



ASSOCIATION BETWEEN THE TEMPORAL EATING PATTERNS AND DIETARY QUALITY IN A SERBIAN POPULATION SAMPLE



Milica Zeković^{1*}, Zora Đurić², Marina Nikolić³, Melissa Plegue², Marija Glibetić¹

¹Center of Research Excellence in Nutrition and Metabolism, National Institute for Medical Research, University of Belgrade, Belgrade, Serbia; ²Department of Family Medicine, Rogel Cancer Center, University of Michigan, Ann Arbor, MI, USA; ³European Food Safety Authority, Parma, Italy

BACKGROUND

• Meal timing, regularity, and frequency of eating occasions may have a significant impact on health due to the complex interplay between dietary intake, circadian rhythms, metabolic and physiological factors. Chronological aspect of nutrition is an promising field of research that refers to the temporal variations in the distribution of food and beverage consumption or patterning of eating occasions, including main meals and snacks, across the day.

OBJECTIVE

• This study aimed to evaluate whether meal timing is related to diet quality in a Serbian nationally representative sample as determined by the latest census and three stratification layers (age, gender, and region of residence).

METHODS

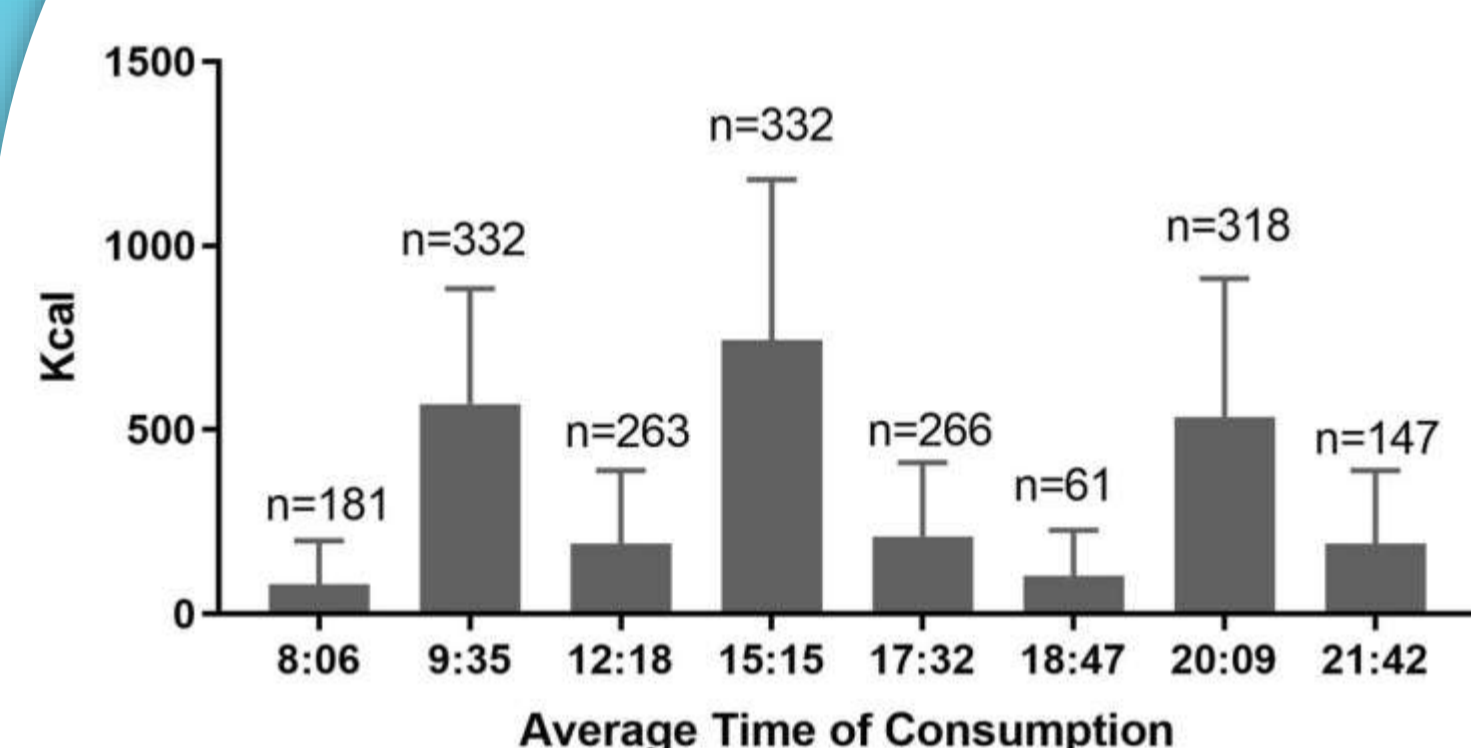
• The dietary assessment was conducted following the strict guidelines of the European Union (EU) Menu methodology: consumption estimation was based on two interviewer-administered non-consecutive 24-h recalls conducted with an interval of at least one week. Questionnaires were processed with Diet Assess & Plan, advanced nutritional software, and nutrient intake calculations were performed using the Serbian Food Composition Database.

• The eating occasions were denoted in the data output as before breakfast, breakfast, morning snack, lunch, afternoon snack, dinner, and after dinner snack. The times for each eating occasion for each subject across the 2 days of intake were averaged.

• The dietary quality score (DQS) was computed for each participant and it integrated one point for meeting each of the EU Science Hub recommendations for 5 items: fruits and vegetables, fiber, saturated fat, sugar, and sodium.

RESULTS

• The dietary intakes of children aged 10–17 (n=74) and adults aged 18–74 (n=260) were similar and high in total fat intake, with an average of 40% of energy derived from fat.



Mean energy intakes (with SD) across eating occasions in 334 adults and children: Breakfast was at about 9 am, lunch at 3 pm and dinner at 8 pm. The other eating occasions were reported as snacks. For both children and adults, linear mixed models indicated that lunch had a significantly higher calorie content than either breakfast or dinner, and there were no significant differences in calorie content between breakfast and dinner

• Mean fruit and vegetable intakes (463±288 g/day) exceeded the threshold of EU recommendation. Fiber was derived mainly from three groups of foods: fruits and vegetables (38%), grains (33%), and seeds and nuts (12%). Mean fiber intake reached the recommendation for consuming at least 14 g/1000 kcal only in adults of ages 65–74.

• Only 12 adults and one child had a maximal DQS of 5, and 78% of adult subjects had scores of 3 or lower. Among the 260 adult subjects, there were 139 with at least 400 g/day fruits and vegetables, 130 with at least 14 g fiber/1000 kcal, 90 with less than 10% of energy from sugar, 66 with 2.3 g or less of sodium/day, and 58 with a diet < 10% of energy from saturated fat.

• The most worrisome aspects of the Serbian diet were high intakes of saturated fat, sugar and sodium.

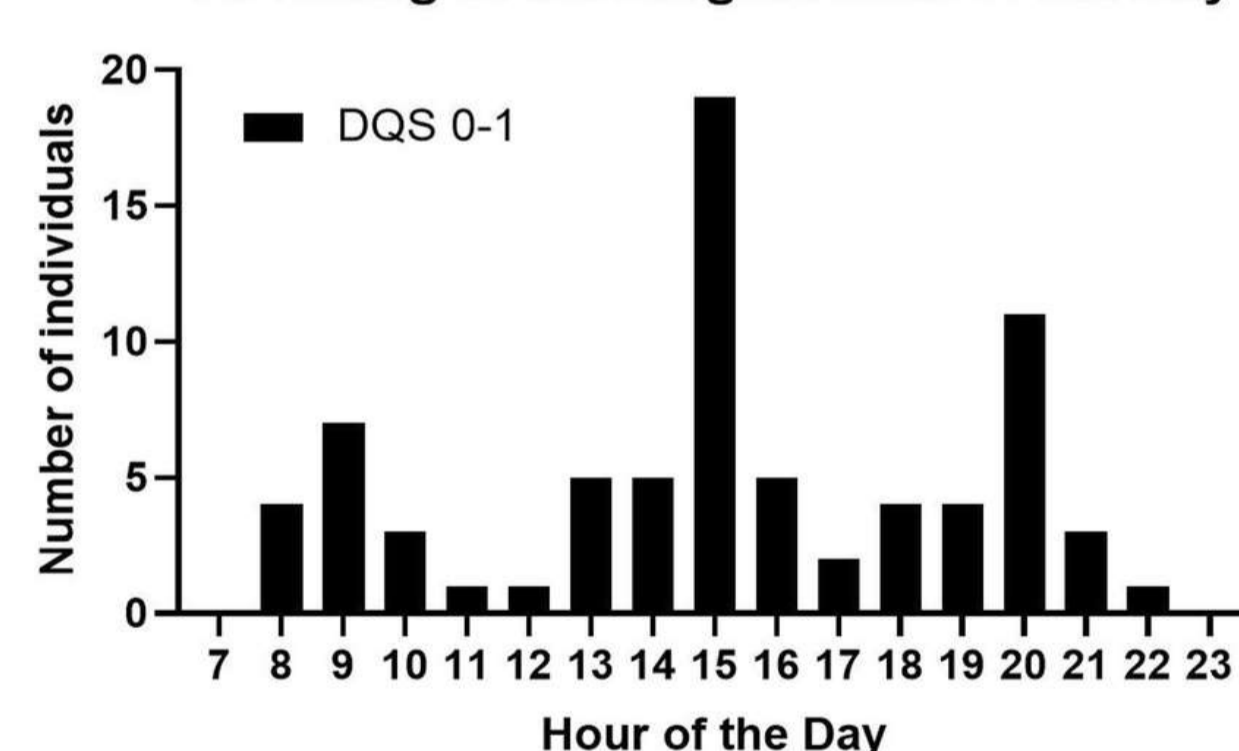
Nutrient intakes in the Serbian population sample

Nutrient	Children (ages 10–17) n = 74	Adults (ages 18–74) n = 260	All subjects, n = 334
Energy (kcal/day)	2280 (951)	2265 (987)	2268 (978)
Carbohydrate (% of energy)	46 (8)	44 (10)	44 (10)
Protein (% of energy)	15 (4)	16 (4)	15 (4)
Fat (% of energy)	39 (8)	40 (9)	40 (9)
Saturated Fat (% of energy)	12 (4)	13 (4)	13 (4)
Fiber (g/1000 kcal)	8.1 (3.4)	10.9 (6.4)	10.3 (6.0)
Fruit (g/day)	169 (173)	184 (188)	181 (184)
Vegetables (g/day)	256 (200)	289 (207)	281 (205)
Fruit and Vegetables (g/day)	424 (259)	473 (295)	463 (288)
Sodium (g/day)	3.66 (2.69)	3.99 (3.00)	3.92 (2.93)
Sugar (% of energy)	13.6 (6.4)	13.2 (7.4)	13.3 (7.2)
Water (ml/day)	1996 (1327)	2246 (1333)	2191 (1334)
Protein, g/kg body weight	1.45 (0.56)	1.11 (0.46)	1.19 (0.51)
Energy density (kcal/g food)	1.01 (0.34)	0.89 (0.32)	0.92 (0.32)
% of energy consumed before 16:00	59 (16)	61 (18)	60 (18)
Number of eating occasions per day	6.1 (1.0)	6.1 (1.1)	6.1 (1.1)

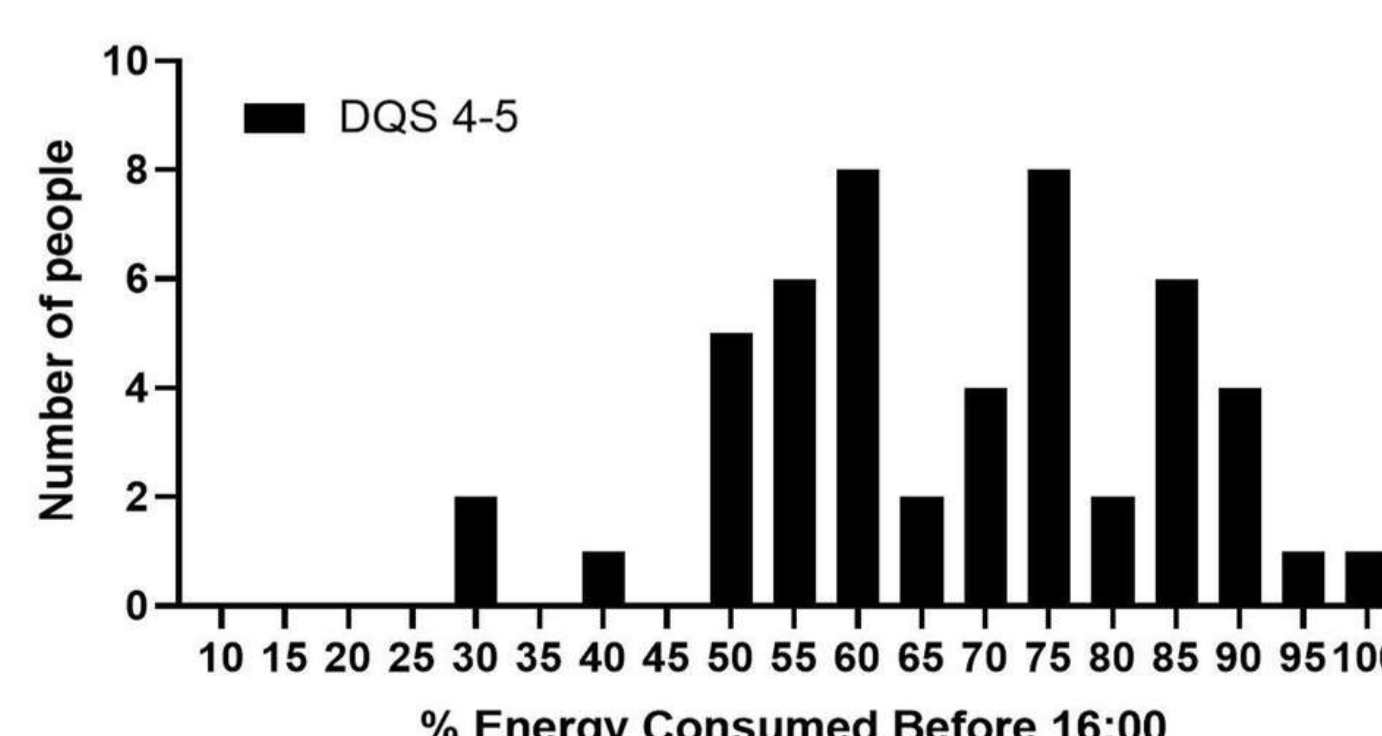
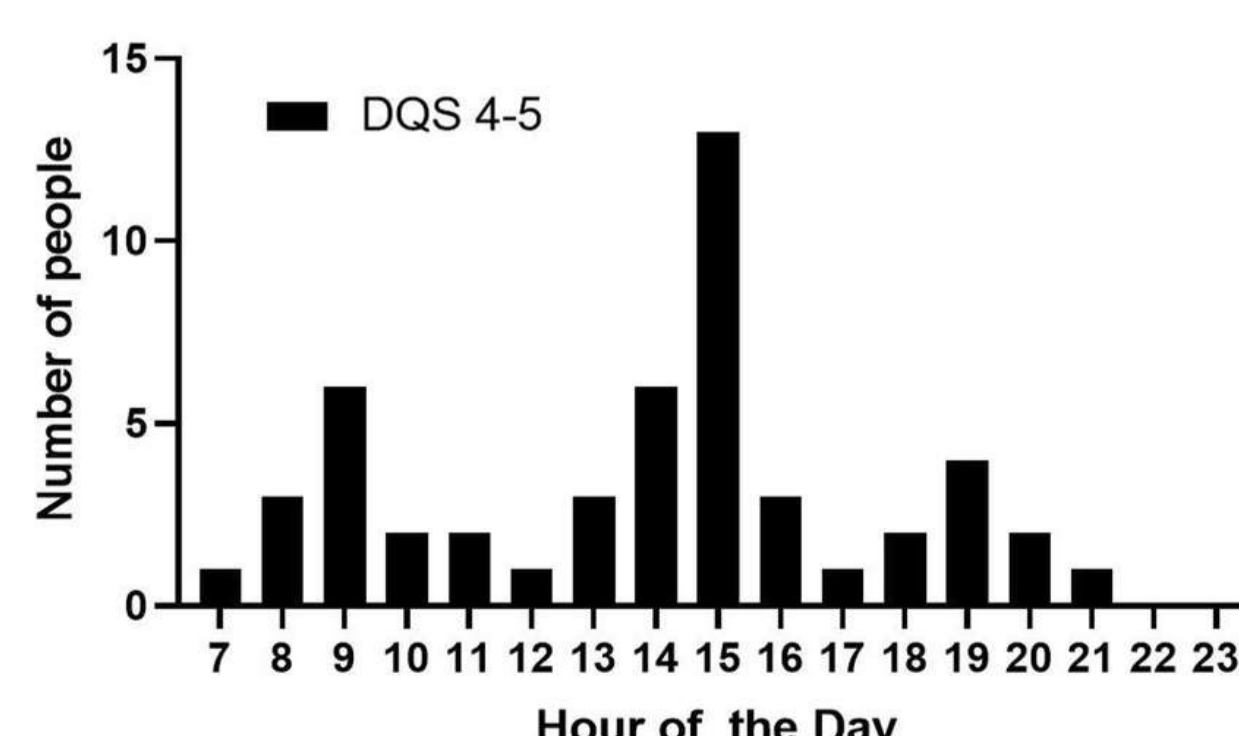
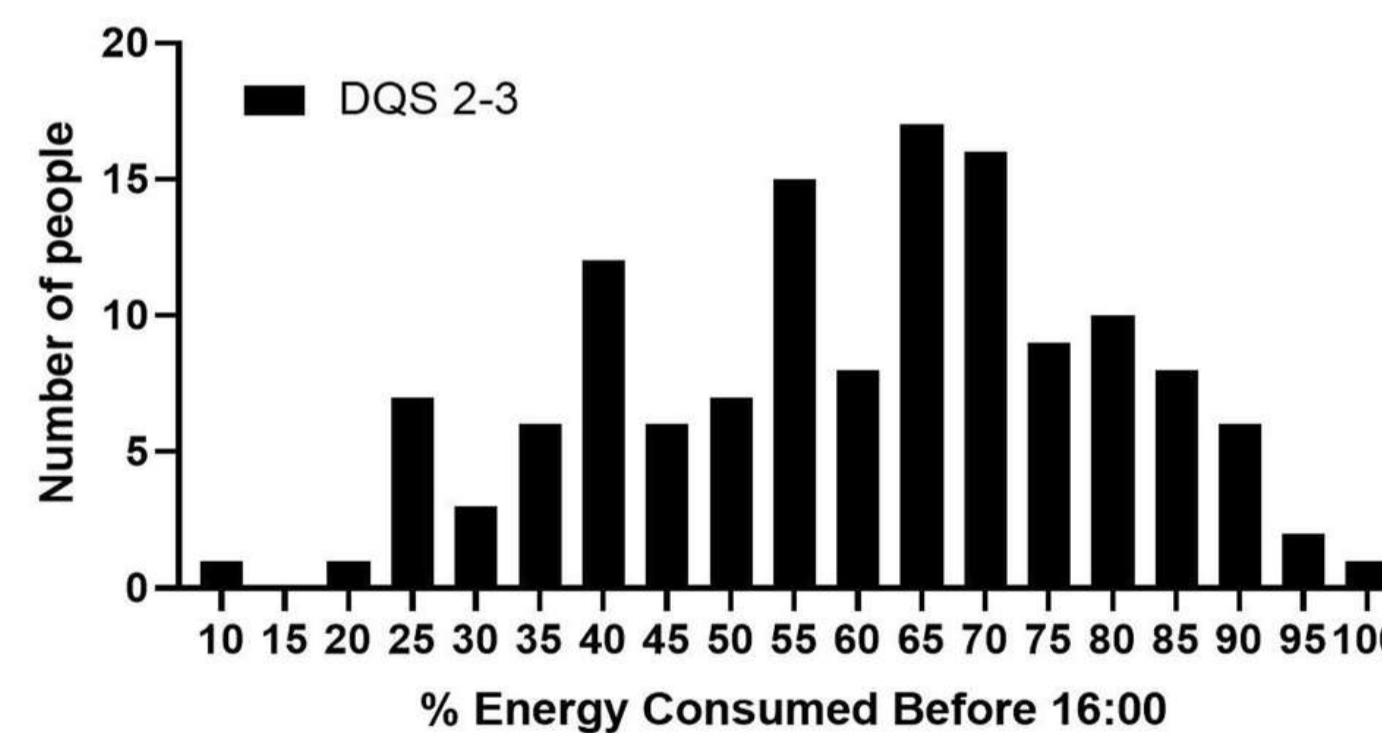
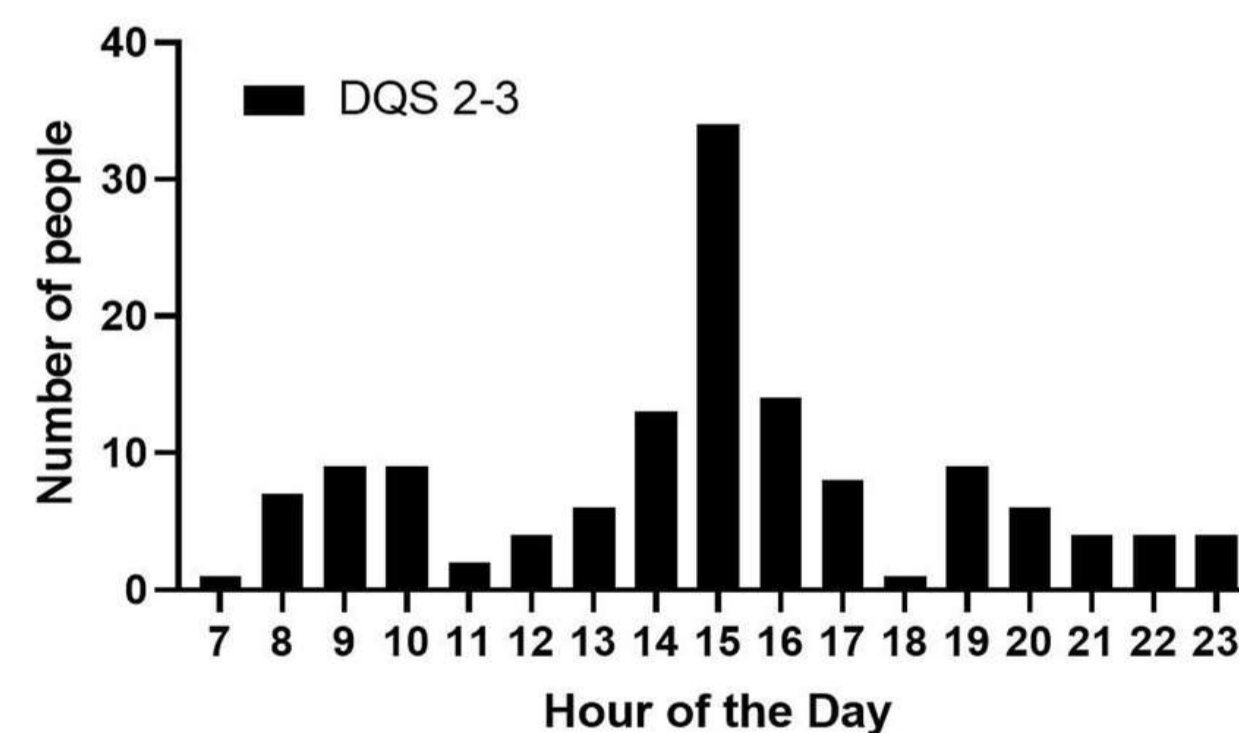
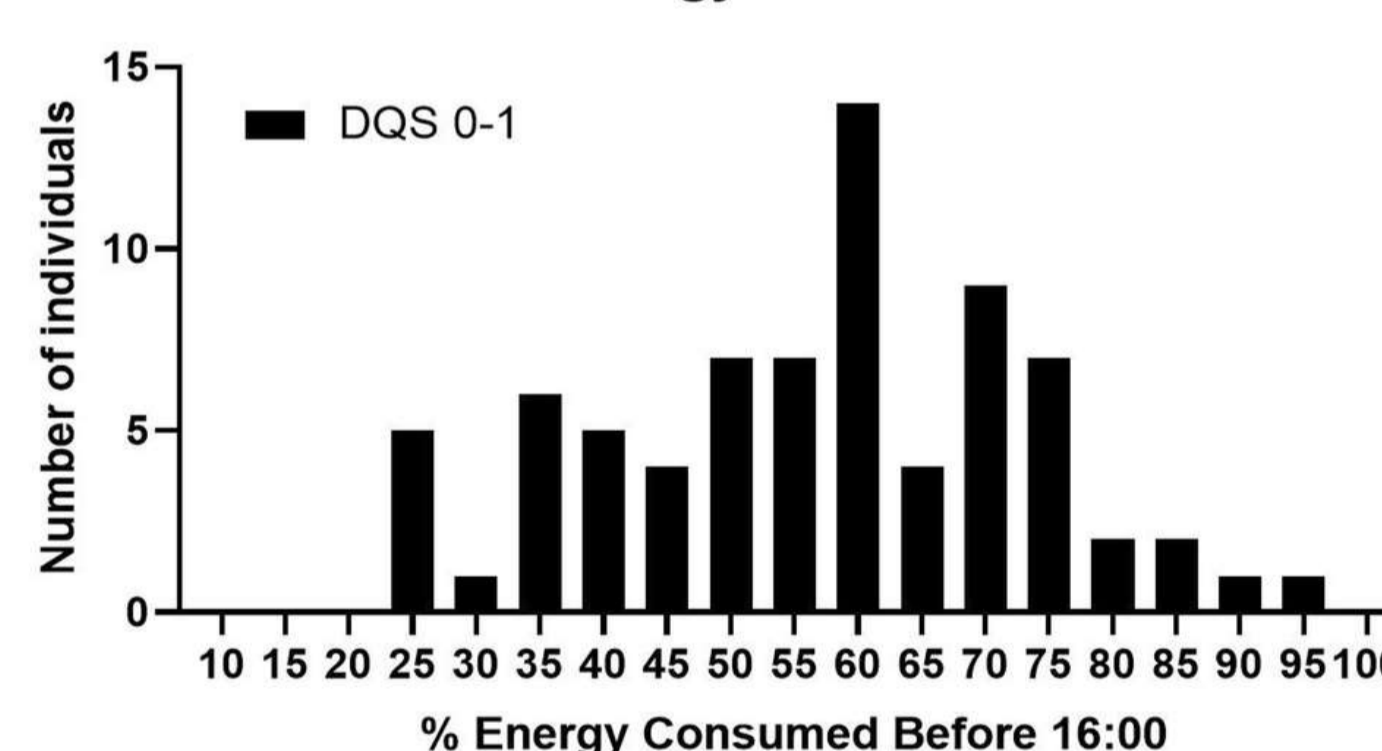
Characteristics of adult subjects who did or did not consume at least 60% of their daily energy intake by 16:00

Characteristic	Early eaters N = 133	Late eaters N = 127	P-value
Percent of calories consumed by 16:00	75 (9)	46 (12)	< 0.001
Total calorie intake, kcal/d	2135 (880)	2402 (1076)	0.029
Age, years	47.1 (16.6)	39.6 (15.2)	< 0.001
Female, number and %	72 (51%)	70 (48%)	0.874
Employed outside the home, number and %	78 (59%)	75 (59%)	0.764
BMI, kg/m ² (all data)	25.7 (3.7)	24.8 (4.4)	0.111
BMI, kg/m ² (measured only, n = 83 early, n = 68 late eaters)	25.6 (3.6)	24.5 (4.2)	0.103
Overweight or obese, number and %	51 (38%)	67 (53%)	0.153
Number of eating occasions/day	6.1 (1.1)	6.2 (1.0)	0.733
Energy density (kcal/gram food)	0.87 (0.28)	0.92 (0.35)	0.219
Fruits and vegetables, g/day	521 (332)	425 (242)	0.008
Fiber, g/1000 kcal	11.7 (7.1)	10.2 (5.5)	0.065
Saturated fat, % of energy	13.3 (4.7)	13.3 (4.3)	0.893
Sugar, % of energy	13.4 (8.3)	13.1 (6.2)	0.748
Sodium, g/day	4.1 (3.6)	3.9 (2.3)	0.636
Diet Quality Score of 4–5, number and %	40 (30%)	26 (21%)	0.075
Diet Quality Z-score	-1.76 (2.48)	-2.23 (1.87)	0.089

A. Timing of the Largest Meal of the Day



B. Percent of Energy Consumed Before 16:00



Timing of dietary intakes in adults who met 0–1, 2–3, or 4–5 of the EU dietary recommendations, indicated as Dietary Quality Scores (DQS). Data shown is number of adults as a frequency distribution for: A. Time at which the largest meal of the day was consumed and B. Percent of energy consumed before 16:00.



• For adults, the mean percentage of calories consumed by 16:00 was 60%. Using two-sample t-tests, adults who consumed at least 60% of their daily energy intake by 16:00 h versus those that did not, were older (mean age 47 vs. 40 years), and consumed greater amounts of fruits and vegetables (mean 521 v. 425 g/day).

• Early eaters also consumed less total calories per day (2135 v. 2402 kcal/day), but this was not significant after adjusting for multiple comparisons, and mean DQS was higher although not significantly so. Fruit and vegetable intakes were the main statistically significant difference in diet quality between early and late eaters.

• A later meal pattern with the largest meal consumed after 20:00 representing a shift from the traditional Serbian eating pattern was more prevalent in younger individuals, men, and working adults.

CONCLUSIONS

The findings of this study provide novel insight into temporal eating patterns among individuals residing in Serbia. Further research is warranted to explore the associations of these eating behaviors with health outcomes.

PUBLICATION

Z. Djuric, M. Nikolic, M. Zekovic, M. Plegue, and M. Glibetic, "Association of meal timing with dietary quality in a Serbian population sample," BMC Nutr., vol. 6, no. 1, 2020.