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Nutritional Status and Consumption of Omega-3 Fatty Acids by Substance Abusers in Recovery

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Abstract

Substance abuse induces the brain to decrease the production of dopamine and serotonin, a fact that characterizes the chemical dependent. Among the changes caused by frequent use of drugs, there is a change in dietary habits and nutritional status of the user, due to the modification of appetite and food intake or nutrient metabolism. These changes can lead to nutritional deficiencies that can disrupt the brainwaves and their functioning. An example is the omega-3 deficiency that affects neurotransmission resulting in hypo functioning of the mesocortical pathway, system associated with reward and dependence. Based on this, we aimed to perform a nutritional analysis of recovering substance abusers, particularly their consumption of omega-3 containing foods. The sample consisted of 45 male patients from five therapeutic communities in the states of Paraná and Santa Catarina, in the southern region of Brazil. Anthropometric evaluations, general health status assessments and food consumption analyses were performed. According to the body mass index of the individuals evaluated, 51.11% were overweight and 71.11% gained weight after starting treatment. Mean caloric intake was low and was insufficient in most nutrients, including omega-3. In addition, there was a negative correlation between consumption of omega-3 and the duration of addiction. In view of these findings, we suggest that the poor eating habits of the patients could have affected the consumption of omega-3 fatty acids, thereby prolonging addiction. Thus, further studies on supplemental omega-3 therapy may be useful for the process of recovery.

Keywords: Food consumption; Omega-3 fatty acids; Nutritional status; Substance-related disorders

Introduction

Psychoactive substance abuse is the third most prevalent Brazilian psychiatric disorder [1], affecting men and women of all ages, ages and races. This includes newborn infants who inherit diseases and/or dependence from their mothers [2-3].

According to the Minnesota Department of Human Services [4], individuals who are no longer able to control the frequency with which they use psychoactive chemicals are considered to be chemically dependent, in spite of the harmful consequences, since these substances can alter the body, behavior and mind. Furthermore, according to Williams and McElhiney [5], this condition is the result of adaptations of specific neurons (dopaminergic and serotonergic) to continuous exposure to one or more drugs of abuse. Thus, psychoactive substances may induce various disorders, including intoxication, withdrawal syndromes, delusions, psychoactive disorders, mood and sleep disorders, dementia, anxiety disorders, memory loss and sexual dysfunction [6].

In addition to the changes caused by frequent drug use, there is a change in eating habits and nutritional status of the user, since the use of psychoactive substances can affect appetite and food intake or can act directly on the metabolism of some nutrients [7-8]. In addition to inadequate dietary intake, nutrient absorption may be altered, causing nutritional deficiencies. According to Benton, Fordy and Haller [9], these deficiencies can disturb brain waves and brain function.

Thus, since addicts tend to have poor eating habits, omega-3 deficiency may occur. Omega-3 is an essential polyunsaturated fatty acid, i.e., it is obtained only through the dietary intake of certain grains, fish and marine plants [10]. According to Ahmad *et al.* [11], inadequate Polyunsaturated Fatty Acids (PUFAs) content in the diet, especially omega-3, is related to hypofunction of the mesocortical pathway, a system associated with reward and dependence. In addition, PUFA deficiency is associated with deregulation of the cerebral dopaminergic system that participates in the spread of withdrawal symptoms. Similarly, adequate consumption of omega-3s may increase the capacity for serotonergic neurotransmission, because they participate in serotonin and increase its availability in the synaptic cleft. In addition, omega-3s modulate the biosynthesis and accumulation of phosphatidylserine, responsible for stimulating the release of some neurotransmitters such as dopamine, activity of which would have been modified by substance abuse [12]. On this basis, it is believed that adequate intake of omega-3s may aid in the normalization of the dopaminergic and serotonergic systems, as well as in the reduction of withdrawal symptoms.

Therefore, due to the scarcity of studies relating omega-3 consumption with substance abuse, the present study aimed to correlate the consumption of this nutrient with adherence to substance abuse treatment, hopefully contributing to a greater understanding of the subject of addiction.

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Table 1: Addiction profiles of substance abuse patients hospitalized in therapeutic communities in Cascavel (PR) and Chapecó (SC), Brazil, 2017.

Variable	%	N
Substances used		
Alcohol	91.11%	41
Tobacco	75.55%	34
Cocaine	60.00%	27
Marijuana	53.33%	24
Crack	46.67%	21
Inhalants	37.78%	17
LSD	22.22%	10
Benzodiazepines	15.55%	7
Ecstasy and amphetamines	15.55%	7
Heroin	2.22%	1
Number of substances used		
1 substance	15.55%	7
2 substances	26.66%	12
3 substances	6.66%	3
More than 3 substances	51.11%	23
Previous treatment		
Yes	64.45%	29
No	35.55%	16
Duration of hospitalization in current facility		
Less than 1 month	13.30%	6
1 to 5 months	53.33%	24
More than 5 months	35.55%	16
Substances responsible for current hospitalization		
Alcohol	37.78%	17
Crack	22.22%	10
Cocaine	17.78%	8
Tobacco	6.67%	3
Marijuana	2.22%	1
Alcohol and crack	8.89%	4
Cocaine and crack	4.44%	2
Withdrawal symptoms		
Yes	73.33%	33
No	26.67%	12
Character of withdrawal symptoms		
Anxiety	48.49%	16
Depression	24.24%	8
Tremors	24.24%	8
Nervousness/irritability	15.15%	5
Delirium/nightmares	15.15%	5
Hyperactivity/Restlessness	15.15%	5
Bodily pain	9.09%	3
Loss of appetite	3.03%	1
Number of symptoms		
1	45.45%	15
2	18.18%	6
3	21.21%	7
More than 3	15.15%	5

Source: prepared by the authors, 2017.

Materials and Methods

The present study was a cross-sectional observational study. We selected a total of 45 male individuals, who met the following criteria: age 18 years to 59 years, with residence into therapeutic communities. It was chosen five therapeutic communities in the municipalities of Cascavel and Chapecó, located in the western region of the states of Paraná and Santa Catarina, respectively. Three institutions were public and two were private. Initially, the individuals were recruited in a reserved room in each of the communities. Through an informal conversation, the purpose of the study and its methodology was explained in order to gauge individual interest. Any patient could participate, regardless of the duration of addiction or hospitalization. If they all participate, regardless of the time of addition or hospitalization. Next, the individuals who signed the free and informed consent term (TCLE) were included after understanding the project intention. This study was approved by the Ethics Committee of the Federal University of Southern Frontier, through a certificate of presentation for ethical evaluation number 61355816.0.0000.5564. All the procedures performed were conducted according to ethical protocols.

The following instruments were used for data collection: interview through which three questionnaires were administered, as well as weight and height collection for anthropometric evaluation.

First, we administered a general health questionnaire adapted by the authors with descriptive, multiple choice questions based on the questionnaire of Rossi, Caruso and Galante [13] as well as the Addiction Severity Index (ASI) Version 6 of Kessler and Pechansky [14]. Subsequently, food consumption of macro- and micronutrients, in particular omega-3, was evaluated using two questionnaires focusing on frequency of food consumption (QFCA) with a quantitative model elaborated by the author. The first dealt with general consumption and the second focused on the consumption of foods containing especially omega-3 during the last 3 months. We asked about fixed amounts of intake, with options of 1 to 10 times per day, week or month, where 54 foods were evaluated. In order to measure the quantity of the various nutrients, the following tables were used: Table of Nutritional Composition of Foods Consumed in Brazil by IBGE [15], the Table of Chemical Composition of Foods [16], the Brazilian Table of Food Composition [17] and the United States Department of Agriculture's Food Composition Chart [18]. The values obtained from the tables were divided by 1, 7 or 30 depending on the frequency of food consumption defined as day, week or month, in order to be evaluated according to the recommendation of the Estimated Average Requirement (EAR) - provided to evaluate whether the daily intake of a nutrient met the needs of 50% of healthy individuals in a certain group of the same gender and stage of life [19]. We incorporated the Basal Metabolic Rate (BMR) according to the Harris and Benedict calculations [20] as well as the Estimated Energy Requirement (EER) based on the Institute of Medicine/Food and Nutrition Board [21] calculation for adults, considering nutritional status, without reducing calories.

Finally, an anthropometric evaluation was performed using weight and height measurement. For this purpose, we used a Zeex® brand portable scale, with a precision of 0.1 kg and a maximum capacity of 150 kg, and an inelastic tape measure with graduation in centimeters and extension of 2 m, fixed to a smooth wall without skirting boards. Body Mass Index (BMI) was calculated using the formula kg/height^2. BMI classifications were as per the WHO [22], where low weight/malnutrition is equivalent to a BMI<18.5 kg/m^2, eutrophic weight among 18.5 to 24.9 kg/m^2, overweight or pre-obesity when>25 to 29.9 kg/m^2, obesity grade I among 30.0 to 34.9 kg/m^2, obesity grade *II* between 35.0 to 39.9 kg/m^2 and obesity grade *III* when>40 kg/m^2.

Data were recorded in Microsoft Excel, version 2010 and statistical analysis was performed using the free software PSPP, version 1.3. The Pearson correlation test and one-way Analysis of Variance (ANOVA) were used to determine the correlation between omega-3 consumption, nutritional assessment, macro- and micronutrient food intake, and addiction. A value of p <0.05 was considered statistically significant.

Results

The sample consisted of 45 male subjects in outpatient treatment for chemical dependence in five therapeutic communities. Of these, 76.27% agreed participate. The mean age of the individuals evaluated was 40.67 +/- 10.79 years. Addiction profiles were created based on the number and type of substances used, the number of previous treatments, time of hospitalization, as well as substances responsible for hospitalization, presence and number of withdrawal symptoms and their characteristics (Table 1).

The mean BMI was 27.13 +/- 4.51 kg/m^2, with 51.11% (n = 23) being overweight/pre-obese, 28.89% (n = 13) being eutrophic, 15.56% (n = 7) being obesity grade I, 2.22% being obesity grades *II* and *III*. Of the total, 71.11% (n = 32) gained weight after starting treatment, whereas 22.22% (n = 10) lost weight, with means of 7.22 +/- 6.80 kg gained and 1.82 +/- 3.99 kg lost, respectively. Only 6.67% (n = 3) remained at the same weight regarding eating responses, 51.11% (n = 23) reported having increased the number of meals, quantity and variety of foods after starting treatment, and 8.88% (n = 4) reported having regulated their schedules to eating at fixed times. This fact presumes that, before admission to the clinic, most patients had poor eating habits, although 40% (n = 18) reported not having changed their eating habits at all. When questioned about the number of meals consumed, the majority of respondents (55.56%, n = 25) reported four meals a day, 22.22% (n = 10) reported three meals a day, 13.33% (n = 6) reported five meals per day, and 8.89% (n = 2) reported two meals per day. With respect to food consumption analysis, the tables below (Tables 2, 3) display the information derived from the application of QFCAs.

Based on (Table 2), we observed an average hypocaloric diet, not reaching even the average for the basal metabolic rate, despite most patients having adequate carbohydrate, protein and lipid intake. Recommended intake was observed for vitamin B6, iron, sodium and selenium. It should be noted that the addition salt of the food was not evaluated. This might give rise to underestimates of the amounts of these micronutrients actually consumed. As for the other micronutrients evaluated, all were below recommended levels, including omega-3.

In relation to the number of drugs used, there was a significant correlation (p < .05) with respect to addiction duration, number of withdrawal symptoms, BMI value, current weight, kcal, carbohydrates, proteins, lipids and omega-3 (Table 4).

Furthermore, a negative correlation (p = 0.049) was observed between the duration of addiction and daily consumption of omega-3s by the substance abusers under treatment (Figure 1).

Discussion

The sample was composed exclusively of men, since no women were present in the therapeutic communities studied. The majority reported consuming more than three substances, alcohol being the most cited and the largest cause of hospitalization. In addition, more than half of the individuals were not on their first treatment. Most had withdrawal symptoms, including anxiety. With respect to anthropometric measurements, a greater frequency of overweight was observed, since the majority reported gaining weight during the treatment, possibly due to the increase in food consumption throughout the treatment. However, it appears that the majority had diets with low nutritional value, with negligible consumption of most nutrients, including omega-3. In addition to all the variables found, it was possible to verify a correlation between the amount of drugs with duration of addiction, number of withdrawal symptoms, BMI and weight, in addition to longer addiction duration in individuals with low omega-3 intake.

The age of the patients was similar to the results reported in a study performed in a tertiary hospital in southern Brazil, in which the mean age of the participants was 41.04 ± 10.19 years [23]. In the present study, the average age was 40.67 + 10.79 years.

Regarding addiction characteristics, we observed that the drugs most consumed were alcohol, followed by tobacco, cocaine, marijuana and crack. In addition, we observed a preponderance of polysubstance consumption: 51.11% used more than three substances. This result was similar to that found by other studies [24-26].

Patients who reported consuming only one drug (alcoholics) had a longer duration of addiction than did those who reported consuming more than one substance. This may be related to the development of tolerance, which causes the individual to increase the amount of the substance used to achieve intoxication or other desired effect. Furthermore, the longer duration of addiction may be explained by the low price and availability of the substance, since alcohol is considered a widely available legal substance and is marketed in most establishments in the same way as tobacco [27]. In addition, we observed that users of multiple substances had more withdrawal symptoms than did users of a single substance. The most commonly reported symptoms were anxiety and depression, a finding similar to that reported in other studies [28-30].

The mean BMI found was similar to the value of 27.73 ± 4.15 kg/m^2 observed in an outpatient service of a tertiary hospital in the south of Brazil [23], as well as the prevalence of excess weight [31]. This value differed only from the value reported in a study carried out by Ribeiro [32], which reported low weight/malnutrition, a finding that was not observed in the present study.

With respect to dietary habits, our results were similar to those of a study of 52 drug addicts at a recovery facility in Maringá (PR), where 98.08% of the interviewees stated that their eating habits were affected by drug use, consuming 2 to 3 meals a day [33]. In addition, similarity was observed to the study of 14 substance abusers in a therapeutic community in the city of Frederico Westphalen (RS), where the patients showed a gain of 15.8% in weight after starting treatment [8].

Furthermore, we showed a positive correlation between current weight and BMI value with the number of drugs used. This finding is probably related to compensatory food consumption due to abstinence, among other factors. In addition, the weight gain we observed corresponded to withdrawal symptoms, including anxiety, where increased consumption of food is undertaken to lessen the desire to use the drug [34]. In addition, the systems for regulating food intake and drug use are the same; therefore, similar adaptive responses may trigger the reward system in the brain. Thus, obesity may be the result of a form of compulsive behavior, similar to addiction to psychoactive substances [35], and this phenomenon may be attributed much more to the substitution of the drug in the reward mechanism [36]. In addition, after food deprivation, energy deficiency can be quickly restored with the initiation of feedback,

Table 2: Food consumption (kcal and macronutrients) by patients during hospitalization (n = 45).

	Mean ± SD	Range	Recommendation (DRIs)	Below % (N)	Adequate % (N)	Above % (N)
Total energy (kcal)	1465.50 ± 583,21	625.72 – 3449.42	BMR:1768.78 EER:2518.69	73.33(33)	20.00 (9)	6.67(3)
Carbohydrate (g)	47.53% 174.12 ± 97.57	54.95 – 519.81	45-65% 164.87-238.14	26.67(12)	68.89(31)	4.44(2)
Protein (g)	17.81% 65.24 ± 21.57	20.67 – 166.47	10-35% 36.64-128.23	0.00(0)	97.78(44)	2.22(1)
Fat (g)	25,57% 41.63 ± 21.57	14.02 – 102.67	20-35% 32.57-56.99	15.56(7)	64.44(29)	20.00(9)
Cholesterol (g)	128.40 ± 69.82	87.31 – 413.12	*	0.00(0)	100.0(45)	0.00(0)
Omega-3 fatty acids (g)	0.77± 0.37	0.39 – 1.95	1,6	86.67(39)	13.33(6)	0.00(0)
Eicosapentaenoic acid (g)	0.00 ± 0.00	0.00 – 0.01	ND	100.00(45)	0.00(0)	0.00(0)
Docosahexaenoic acid (g)	0.00 ± 0.00	0.00 – 0.01	ND	100.00(45)	0.00(0)	0.00(0)
Omega-6 fatty acids (g)	7.25 ± 3.04	3.42 – 16.20	17	95.56(43)	4.44(2)	0.00(0)
Trans fats (g)	1.76 ± 2.89	0.22 – 13.78	Less than 1%	0.00(0)	77.78(35)	22.22(10)

Note: SD: Standard deviation; DRIs: *Dietary Reference Intakes*. BMR: Basal metabolic rate. EER: Estimated Energy Requirement . ND: not determined. * no reference value according to the Brazilian Society of Cardiology (56)
Source: prepared by the authors, 2017.

Table 3: Consumption of micronutrients by patients during hospitalization (n = 45).

	Mean ± SD	Range	Recommendation (DRIs)	Below % (N)	Adequate % (N)	Above % (N)
Fiber (g)	13.05 ± 6.91*	3.76 – 31.20	38	100.00(45)	0.00(0)	0.00(0)
Calcium (mg)	208.88 ± 185.28*	25.37 – 820.03	800	97.78(44)	2.22(1)	0.00(0)
Magnesium (mg)	161.35 ± 83.85*	39.16 – 440.43	350	95.56(43)	4.44(2)	0.00(0)
Selenium (µg)	71.04 ± 34.98	24.72 – 178.51	45	24.44(11)	75.56(34)	0.00(0)
Zinc (mg)	7.46± 4.22*	2.43 – 22.92	9.4	75.56(34)	24.44(11)	0.00(0)
Copper (µg)	660 ± 350*	190 – 1840	700	60.00(27)	31.11(14)	8.89(4)
Iron (mg)	6.50 ± 3.39	2.06 – 18.83	6	48.89(22)	51.11(23)	0.00(0)
Sodium (mg)**	968.60 ± 521.69	133.13 – 2301.48	1500	88.89(40)	8.89(4)	2.22(1)
Vitamin A (µg)	73.22 ± 61.87*	7.19 – 343.88	625	100.00(45)	0.00(0)	0.00(0)
Vitamin C (mg)	25.03 ± 21.72*	0.04 – 76.70	75	95.56(43)	4.44(2)	0.00(0)
Vitamin E (mg)	2.79 ± 1.26*	0.76 – 6.71	12	100.00(45)	0.00(0)	0.00(0)
Vitamin B6 (mg)	2.00 ± 0.99	0.57 – 4.62	1.10	13.33(6)	85.67(39)	0.00(0)
Vitamin B9 (µg)	169.35 ± 98.05*	44.21 – 505.16	320	91.11(41)	8.89(4)	0.00(0)
Vitamin B12 (µg)	1,98 ± 1.34*	0.49 – 7.56	2	62.22(28)	37.79(17)	0.00(0)

Note: SD: Standard deviation; DRIs: *Dietary Reference Intakes*. *less than recommended.**additional salt not considered.
Source: prepared by the authors, 2017.

Table 4: Correlation between number of drugs used by patients and variables.

Variable	R	P
Duration of addiction (years)	- 0.1236	0.018
Number of withdrawal symptoms	0.2259	0.001
BMI (kg/m²)	0.0993	0.035
Weight (kg)	0.0912	0.044
Kcal	- 0.0038	0.924
Carbohydrates (g)	- 0.0091	0.511
Proteins (g)	0.0689	0.348
Lipids (g)	- 0.0112	0.836
Omega-3 fatty acids (g)	0.0087	0.543

Source: prepared by the authors, 2017.

with rapid weight gain and fat accumulation [37].

In addition, among hospitalization locations evaluated, two received food through donations, hindering the variety of the menu. In addition, none of the sites had a follow-up by a nutritionist, making it difficult to plan suitable menus. Therefore, irregular availability, combined with low fractionation of meals and the trend towards higher consumption of high-energy foods in substitution for drugs [38] favor weight gain during the course of treatment.

With respect to food consumption, we observed a discrepancy between ours and a study that reported much higher caloric intake, with a similar distribution of carbohydrates and proteins, but high values for lipids. Regarding micronutrients, there was no similarity to the aforementioned study. The difference between the lipid consumption mentioned above can be explained by different methodology, because in this study, no hyper-lipid foods such as snacks, fried foods and industrialized products were considered, since they were not offered in the therapeutic communities evaluated. In the abovementioned study, a three-day food diary was used, where the food consumption report was free, without being restricted to a food established in the food consumption frequency questionnaire (QFCA) [39]. However, our result was similar to that of a study carried out with 33 drug addicts living in a therapeutic community in Chapecó (SC), where there was low consumption of vitamin C, vitamin A, B vitamins, iron, calcium, potassium and magnesium [40].

The diet of drug addicts is less than ideal due to lack of appetite, lack of interest in food during the drug effect or due to the fact that they tend to use money for drugs instead of food [41]. In the last 100 years, the intake of saturated fatty acids, linoleic acid and trans fatty acids increased dramatically in Western society, whereas consumption of omega-3 fatty acids decreased [42], a fact that was also observed in the present study.

The recommendation for omega-3 intake needed to meet human needs is still in the process of being determined and will have to await completion of the additional trials. In addition, these recommendations vary from country to country and depend, in part, on the amounts of omega-6s present in diets [43]. Hibbeln, Linnoila, Umhau, Rawlings, George and Salem [44] have suggested that the amount that would protect against major psychiatric illnesses should

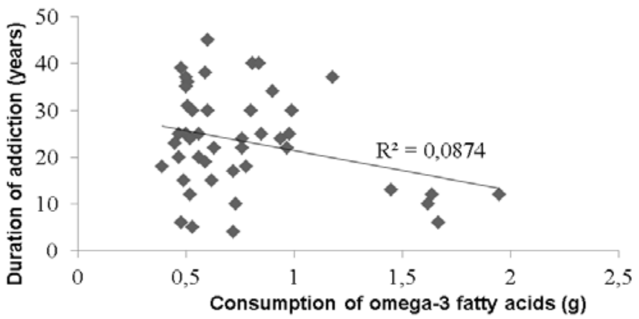

Figure 1: Correlation between duration of addiction and omega-3 intake.

be as high as 3.5 g omega-3 per day. In our study, we observed that the consumption of omega-3 was 0.77 + 0.37 g, not even reaching the recommendation of 1.6 g/day of the DRI.

Moreover, we demonstrated a negative correlation between drug consumption and duration of addiction: and the lower the omega-3 intake, the longer the duration of addiction, and vice versa. In this sense, it has been observed that omega-3 deficiency can alter basic neuronal processes, including synapse formation, signal transduction, increased vulnerability to apoptosis, and changes in membrane physical properties. In addition, fatty acids play a crucial role in the dopaminergic neurotransmission in the meso-cortico-limbic pathway [45], associated with reward and dependence [11]. Therefore, omega-3 deficiency results in hypo-functioning of these pathways [46], contributing to high drug craving [47]. Finally, the end-result would be an altered reward and dependency response, increased cravings, frustrating cessation attempts [48].

This concept was demonstrated by Buydens-Branchey, Branchey, McMakin, and Hibbeln [49], who showed that patients who relapsed had significantly lower levels of n-3 PUFAs than they did when they were hospitalized. In addition, another study showed that daily administration of PUFAs for 3 months along with naltrexone (a drug used for treatment) significantly reduced the amount of alcohol ingestion and compulsion, as well as the severity of dependence [50], showing that high intake of omega-3s can reduce withdrawal symptoms including distress, stress and anxiety [51-53].

The finding that omega-3s reduce drug craving and withdrawal symptoms suggests that supplementation may be advantageous, serving as an adjunct in the treatment of addiction, since most of the pharmacological drugs available for treatment are associated with adverse effects and/or low efficacy. In this way, we stress the fact that studies of new strategies and treatments for drug addiction are necessary [54], combined with the evidence that PUFA supplements of the n-3 series show promising results [55].

Conclusion

Though we cannot assert a causal relationship between omega-3 and chemical dependence, we nevertheless provided a rational basis for further exploration of addiction and deficiencies of PUFAs. Likewise, our findings suggested that increased dietary intake of omega-3s may represent a supplementary approach to increase the effectiveness of alcohol and drug-dependent rehabilitation programs, and may provide valid support during drug abstinence.

However, there were some limitations to our study. These included a low number of participants as well as dietary data collection through self-reported questionnaires, where recall bias or even omission of some information may have occurred, leading under over- or underestimation of food consumption.

Despite these limitations, treatment with omega-3 appears promising. Therefore it is necessary to carry out new studies in order to identify the profile of the individuals capable of benefiting from this type of complementary treatment. In addition, it would be important to determine the dose and time of treatments based on clinical and biochemical diagnostic tests.

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