

**ASSOCIATION BETWEEN FREQUENCY OF FAST-FOOD CONSUMPTION
AND THE LIPID PROFILE OF MEDICAL STUDENTS**
**ASOCIÁCIA FREKVENCIE KONZUMÁCIE RÝCHLEHO OBČERSTVENIA A LIPIDOVÉHO
PROFILU POSLUCHÁČOV MEDICÍNY**

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ABSTRACT

Background: Cardiovascular diseases (CVD) are the leading cause of death worldwide, and unhealthy dietary habits are one of the most important risk factors for CVD. University students constitute a particularly vulnerable group, as dietary habits established in young adulthood may significantly predict long-term health outcomes later in life.

Objective: To analyse dietary habits in a sample of university students with a particular focus on the frequency of fast-food consumption and its associations with blood lipid levels as one of the main cardiometabolic risk indicators.

Sample and Methods: The study sample consisted of 500 young, healthy respondents (31.8 % of men), university students aged 22 - 39 years. Objective health indicators included blood lipid levels measured from capillary blood using the Abbott Afinion 2 Analyser: total cholesterol (TC), high-density lipoprotein cholesterol HDL-cholesterol (HDL-C), triglycerides (TG); and calculated levels of low-density lipoprotein cholesterol LDL-cholesterol (LDL-C), non-HDL cholesterol (non-HDL-C), and TC/HDL-C ratio were calculated. Data concerning dietary habits, particularly the frequency of fast-food consumption, were obtained using the validated CINDI questionnaire. Descriptive statistical characteristics, simple linear regression analysis, and Spearman's correlation were used for statistical processing.

Results: The highest values of the levels of LDL-C ($p = 0.006$), non-HDL-C ($p = 0.024$) and the TC/HDL-C ratio ($p = 0.022$) were observed in the group of respondents who reported almost daily fast-food consumption. Linear regression analysis showed that the frequency of fast-food consumption was a significant negative predictor of several lipid parameters.

Conclusion: Our results showed significant differences in the lipid profile of medical students depending on the frequency of fast-food consumption. Less frequent consumption was associated with a more favourable lipid profile, indicating a potentially lower cardiovascular risk.

Key words: Dietary habits. Fast-food consumption. Blood lipids profile. University students.

ABSTRAKT

Východiská: Kardiovaskulárne ochorenia (KVO) sú hlavnou príčinou úmrtí na celom svete a jedným z najdôležitejších rizikových faktorov KVO sú nesprávne stravovacie návyky. Vysokoškolskí študenti predstavujú obzvlášť zraniteľnú skupinu, pretože stravovacie návyky v mladosti môžu významne predpovedať dlhodobé zdravotné dôsledky v dospelosti.

Cieľ: Analyzovať stravovacie návyky v súbore vysokoškolských študentov so zameraním na frekvenciu konzumácie rýchleho občerstvenia a jej súvislosti s hladinami lipidov v krvi ako jedným z hlavných kardiometabolických rizikových ukazovateľov.

Súbor a metódy: Súbor tvorilo 500 (31,8 % mužov) mladých zdravých respondentov – vysokoškolských študentov vo veku 22-39 rokov. Z objektívnych zdravotných ukazovateľov boli pomocou analyzátora Abbott Afinion 2 vyšetrené hladiny krvných lipidov z kapilárnej krvi: celkového cholesterolu (TC), HDL-cholesterolu (HDL-C), triacylglycerolov (TG) a vypočítané hladiny LDL-cholesterolu (LDL-C), non-HDL-C a pomeru TC/HDL-C. Údaje týkajúce sa stravovacích návykov – najmä frekvencia konzumácie rýchleho občerstvenia – boli získané pomocou validovaného dotazníka CINDI. Na štatistické spracovanie boli použité deskriptívne štatistické metódy, jednoduchá lineárna regresná analýza a Spearmanova korelácia.

Výsledky: Najvyššie hodnoty hladín LDL-C ($p = 0,006$), non-HDL-C ($p = 0,024$) a pomeru TC/HDL-C ($p = 0,022$) boli zistené v skupine respondentov, ktorí uviedli takmer dennú konzumáciu rýchleho občerstvenia. Lineárna regresná analýza ukázala, že frekvencia konzumácie rýchleho občerstvenia bola významným negatívnym prediktorom viacerých lipidových parametrov.

Záver: Naše výsledky ukázali významné rozdiely v lipidovom profile študentov medicíny v závislosti od frekvencie konzumácie rýchleho občerstvenia. Menej častá konzumácia bola spojená s priaznivejším lipidovým profilom, čo naznačuje potenciálne nižšie kardiovaskulárne riziko.

Kľúčové slová Stravovacie návyky. Konzumácia rýchleho občerstvenia. Krvné lipidy. Vysokoškolskí študenti.

INTRODUCTION

Cardiovascular diseases (CVD) have long been the leading cause of death worldwide [1, 2]. A growing body of scientific evidence confirms that poor nutrition is one of the most important CVD risk factors. It is estimated that nutrition may contribute to the development of CVD and some cancers in up to 20 – 60 % of cases [3]. A diet high in saturated fat, simple sugars and salt leads to dyslipidemia, insulin resistance and chronic inflammation, which represent key mechanisms of metabolic syndrome

and atherogenesis [4, 5]. A properly composed, biologically valuable diet should be adequate for the energy and nutritional needs of the individual, reflecting their age, sex, physical activity and environmental conditions [6].

University students coming from their homes to more autonomous environment, represent a particularly vulnerable group from a nutritional point of view. Although they are young, healthy, and above-average educated, they face high performance demands, stress, and time pressure, which in turn lead to skipping meals, evening overeating, and increased consumption of fast-food [7, 8].

Dietary habits in youth can significantly predict long-term health outcomes in adulthood and therefore require special attention. For example, a study by Yoon et al. [9] conducted among young Korean adults (20 – 39 years) showed that frequent fast-food consumption, combined with skipping breakfast and low physical activity, increased the risk of abnormal blood lipid levels and obesity. Similarly, a 2022 systematic review by Li et al. [10] noted that the university environment plays a crucial role in the formation of dietary habits and recommended targeted interventions such as education, food supply regulation, and the promotion of healthy choices.

Changes in blood lipid levels are among the most sensitive biochemical markers of early cardiometabolic risk. LDL-cholesterol (LDL-C), non-HDL-cholesterol (non-HDL-C) levels, and total cholesterol/HDL-cholesterol (TC/HDL-C) ratios are currently considered robust predictors of future cardiovascular events and are responsive to lifestyle and nutritional changes [11, 12]. Therefore, lipid profile monitoring in relation to the dietary habits of young people may provide important insights for preventive strategies.

OBJECTIVES

This study aimed to analyze the dietary habits of a sample of medical university students, with a focus on the frequency of fast-food consumption and its associations with the lipid profile as one of the main cardiometabolic risk indicators.

MATERIALS AND METHODS

A total of 610 university medical students were examined during 2024 - 2025, after obtaining informed consent, as part of the overall cardiovascular risk assessment. Participation in the study was voluntary and anonymous. In the statistical analysis,

500 respondents were included, who provided complete data necessary to evaluate all monitored variables. This sample represented an educationally and professionally homogeneous group of young, healthy individuals with medical education and with a high level of awareness and knowledge of the primary prevention of chronic diseases and healthy nutrition.

Blood lipid levels were examined in this sample of students: total cholesterol (TC), LDL-C, HDL-C and triglycerides (TG) as well as non-HDL-C levels and TC/HDL-C ratio.

Blood lipid examination was performed using the Abbott Afinion 2 Analyzer. This compact and automated point-of-care analyzer allows the quantitative determination of the lipid profile including TC, HDL-C, and TG directly from capillary blood. A blood sample (15 μ l) is analyzed in approximately 8 minutes using the Afinion™ Lipid Panel test cassette, which contains all necessary reagents. The analyzer automatically recognizes the sample type and performs corrections, including hematocrit measurement and whole blood lysis.

The Affinion 2 analyzer uses colorimetric enzymatic methods to determine the levels of TC, based on its oxidation and the formation of a colored quinone-imine complex; TG, through hydrolysis by lipoprotein lipase and subsequent reaction with glycerol; and HDL-C, by specific inhibition of non-HDL particles by antibodies and enzymatic oxidation of the HDL fraction. The analyzer simultaneously calculates the level of LDL-C, non-HDL-C and the TC/HDL-C ratio [13].

Data on dietary habits, particularly the frequency of fast food consumption and adherence to a healthy dietary pattern, were collected using the relevant section of the validated CINDI questionnaire. Frequency was recorded as an ordinal variable with the following coding: 0 = every day, 1 = almost every day, 2 = 1 – 2 \times per week, 3 = 1 – 2 \times per month, 4 = rarely/never.

Statistical analysis of the data was performed using IBM SPSS Statistics software. The normality of the distribution of quantitative variables was tested using the Shapiro-Wilk test. Since most lipid parameters did not show a normal distribution, non-parametric statistical tests were used in further analyses. We used the Mann-Whitney U-test to compare medians between two groups, and the Kruskal-Wallis test to compare multiple groups according to the frequency of fast-food consumption. To assess the

relationship between dietary habits – specifically the frequency of fast-food consumption – and individual lipid profile parameters, we used simple linear regression analysis. Each model included one of the biochemical indicators (TC, HDL-C, LDL-C, non-HDL-C, TC/HDL-C ratio or TG) as a dependent variable and the frequency of fast-food consumption as an independent variable. We subsequently verified the relationships using Spearman's correlation. We considered results with a p-value < 0.05 to be statistically significant.

RESULTS

The sample of 500 university students consisted of 341 women (68.2%, mean age 23.2 ± 1.3 years) and 159 men (31.8%, mean age 23.3 ± 1.5 years).

To the question “How often do you consume fast-food?”, the most common answers given by respondents were 1 - 2 times per month (48.6 %) and rarely/never (34 %). Less frequently, the answers were 1 - 2 times per week (15 %) and only a negligible percentage stated the frequency as almost daily (2 %) or every day (0.4 %) (Fig. 1).

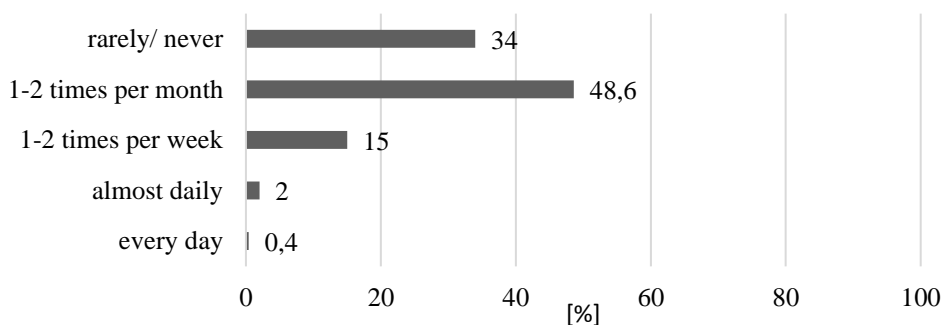


Figure 1 Frequency of fast-food consumption (in %)

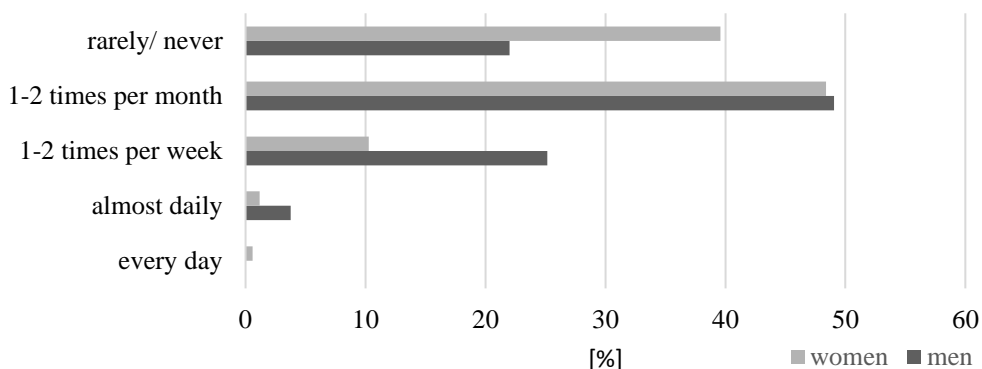


Figure 2 Frequency of fast-food consumption by sex (in %)

The chi-square test ($\chi^2 = 30.498$; $p < 0.001$) showed a statistically significant relationship between sex and the frequency of fast-food consumption. Men reported more frequent consumption than women, especially in the category 1 - 2 times per week (men 25.2 % vs. women 10.3 %) and in the category almost daily (men 3.8 % vs. women 1.2 %) (Fig. 2).

In response to the question, “Do you try to eat so that your diet meets the requirements of a healthy diet?”, most students responded positively. Nearly half of the respondents (47.4 %) answered “Yes, I usually pay attention to it”, while 41.0 % stated “I sometimes pay attention to it”. Only 11.6 % selected the responses “No, I usually do not pay attention to it” or “No, I cannot judge” (Fig. 3). In the case of the answer to this question regarding adherence to a healthy dietary pattern, a statistically significant difference between the sexes was not found ($\chi^2 = 5.678$; $p = 0.128$). However, the linear trend between sex and the level of adherence to a healthy diet was significant ($p = 0.031$), with women more often reporting that they pay attention to healthy eating.

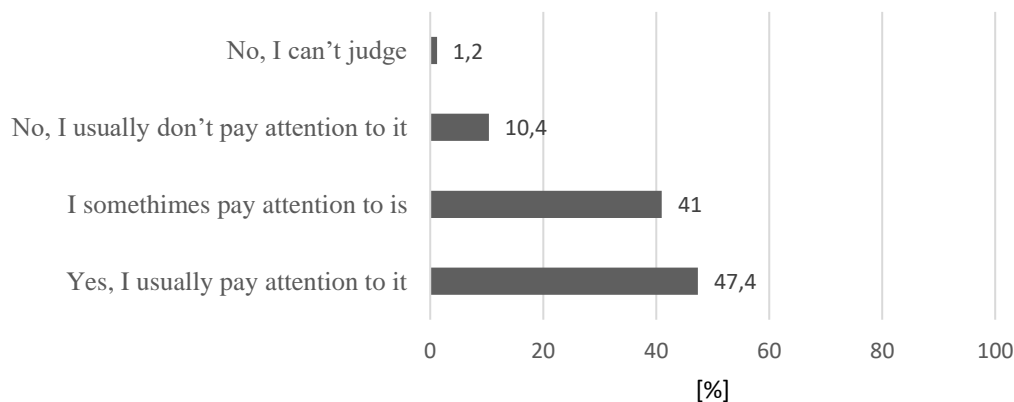


Figure 3 Self-assessment of nutritional habits among students (in %)

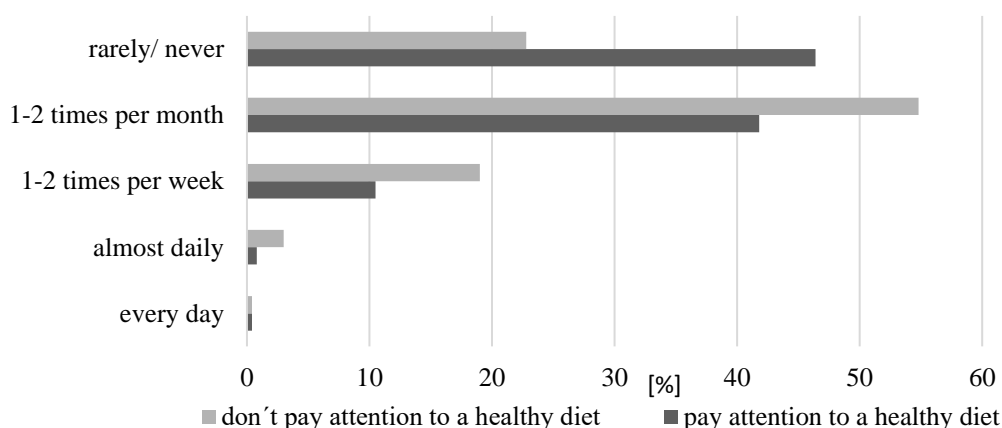


Figure 4 Relationship between adherence to healthy dietary pattern and frequency of fast-food consumption (in %)

The analysis of the relationship between adherence to healthy dietary pattern and the frequency of fast-food consumption revealed a highly significant difference ($\chi^2 = 33.712$; $p < 0.001$). Students who have better adherence to the healthy dietary pattern consume fast-food considerably less often. As many as 46.4% reported that they eat such meals rarely or never. In contrast, among students who do not pay attention to healthy eating, the majority reported consuming fast-food 1-2 times per month (54.8%) or 1-2 times per week (19.0%) (Figure 4).

The median values of the lipid profile (TC, LDL-C, HDL-C, TG, non-HDL-C and TC/HDL-C) indicate that for the entire group, the values were within the reference range, with the atherogenic profile being worse in men (Table 1).

Comparison of blood lipid levels in women and men (Mann-Whitney test) showed statistically significant differences in LDL-C ($p = 0.036$), HDL-C ($p < 0.001$), non-HDL-C ($p = 0.002$) levels and TC/HDL-C ratio ($p < 0.001$) (the difference in TG levels was at the borderline of significance), with

men having worse lipid values in the above-mentioned parameters (Table 1).

Spearman correlation analysis showed that for the entire sample, the frequency of fast-food consumption was negatively correlated with LDL-C levels ($\rho = -0.114$; $p = 0.011$), non-HDL-C ($\rho = -0.108$; $p = 0.016$) and TC/HDL-C ratio ($\rho = -0.114$; $p = 0.011$). In women, we did not find any statistically significant correlation between the frequency of fast-food consumption and blood lipid levels. However, in men we identified a statistically significant negative correlations between the frequency of fast-food consumption and TC ($\rho = -0.247$; $p = 0.002$), LDL-C ($\rho = -0.286$; $p < 0.001$), non-HDL-C ($\rho = -0.251$; $p = 0.001$) and TC/HDL-C ratio ($\rho = -0.181$; $p = 0.023$), indicating that among men, more frequent fast-food consumption was significantly associated with a worse lipid profile.

When comparing individual groups of respondents according to the frequency of fast-food consumption (Kruskal-Wallis test), we found

Table 1 Comparison of the lipid profile in women and men (median, interquartile range, Mann–Whitney test)

Parameter	Women (n = 341)	Men (n = 159)	p
Total cholesterol (mmol/L)	4.33 (3.88, 4.86)	4.21 (3.64, 4.82)	0.185
LDL-cholesterol (mmol/L)	1.87 (1.57, 2.34)	2.08 (1.59, 2.52)	0.036
HDL-cholesterol (mmol/L)	1.74 (1.51, 1.99)	1.40 (1.25, 1.62)	< 0.001
Triglycerides (mmol/L)	1.33 (0.98, 1.70)	1.40 (1.07, 1.87)	0.055
Non-HDL-cholesterol (mmol/L)	2.51 (2.17, 3.03)	2.75 (2.3, 3.33)	0.002
Total cholesterol/HDL-cholesterol	2.33 (1.93, 2.78)	3.09 (2.55, 3.54)	< 0.001

Table 2 Relationship between frequency of fast-food consumption and blood lipid levels

Parameter	B	95 % CI	p
Total cholesterol (mmol/L)	-0.103	-0.202, -0.004	0.042
LDL-cholesterol (mmol/L)	-0.208	-1.145, 0.730	0.663
HDL-cholesterol (mmol/L)	0.033	-0.011, 0.077	0.144
Triglycerides (mmol/L)	-0.029	-0.105, 0.046	0.445
Non-HDL-cholesterol (mmol/L)	-0.132	-0.222, -0.042	0.004
Total cholesterol/HDL-cholesterol	-0.120	-0.197, -0.404	0.002

Legend: B – unstandardized regression coefficient; CI – confidence interval; p – significance level

statistically significant differences in the levels of LDL-C ($p = 0.006$), non-HDL-C ($p = 0.024$) and the TC/HDL-C ratio ($p = 0.022$). The highest values of these parameters occurred in the group of respondents who reported almost daily fast-food consumption, which supports the hypothesis of a negative impact of frequent fast-food consumption on the lipid profile. Linear regression analysis showed that the frequency of fast-food consumption was a significant negative predictor of several lipid parameters. Specifically, less frequent consumption of fast-food predicted lower levels of non-HDL-C ($B = -0.132$; $p = 0.004$) and a lower TC/HDL-C ratio ($B = -0.120$; $p = 0.002$), indicating a more favorable lipid profile in respondents with a lower frequency of consuming such a diet. Although the association between frequency of consumption of fast-food and TC was less pronounced, the result was statistically significant ($B = -0.103$; $p = 0.042$). In contrast, the relationship between frequency of consumption of fast-food and LDL-C, HDL-C, and TG levels was not statistically significant (Table 2).

DISCUSSION

There is growing global concern regarding fast-food consumption and its related cardiometabolic outcomes [14]. As shown by a systematic review by Jardim et al. [15] ultra-processed foods, which also include fast-food, may increase the risk of noncommunicable chronic diseases, whereas natural foods may reduce it. Ultra-processed foods not only introduce poor-quality nutrients and ingredients, including refined carbohydrates and simple sugars, into

the diet, but also displace healthy whole foods, such as fruits and vegetables. Key biological pathways include altered serum lipid concentrations, modified gut microbiota and host–microbiota interactions, obesity, inflammation, oxidative stress, dysglycemia, insulin resistance, and hypertension [16]. In the Framingham Offspring Study, after 18 years of follow-up, each additional daily serving of ultra-processed foods was associated with a 7% increase in the risk of incident CVD [17].

In our cross-sectional study of a sample of 500 healthy and highly educated medical students, we confirmed that a higher frequency of fast-food consumption was negatively associated with several lipid profile parameters. These findings are consistent with studies that have shown an association between fast-food consumption and an unfavorable lipid profile [5, 9, 11]. For example, Yoon et al. [9] found among a sample of young Korean adults that frequent fast-food consumption increased the risk of obesity and dyslipidemia, especially when accompanied by irregular eating or skipping breakfast. Similarly, Marrat et al. [18] found in a sample of 367 healthy adolescents aged 11 to 18 years that skipping breakfast and fast-food consumption appear to be related to important metabolic syndrome biomarkers for chronic disease.

Li et al. [10] also highlighted the negative impact of consuming highly processed foods on the metabolic health of students in their systematic review. From a mechanistic perspective, it can be assumed that a diet rich in saturated fats, trans-fatty acids, and simple sugars (typical of fast-food) promotes

the formation of atherogenic lipoproteins, especially by increasing non-HDL-C and decreasing HDL-C levels [12].

Similarly, Bahadoran et al. [14] in their longitudinal study of 1,476 adults in mean age 37.8 ± 12.3 years confirmed that fast-food consumers were significantly younger, and that higher fast-food consumption was accompanied by a greater increase in TG levels and TG/HDL-C ratio after a 3-year follow-up. Conversely, a diet with an emphasis on a low glycemic index, a higher proportion of fiber, and healthy fats (e.g. containing omega-3 fatty acids) leads to favorable changes in the lipid profile [6].

Our results also suggest a significant sex difference – women reported a better adherence to the healthier dietary pattern and at the same time had more favorable lipid parameter values (higher mean HDL-C level, lower TC/HDL-C ratio). Although this difference may also be related to hormonal and metabolic factors, nutritional behavior and motivation for a healthier lifestyle also seem to play a role [19].

Medical students should have an above-average knowledge of the healthy dietary pattern principles and it is important that they follow them as well. In our sample, students who had better adherence to the healthy dietary pattern, consumed fast-food significantly less often and had more favourable lipid profile. As shown by the results of several studies, greater adherence to various healthy eating patterns was consistently associated with lower risk of CVD, with a lower prevalence of metabolic syndrome and its components and was associated with reduced risk of all-cause mortality, as well as cardiovascular and/or cancer mortality [20-22].

CONCLUSIONS

Our results showed a less favorable lipid profile in men compared to women, especially with regard to LDL-C, non-HDL-C and TC/HDL-C ratio. They also showed significant differences in the lipid profile of medical students depending on the frequency of fast-food consumption. Less frequent consumption was associated with a more favorable lipid profile, indicating a potentially lower cardiovascular risk.

Starting university studies is an important milestone in the lives of young people, in which new life habits are formed or already established ones are modified. If negative changes in lifestyle become

routine, the consequences may negatively affect a person's health in the future, therefore it is necessary to know the individual factors of their lifestyle, especially eating habits, for effective prevention. Our results support the need for more research to determine the link between fast-food consumption and cardiovascular risk, as well as for targeted interventions and education in the field of nutrition during university studies to prevent the long-term consequences of an unhealthy lifestyle. Identification of risk factors, such as frequent consumption of fast-food, can contribute to the effective prevention of chronic diseases in later life.

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