Nutritional status, n (%)				
Nourished (SGA = A)	2 (10)	71 (32.6)	0.21 (0.05–0.92)	0.024
Moderate malnourished (SGA = B)	12 (60)	101 (49.8)	1.51 (0.59–3.9)	0.382
Severe malnourished (SGA = C)	6 (30)	31 (15.3)	2.38 (0.85–6.7)	0.091
Malnourished (SGA = B and C)	18 (90)	132 (65)	4.84 (1.09–21.5)	0.024
Sarcopenia risk (SARC-F ≥4 points), n (%)	6 (30)	34 (16.7)	2.13 (0.76–5.9)	0.141
Low HGS, n (%)	3 (15)	19 (9.4)	1.7 (0.46–6.3)	0.428
Probable sarcopenia, n (%)	3 (15)	7 (3.4)	4.9 (1.2–20.7)	0.049
Overlap of probable sarcopenia and malnutrition, n (%)	3 (15)	4 (2.0)	8.9 (1.8–42.5)	0,017
Operating time >180 minutes, n (%)	11 (64.7)	43 (25.6)	5.3 (1.85–15,3)	0.001
Clavien–Dindo Score >2	4 (20)	8 (3.9)	6.1 (1.6–22.5)	0.015
Infectious complication, n (%)	7 (35)	17(8.4)	5.9 (2.1–16.7)	<0.001

ASA: American Society of Anesthesiologists; SGA: Subjective global assessment; SARC-F: strength, assistance with walking, rise from a chair, climb stairs, falls; HGS: handgrip strength; OR: odds ratio; 95%CI: 95% confidence interval.

Multivariate models

Upon multivariate analysis, the only factor that continued to be a significant predictor of the 30-day unplanned readmission rate was an overlap of probable sarcopenia and malnutrition (OR = 8.10, 95%IC = 1.20-0.55; p=0.032) (Table 3).

Table 3. Multivariate logistic regression for risk factors associated with the 30-day unplanned readmission

Variables	OR	95%CI	p value
Infectious complication	3.92	0.98–15.7	0.053
Operating time >180 minutes	2.84	0.82–9.83	0.098
Overlap probable sarcopenia and malnutrition	8.10	1.20-0.55	0.032
ASA Score >2	3.39	0.77–14.9	0.106

OR: odds ratio; CI: confidence interval; ASA: American Society of Anesthesiologists.

DISCUSSION

Our 30-day unplanned readmission rate after surgery was 9.0%; further, patients with cancer showing a preoperative overlap of probable sarcopenia and malnutrition were 8.1 times more likely to undergo unplanned readmission within 30 days postoperatively. Therefore, the overlap of probable sarcopenia and malnutrition is an independent risk factor for the 30-day unplanned readmission postoperatively in patients with cancer. A recent study reported an unplanned readmission rate of 16.3%[27] among patients with burns who underwent surgery. This reported rate was twice the rate found in our study, and was probably attributed to the severity of burns in the patients. Furthermore, the duration of the operation, the location and type of cancer, nutritional status, and preoperative muscle mass and function, can the influence outcomes and hospital readmission rates. Another study on patients with cancer who underwent gastrectomy reported a readmission rate of 7%.[29] The most common factors included gastrointestinal complications (27.6%), surgical site infections (22.1%), and malnutrition (10.4%).[30] Our study showed that malnourished patients were almost five times more likely to be readmitted. Malnutrition is a common condition among patients with cancer[31] and the reduction in strength and muscle mass, known as sarcopenia, is a characteristic of malnutrition with a strong negative effect on prognosis.[15,17] In patients with cancer, the global loss of muscle mass can reach 39%,[32] whereas the range of malnutrition is 25-70%.[33,34] These discrepancies are attributed to the different screening and diagnostic tools used worldwide and the type of cancer, duration of operation and cancer location.[31] Therefore, this finding may justify the need to determine, whether the patient is malnourished and sarcopenic before surgery, because alteration in musculature is common in both conditions but not always overlapping. Moreover, a study reported that 31.7% of patients were malnourished and had a greater chance of readmission than that of nourished patients.[35] These results emphasize that hospitalized undernourished patients have more severe conditions and a greater chance of readmission. Furthermore, surgery is trauma and leads to losses in muscle function, mass, and performance.[13] Our results showed that patients with probable sarcopenia had a risk of readmission similar to that of malnourished patients (OR=4.94). Sarcopenia is associated with asthenia, fatigue, impaired physical performance, reduced tolerance to treatments, worsened quality of life, and reduced survival.[36] Among patients with cancer patients, the prevalence of sarcopenia is 20-70% and low muscle strength, is decisive for the increase in the postoperative readmission rate.[35] Pipek et al.[37] showed that 6.8-35.9% of patients undergoing gastrointestinal surgery were sarcopenic and had a greater chance of postoperative complications (OR=3.01 95%CI= 2.55-3.55) and the 30-day readmission (OR=2.2, 95%CI= 1.44-3.36). A major difference in our study was the assessment of readmission rates among patients with an overlap of probable sarcopenia and malnutrition. In this situation, both conditions overlapped, and the

chance of readmission was almost nine times greater (OR=8.9), indicating that the risk was almost twice as much compared to that with the isolated presence of malnutrition or probable sarcopenia. Both conditions when diagnosed in the same patient, were an independent risk factor for the 30-day readmission. Additionally, one of the main characteristics of malnutrition is the involuntary weight loss associated with loss of skeletal muscle mass and function. Therefore, an adequate assessment of musculature must be instituted in clinical practice.[17,38,39] Muscle dysfunction, reflected by decreased HGS, is a well-known consequence of malnutrition and sarcopenia[15] and a good marker of immediate postoperative complications.[13,14] Therefore, although awareness regarding the importance of hospital nutritional status began more than 40 years ago,[40] the most relevant phenotypic characteristics, such as muscle loss, comprising the criteria of sarcopenia, have become relevant only recently.[38] In this manner, during preoperative admission sarcopenia must be assessed using the SARC-F questionnaire and HGS while malnutrition should be assessed using SGA to reduce unplanned readmissions rates among oncological patients undergoing surgery.

In addition, peri-operative care to accelerate postoperative recovery as recommended using the ACERTO (*Aceleração da Recuperação Total Pós-operatória*) protocol with pre-habilitation before the operation, including immunonutrition, hypercaloric, and hyperproteic nutritional therapy combined with aerobic and resistance-based physical exercise. This preoperative protocol can improve clinical outcomes, including reduction in infection complications, length of hospital stays, and 30-day unplanned hospital readmission rates.[24,25,41] Although the present study adds interesting data to the literature, these results should be evaluated with caution owing to its limitations. Although, all patients underwent major surgery, the various locations of the primary tumor showed sample heterogeneity. This could be a limiting factor and a confounding bias for this study. Further, we could not perform a logistic regression of data related to the primary tumor location because of insufficient statistical power. Therefore, additional studies are needed to confirm the association of overlapping sarcopenia and malnutrition with 30-days unplanned readmission as an independent predictor.

CONCLUSION

The 30-day unplanned readmission rate in our study was 9.0%, and an overlap of probable sarcopenia and malnutrition was associated with the 30-day unplanned readmission after major oncologic surgery.

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AUTHORS' CONTRIBUTION

Hadassa Hillary Novaes Pereira Rodrigues: conceptualization, formal analysis, investigation, methodology, and writing - original draft. Dietitian Kathyelli Thaynara Pimenta de Araujo: conceptualization, investigation and writing - original draft. José Eduardo de Aguilar-Nascimento: conceptualization, formal analysis and writing - review & editing. Diana Borges Dock-Nascimento: conceptualization, data curation, formal analysis, methodology, project administration and writing - review & editing.

AUTHORS' INFORMATION

Rodrigues HH: http://orcid.org/0000-0002-3553-4999
Araujo KT: http://orcid.org/0009-0008-4295-1759
Aguilar-Nascimento JE: http://orcid.org/0000-0002-3583-6612
Dock-Nascimento DB: http://orcid.org/0000-0003-0205-6676

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