Overweight in Older Adults with Kidney Disease: Association with Frailty and its Domains

Excesso de Peso em Idosos com Doença Renal: Associação com Fragilidade e seus Domínios
Sobrepeso en Adultos Mayores con Enfermedad Renal: Asociación con la Fragilidad y sus Dominios

RESUMO
Objetivos: Avaliar a associação entre o excesso de peso e a fragilidade, bem como seus domínios, em idosos com doença renal crônica (DRC). **Métodos:** Estudo transversal com 65 idosos atendidos em ambulatório de nefrologia. A fragilidade foi avaliada pela Edmonton Frail Scale e a composição corporal por antropometria e bioimpedância elétrica. Dados laboratoriais foram obtidos dos prontuários. Foram realizadas associações entre IMC, fragilidade e seus domínios, ajustadas por idade e sexo. **Resultados:** A média de idade foi de 69,8, 55,4% eram homens e o IMC médio foi 32,6kg/m². A fragilidade foi observada em 58,5% dos participantes. Indivíduos com excesso de peso apresentaram menor massa muscular e maior massa gorda ($p < 0{,}01$), além de maior uso de medicamentos e menor continência urinária ($p < 0{,}05$). **Conclusão:** O excesso de peso associou-se a pior composição corporal e maior fragilidade, indicando impacto negativo na saúde funcional de idosos com DRC.
DESCRITORES: Doença Renal Crônica; Sobrepeso; Fragilidade; Pessoa idosa.

ABSTRACT
Objectives: To evaluate the association between overweight and frailty, as well as its specific domains, in older adults with chronic kidney disease (CKD). **Methods:** A cross-sectional study was conducted with 65 older adults attending a nephrology outpatient clinic. Frailty was assessed using the Edmonton Frail Scale (EFS), and body composition was measured by anthropometry and bioelectrical impedance analysis. Laboratory data were obtained from medical records. Associations between BMI, frailty, and its domains were adjusted for age and sex. **Results:** The mean age was 69.8 years, 55.4% were men, and mean BMI was 32.6 kg/m². Frailty was identified in 58.5% of participants. Overweight individuals had lower muscle mass and higher fat mass ($p < 0.01$), along with greater medication use and lower urinary continence ($p < 0.05$). **Conclusion:** Overweight was associated with poorer body composition and higher frailty, highlighting its negative impact on functional health in older adults with CKD.
DESCRIPTORS: Chronic Kidney Disease; Overweight; Frailty; Older Adults.

RESUMEN
Objetivos: Evaluar la asociación entre el sobrepeso y la fragilidad, así como sus dominios específicos, en adultos mayores con enfermedad renal crónica (ERC). **Métodos:** Estudio transversal realizado con 65 adultos mayores atendidos en un consultorio de nefrología. La fragilidad se evaluó mediante la Edmonton Frail Scale (EFS) y la composición corporal por antropometría y bioimpedancia eléctrica. Los datos de laboratorio se obtuvieron de las historias clínicas. Las asociaciones entre IMC, fragilidad y sus dominios se ajustaron por edad y sexo. **Resultados:** La edad media fue de 69,8 años, el 55,4% eran hombres y el IMC medio fue de 32,6 kg/m². La fragilidad se observó en el 58,5% de los participantes. Los individuos con sobrepeso presentaron menor masa muscular y mayor masa grasa ($p < 0{,}01$), así como mayor uso de medicamentos y menor continencia urinaria ($p < 0{,}05$). **Conclusión:** El sobrepeso se asoció con peor composición corporal y mayor fragilidad, evidenciando su impacto negativo en la salud funcional de los adultos mayores con ERC.
DESCRIPTORES: Enfermedad Renal Crónica; Sobrepeso; Fragilidad; Adultos Mayores.

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INTRODUCTION

Aging is a physiological process characterized by several metabolic, hormonal, and functional changes that directly affect nutritional status [1]. It is marked by increased adiposity, particularly central fat accumulation, and a progressive loss of lean mass and muscle function, a condition known as sarcopenia [2]. These changes significantly influence energy balance, as lean mass represents the main determinant of total energy expenditure, directly affecting basal metabolic rate and the body's metabolic efficiency [3].

Among the physiological factors responsible for these changes are hormonal alterations, such as decreased levels of growth hormone (GH) and insulin-like growth factor 1 (IGF-1), and increased catabolic hormones [4]; low-grade chronic inflammation with elevated pro-inflammatory cytokines such as TNF-α, IL-6, and C-reactive protein, which promote protein degradation [5]; mitochondrial dysfunction and accumulation of reactive oxygen species, affecting both energy production and the regenerative capacity of muscle cells; and insulin resistance, along with disturbances in glucose and lipid metabolism [6].

Chronic kidney disease (CKD), which affects approximately three to six million people in Brazil, is defined as structural or functional abnormalities of the kidney persisting for at least three months, with implications for health [7,8].

As CKD progresses, glomerular filtration rate gradually declines, leading to the accumulation of uremic toxins and worsening of the uremic state. This unfavorable metabolic environment intensifies protein catabolism and is associated with anabolic resistance, chronic inflammation, and oxidative stress factors that contribute to the degradation of skeletal muscle mass [9]

These changes make patients more susceptible to the deterioration of their clinical, nutritional, functional, and cognitive status, leading to easier loss of body weight and muscle mass characteristics of clinically frail individuals [10]. Frailty is a concept that describes the cumulative loss of complexity across multiple physiological systems that occurs with aging [11, 12].

From a clinical perspective, frailty represents a health state characterized by increased systemic vulnerability to physical or psychological stressors and a decline in functionality across several domains cognitive, physical, and social[11]. The main clinical features of frailty include decreased muscle strength, reduced endurance, impaired agility and coordination, constant fatigue, unintentional weight loss, and cognitive decline [12]. Although several assessment methods exist, no single standardized tool is universally accepted for frailty identification. The *Edmonton Frail Scale* (EFS) was developed as a practical instrument for patient evaluation. It assesses nine dimensions: (1) cognition, (2) general health status, (3) functional independence, (4) social support, (5) medication use, (6) nutrition, (7) mood, (8) continence, and (9) functional performance. Additionally, it allows classification of individuals as non-frail, vulnerable to frailty, or as having mild, moderate, or severe frailty [13].

METHODOLOGY

This is a cross-sectional study conducted with 65 older adults (≥60 years) of both sexes attending the nephrology outpatient clinic of a university hospital in Maceió, Alagoas, Brazil. The sample size (n = 65) was estimated based on the total number of patients seen at the service, assuming a 5% sampling error and a 95% confidence level. Initially, the project was presented to potential participants, explaining the study objectives, procedures, and ethical aspects. Those who agreed to participate signed the Informed Consent Form (ICF) in accordance with Resolution 196/96 of the National Health Council (CNS). Only after obtaining consent were demographic, socioeconomic, biochemical, and clinical data collected from medical records to complete the evaluation.

Participants were then interviewed using a standardized questionnaire developed by the research group to obtain demographic, socioeconomic, and clinical information. Frailty was assessed using the Edmonton Frail Scale (EFS), previously translated and culturally adapted for Brazil, which evaluates nine domains: cognition, general health status, functional independence, social support, medication use, nutrition, mood, continence, and functional performance [13]. For analysis, individuals were categorized as non-frail (non-frail or vulnerable) or frail (mild, moderate, or severe).

Body composition was assessed by anthropometry and bioelectrical impedance analysis (BIA) using the tetrapolar RJL Systems® Quantum BIA 101Q device, following standardized protocols. Weight was measured using a digital scale (capacity 150 kg) and height with a portable stadiometer (capacity 200 cm), as recommended by the Ministry of Health [18]. Body mass index (BMI) was calculated as weight divided by height squared (kg/m²), considering dry weight. The classification followed Lipschitz's criteria: without excess weight (BMI <27 kg/m²) and with excess weight (BMI ≥27 kg/m²) [14, 15]. Serum creatinine data were obtained from medical records referring to the three months prior to the evaluation; when unavailable, new measurements were requested. The estimated glomerular filtration

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rate (eGFR) was calculated using the CKD-EPI equation through the calculator provided by the Brazilian Society of Nephrology, and results were classified according to KDIGO (2024) guidelines [8].

Data were organized in Microsoft Excel® 2010 and analyzed using Jamovi software. Quantitative data were expressed as mean ± standard deviation, and categorical data as absolute and relative frequencies. Normality was verified by the Kolmogorov–Smirnov test. Group comparisons used the Student's *t*-test or Mann–Whitney *U* test, and categorical variables were analyzed by Pearson's chi-square test. Associations between BMI, frailty, and EFS domains were examined through logistic regression models adjusted for age and sex. The study was approved by the Institutional Research Ethics Committee, in compliance with ethical and confidentiality standards.

RESULTS

A total of 65 older adults participated in the study, with a mean age of 69.85 years, of whom 55.4% were men. The mean BMI of the population was 28.58 ± 6.09 kg/m². Among participants, 61.5% had a BMI above 27.00 kg/m², with a mean of 32.61 ± 5.06 kg/m² (Table 1). Frailty was identified in 58.5% of the sample, classified as mild in 25 individuals (38.5%) and as moderate to severe in 13 individuals (20.0%) (Table 2).

Regarding the estimated glomerular filtration rate (eGFR), 81.54% had filtration below 60%, with no difference between BMI profiles ($p > 0.05$) (Table 1). When older adults were assessed according to filtration levels (data not shown in tables), 3.1% (n = 2) had eGFR stage 1 (>90), 15.4% (n = 10) had eGFR stage 2 (60–89), 49.2% (n = 32) had eGFR stage 3 (59–30), 26.2% (n = 17) had eGFR stage 4 (29–15), and 6.2% (n = 4) had eGFR stage 5 (<15). Anemia was present in 40.63% of the population, with older adults with excess weight showing a lower prevalence of the condition ($p < 0.04$).

Table 1 – Sociodemographic, clinical, anthropometric, and body composition characteristics of older adults with kidney disease according to the presence of excess weight (n=65).

Characteristics	Sample (n=65)	Without Excess Weight (n = 25) n (%)	With Excess Weight (n=40) n (%)	p-value [a]
Sex	Frequencies			
Male	36 (55,39)	15 (23,1)	21 (32,3)	0,55
Female	29 (44,61)	10 (15,4)	19 (29,2)	
Alcohol Consumption				
No	61(93,85)	24 (36,9)	37 (56,9)	0,57
Yes	4 (6,15)	1 (1,5)	3 (4,6)	
Smoking				
No	59 (90,77)	21 (32,8)	38 (58,5)	0,13
Yes	6 (9,23)	4 (6,2)	2 (3,2)	
Diabetes Mellitus				
No	40 (61,54)	12 (18,5)	28 (43,1)	**0,08**
Yes	25 (38,46)	13 (20)	12 (18,5)	
Hypertension				
No	58 (89,23)	21 (32,3)	37 (56,9)	0,28
Yes	7 (10,77)	4 (6,2)	3 (4,6)	
Anemia				
No	26 (40,63)	14 (21,9)	12 (18,8)	**0,04**
Yes	38 (59,37)	11 (17,2)	27 (42,2)	
Creatinine				
Normal	18 (27,7)	5 (7,7)	13 (20)	0,27
Elevated	47 (72,3)	20 (30,8)	27 (41,5)	

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GFR				
> 60	12 (18,46)	3 (4,6)	9 (13,8)	0,29
< 60	53 (81,54)	22 (33,8)	31 (47,7)	
WC				
High	48 (73,86)	10 (15,4)	38 (58,5)	**0,00**
Adequate	17 (26,14)	15 (23,1)	2 (3,1)	
WHtR				
Higt	49 (75,39)	14 (21,5)	35 (53,8)	**0,00**
Adequate	16 (24,61)	11 (16,9)	5 (7,7)	
CC				
Adequate	53 (81,54)	13 (20)	40 (61,5)	**0,00**
Depleted	12 (18,46)	12 (18,5)	0 (0)	
	Mean ± SD	Mean ± SD	Mean ± SD	p-value [b]
Age (years)	69,85±7,09	70,84±6,81	69,22±7,27	0,37
Weight (kg)	74,45±15,44	59,5±8,27	83,3±10,85	**0,00**
Height (cm)	159,8±9,37	158,3±9,15	160,7±9,51	0,32
WHtR	0,61±0,16	0,55±0,12	0,64±0,17	**0,00**
CC (cm)	36,42±3,4	33,28±2,07	38,43±2,42	**< 0,01**
Muscle Mass (%)	32,2±0,77	36,3±0,07	29,7±0,07	**< 0,01**
Fat (%)	34,94±12,95	26,5±8,8	40,2±12,38	**<0,01**

CKD: Chronic Kidney Disease; GFR: Glomerular Filtration Rate; SD: Standard Deviation
a. p-value for the chi-square test.
b. t-test for independent samples (normal distribution); Mann-Whitney test (non-normal distribution)
Source: Prepared by the authors, 2025

In the anthropometric and body composition assessment, elevated values of waist circumference (WC) and waist-to-height ratio (WHtR) were observed for the majority of the population, corresponding to 73.86% and 75.39%, respectively. Individuals with excess weight presented higher values compared to those without excess weight (WC – 58.5%; WHtR – 53.8%; p<0.001). Calf circumference (CC) was within normal parameters for most of the population (81.54%) and was considered adequate in 61.5% of individuals with excess weight compared to those with normal weight (p<0.01). Regarding body composition, the mean percentages of muscle mass and body fat in the population were 32.2% and 34.94%, respectively, with lower muscle mass (29.7±0.07%) and higher fat mass (40.2±12.38%) in the group with excess weight (p<0.01) (Table 1).

In the evaluation of frailty dimensions, it was observed that 82.81% of the population used five or more medications per day, with older adults with excess weight using more medications than those without excess weight (p<0.01). A similar result was identified for urinary continence, where 46.88% of the population reported urine loss, with a higher prevalence among individuals with excess weight compared to those without excess weight (p<0.01). No statistical differences were found for the other domains (Table 2).

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Table 2 - Frailty characteristics and their dimensions in older people with kidney disease according to the presence of excess weight (n=65).

Characteristics	Sample (n=65)	Without Excess Weight (n = 25) n (%)	With Excess Weight (n=40) n (%)	p-value [a]
Frailty	Frequencies			
Without frailty and/or vulnerable	27 (41,54)	11 (16,9)	16 (24,6)	0,75
With frailty	38 (58,46)	14 (21,5)	24 (36,9)	
Cognition				
With alteration	42 (65,62)	19 (29,7)	23 (35,9)	0,16
Without alteration	22(34,38)	6 (9,4)	16 (25)	
General health status				
With alteration	53 (82,81)	22 (34,4)	31 (48,4)	0,38
Without alteration	11 (17,19)	3 (4,7)	8 (12,5)	
Functional independence				
With alteration	31 (48,44)	11 (17,2)	20 (31,3)	**0,57**
Without alteration	33 (51,56)	14 (21,9)	19 (29,7)	
Social support				
With alteration	54 (84,37)	23 (35,9)	31 (48,4)	0,18
Without alteration	10 (15,63)	2 (3,1)	8 (12,5)	
Medication use				
With alteration	53 (82,81)	17 (26,6)	36 (56,3)	**0,01**
Without alteration	11 (17,19)	8 (12,5)	3 (4,7)	
Nutrition				
With alteration	22 (34,38)	11 (17,2)	11 (17,2)	0,19
Without alteration	42 (65,52)	14 (21,9)	28 (43,8)	
Mood				
With alteration	24 (37,5)	10 (15,6)	14 (21,9)	0,74
Without alteration	40 (62,5)	15 (23,4)	25 (39,1)	
Continence				
With alteration	30 (46,88)	7 (10,9)	23 (35,9)	**0,02**
Without alteration	34 (53,12)	18 (28,1)	16 (25)	
Functional performance				
With alteration	48 (75)	21 (32,8)	29 (45,3)	**0,36**
Without alteration	14 (25)	4 (6,3)	10 (15,6)	

CKD: Chronic Kidney Disease; GFR: Glomerular Filtration Rate; SD: Standard Deviation
c. p-value for the chi-square test.
Source: Prepared by the authors, 2025

In the binomial logistic analysis of the frailty domains assessed by the Edmonton Frail Scale according to body mass index (Table 3), a significant association was observed for the domains medication use (OR=1.21; 95% CI: 1.02–1.42; p=0.03) and continence (OR=1.12; 95% CI: 1.02–1.24; p=0.02). In both cases, excess weight was related to a higher probability of frailty, with narrow confidence intervals suggesting good precision of the analysis. The domains social support (OR=1.10; 95% CI: 0.99–1.22; p=0.07) and nutrition (OR=0.90; 95% CI: 0.82–1.00; p=0.06) showed values close to the threshold of significance, indicating a trend toward association. No statistically relevant differences were observed in the other domains.

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Table 3 - Binomial logistic analysis of frailty domains according to body mass index in older adults with chronic kidney disease

Predictor	OR	CI (95%)	p
Cognition	1,01	0,93 - 1,10	0,86
General health status	1,01	0,90 - 1,12	0,89
Functional independence	1,04	0,95 - 1,13	0,39
Social support	1,10	0,99 - 1,22	0,07
Use of medication	1,21	1,02 - 1,42	0,03
Nutrition	0,90	0,82 - 1,00	0,06
Mood	0,98	0,90 - 1.07	0,62
Composure	1,12	1,02 - 1.24	**0,02**
Functional performance	1,01	0,92 - 1.12	0,83

OR: Odds Ratio; IC: Intervalo de Confiança; CP: Circunferência da Panturrilha

DISCUSSION

The high prevalence of frailty identified in just over half of the evaluated patients constitutes a relevant finding, particularly when considering that, despite being ageing, these individuals were still undergoing conservative treatment. This result suggests that, in addition to factors inherent to the disease itself, other elements may have influenced this diagnosis, since the scale used, the Edmonton Frail Scale[13], has a multidimensional character.

Despite this, the results demonstrate that ageing and frail individuals still present excess body weight, even though most were in stage 3 of CKD. This finding reinforces the complex mechanism underlying frailty, characterized as a clinical-biological syndrome combining increased vulnerability to stressors with reduced physiological reserve. In CKD, it is likely that the metabolic and inflammatory alterations, generally silent in the early stages of the disease, have not yet manifested to the extent of causing significant weight loss [16]. However, excess weight in frail individuals cannot be interpreted as a sign of adequate nutritional status; rather, it may contribute to adverse outcomes, as the coexistence of excessive adipose tissue with reduced muscle mass and strength characterizes sarcopenic obesity, which in turn increases the risk of falls, functional impairment, hospitalizations, and mortality [17].

It is worth noting that adipose tissue undergoes major changes throughout aging. In middle age, visceral white adipose tissue increases markedly, leading to greater abdominal adiposity and redistribution of adipocytes to other metabolically active tissues, such as the liver and skeletal muscle, triggering several metabolic alterations. In advanced age, however, all primary fat depots tend to decrease in size, exhibiting greater fibrosis, hypoxia, basal lipolysis, chronic inflammation, and cellular senescence, factors that contribute to frailty and greater susceptibility to external stressors and infections in ageing individuals [18]. This suggests that the group of patients evaluated in our study may not yet fully exhibit the typical characteristics of a very ageing population but rather are in a transitional phase between age ranges, which may explain the anthropometric profile observed.

Nevertheless, the known physiological changes typical of aging are already occurring, such as NAD loss, telomere attrition, mitochondrial dysfunction, stem cell exhaustion, impaired macroautophagy, DNA damage, loss of proteostasis, inflammation, dysbiosis, deregulated nutrient sensing, and impaired intercellular communication [19], all of which impair cellular function and increase predisposition to various clinical conditions. When these occur at the muscular level, muscles age, lose strength, elasticity, and metabolic capacity, leading to inefficient movements and metabolic disorders. Satellite cells (SCs), the primary muscle stem cells responsible for regeneration, become exhausted during aging, resulting in a reduction of their population and functionality. This process compromises muscle fiber regeneration, favoring the accumulation of adipose and fibrous tissue, which further impairs muscle function [20].

In patients with chronic kidney disease, this scenario is intensified by uremia, resulting from the accumulation of uremic toxins not excreted by the kidneys, which triggers systemic metabolic alterations and multi-organ dysfunction, including the muscular system [21]. In this context, a relevant finding was the difference observed

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between ageing individuals with excess weight, who presented a lower percentage of lean mass and a higher proportion of fat mass compared to those without excess weight. Such alteration may be associated both with aging-related changes and adipose tissue redistribution, as well as with silent muscle proteolysis induced by the subclinical chronic inflammation characteristic of uremia.

In the systematic review and meta-analysis conducted by Yuan Linli et al. [22], aimed at clarifying the association between obesity and the risk of frailty in older adults over 60 years of age, a positive relationship was identified between abdominal obesity and frailty (RR = 1.57; 95% CI: 1.29–1.91; $p = 0.086$). Moreover, BMI ≥ 30 kg/m² was associated with a higher risk of frailty (RR = 1.40; 95% CI: 1.17–1.67). The study also showed that both obesity and underweight increase the risk of frailty among community-dwelling older adults (RR = 1.40; 95% CI: 1.17–1.67; $p < 0.01$ and RR = 1.45; 95% CI: 1.10–1.90; $p < 0.01$, respectively). It is important to note that the criteria used for frailty screening in that study differ from those adopted in our research, mainly due to the wide variety of diagnostic scales available.

According to the criteria proposed by Fried et al. [12], frailty is defined by the presence of at least three of five factors: weakness, low physical activity, exhaustion, slow gait speed, and unintentional weight loss. In a study conducted among community-dwelling older adults, it was found that excess weight associated with poor physical performance substantially increased the likelihood of frailty; participants with overweight or obesity and low balance were more than seven times as likely to be frail (OR = 7.2; 95% CI: 2.3–22.3; $p = 0.006$), whereas those with reduced upper limb strength had a more than fourfold increased risk (OR = 4.5; 95% CI: 2.2–9.2; $p < 0.001$).

The discussion surrounding frailty and its dimensions is hampered by the multiplicity of diagnostic scales and assessment formats, which limit a more standardized debate on the topic. In this regard, the present study stands out as pioneering in investigating a specific population, older adults with chronic kidney disease and excess weight. In renal patients, Garcia-Canton C et al. [23], who used the same scale applied in our research, also highlighted this difficulty. In that study, conducted with hemodialysis patients, 29.6% were frail, 19.1% were vulnerable, and 51.3% were non-frail, results quite different from our findings in patients still under conservative treatment. Moreover, the dimensions of frailty were not assessed, preventing more detailed comparisons with our work.

Interestingly, the results obtained in the present study regarding inappropriate medication use and impaired continence among overweight older adults draw attention as novel findings and serve as an alert to the scientific community and caregivers of this population regarding the prevention of both weight gain and related complications.

Regarding continence, current evidence shows that excess weight can increase intra-abdominal pressure and contribute to pelvic floor dysfunction, resulting in muscle weakness and a higher risk of urinary incontinence, particularly among older adults [24]. Furthermore, abdominal adiposity, common among these individuals, directly interferes with body biomechanics and posture, affecting sphincter control. These factors, when associated with frailty syndrome, negatively impact the quality of life of this population [25].

Another aspect to consider is that excess weight is directly associated with the development of non-communicable chronic diseases (NCDs) such as hypertension, diabetes mellitus, and dyslipidemia [26]. These comorbidities may explain the phenomenon of polypharmacy in this population. The use of multiple medications increases the likelihood of drug interactions, adverse effects, decreased treatment adherence, and potential interference with the absorption and metabolism of essential nutrients, thereby worsening nutritional status and increasing the risk of micronutrient deficiencies [27].

CONCLUSION

This study demonstrated that older adults with chronic kidney disease under conservative treatment exhibit a significant prevalence of frailty, frequently associated with excess weight. Individuals who were overweight or obese showed a lower percentage of lean mass and a higher proportion of body fat, indicating that muscular and adipose tissue alterations contribute to the worsening of the syndrome. These findings reinforce the importance of considering not only renal function but also anthropometric, social, and care-related factors in frailty screening. Furthermore, the use of the Edmonton Frail Scale allowed for a multidimensional assessment, although the diversity of available instruments still limits comparability across studies. The results presented here provide important insights for clinical practice, particularly in guiding preventive and individualized care strategies for this specific population, and highlight the need for further research to deepen the understanding of the relationship between excess weight, frailty, and chronic kidney disease progression.

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