

# Analysis of dietary behaviour in physically active persons' cohort

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**Abstract.** Physical and psychological load need dietary support of energy by balanced diet. Dietary intake influences physical fitness and training performance outcomes of participants. The purpose of the study was to evaluate the nutrition behaviour from physically active persons and impact of nutrition knowledge on their nutritional behaviour. Respondents were at the age of 22-35 years. Respondents of study group got general knowledge about balanced diet in the nutritional education course. Respondents of the study group fulfilled the standardized questionnaire 'Diet 3-day menu diary' and standardized survey 'Physical activity during the current life period before and after nutritional education course. That allows researchers to evaluate the balance between daily intake for energy recovery and daily physical activity as energy expenditure. The study was carried out according to ethical rules for obtaining and processing data. All obtained data was anonymised. The results of the study could be used to develop appropriate diet planning during the pre-training period before planning physical exercises with high physical and psycho-emotional load to improve exercise performance.

## 1 Introduction

Nowadays society members are interested in a healthy lifestyle and diet that support physical health, welfare, and physical working capacities. Health status and physical fitness are indirectly related to dietary habits [1, 2]. Physical load varied in a wide spectrum from low to high. Therefore, knowledge and understanding of the importance of dietary support is an essential point for individual physical fitness and benefits of the results. There is a special diet with a high level of fat components that supports physical capacities during high load physical activities during intensive training schedule [3, 4]. Balanced diet is essential to support as physical as well mental activities during high load of physical exercises [5, 6]. The important point in developing physical fitness is physical capacity restoration regime that supports renewal processes after physical load [7, 8]. Studies concerning the dietary requirement of sportsmen are applicable for physically active persons whose daily regime correlate also to physical load level and endurance exercises plan [9]. A balanced diet provides energy requirements for physical activities and improves performance results. It increases muscle strength components, physical fitness, and endurance, as well as favours renewal processes in the body including recovering processes

after injuries [1, 10-12]. Nutritional education course is important for planning a balanced diet for physically active persons. A healthy diet provides suitable consumption of the components and corresponding metabolic processes. A balanced diet is essential to realize valuable optimal physiological processes in situations of changeable environment with adequate physical and mental activity, which is vitally essential [11, 13]. The balanced diet includes nutrient components in adequate quality and quantity that provides metabolic processes with energy for restoring renewal and growth processes as well as formation of muscular energy reserves and ensures optimal physiological processes [14, 15].

The main topical nutrients are proteins, carbohydrates, and fat. The essential component of the diet is water, various microelements (calcium (Ca), magnesium (Mg), zinc (Zn), iron (Fe), potassium (K), sodium (Na), and vitamins [5, 16]. Balanced diet favours the formation of physical and cognitive working capacities, components of physical endurance. The setting of fatigue is delayed and adequate restoration processes after physical load set in, as well as traumatic injuries diminish, and optimal body composition establishes [6, 11, 17].

## 2 Materials and methods

The study group involved physically active persons- ( $N = 42$ ) of both genders aged from 22 to 35 years. The average age was 24.7 years. Study group participants were involved in a six-month pre-training phase before the high physical load exercises. The participants had nutrition education course (8 acad. hrs), where they discussed topic "Dietary base and its adaptation to physical load". We provided two quizzes - a quiz according to standardized methodology at the beginning of nutrition education course (Quiz 1) and after nutrition education course (Quiz 2) with evaluation of quizzes' results in 1-10-point system. Respondents completed the three-day dietary diary questionnaire twice: before nutritional education course (Diet 1<sup>st</sup>) and after nutritional education course (Diet 2<sup>nd</sup>). The diary questionnaire was developed according to standardised dietary epidemiology guidance [18]. The quiz was developed according to standardised methodology [19] 'Dietary base and its adaptation to physical load'. Evaluation of daily physical activity responses provided by using approved standardized questionnaire [20]. Assessment of physical activity level fixed physical activity type, intensity, and duration and calculated the basal metabolic rate [21, 22]. Total daily energy expenditure that required maintaining current weight calculated according to the Harris-Benedict calculator.

The study was carried out according to ethical rules for obtaining and processing data. The Medical Ethics Committee of the Riga Stradins University (Riga, Latvia, No. 6-3/2/59) has approved the study protocol for biomedical research. Data collection and evaluation made according to UK program Dietplan7 (Forest field Software. 2015). The statistical analysis was performed using IBM SPSS Statistics 27.0 version. The collecting data allowed calculate the amount of daily dietary components (proteins, carbohydrates, fat) in diet before nutritional education course and in diet after nutritional education course and provided analysis that included descriptive statistic parameters (the median (Mdn), first quartile (Q1) and the third quartile (Q3) of daily dietary components and total energy consumption. We provided analysis across the BMI respondents' groups with standard level of BMI when BMI is into interval 18.5-24.9 and with overweight level of BMI when BMI is into interval 25.0-29.9. in diet before nutritional education course and diet after nutritional education course the main components and total diet energy (in kcal). Comparison between two BMI groups (standard BMI < 25 and overweight BMI > 25) was undertaken using Mann-Whitney U Test because of the non-normal distribution of the data.  $P$  values < 0.05 were considered statistically significant.

### 3 Results

Before analysis of dietary behaviour in study group we characterized the physical activity level according questionnaire data. That shows different physical activity levels of respondents (Table 1). The respondents of the study group provided self-assessment of the level of physical activities by using standardized questionnaire. Analysis of questionnaire data showed variations of daily physical activity level from low to high: 21.4% of respondents had low level of physical activities. The moderate physical activities level was fixed for 61.9% of respondents. The high level of physical activities level noted for 14.3% of the respondents, but for 1 respondent (2.4%) physical activity level was unclear. The respondents had physical training activities according to the schedule with duration of 90 minutes, as well as participating in the additional (extra-scheduled) sports activities. Of the study group participants, 12% had additional physical training once a week, but 4.8% twice a week. The majority of respondents (69%) had physical training activities three to five times a week and a small number of respondents (7.1%) had physical activities six times a week.

**Table 1.** Assessment of respondents physical training activities in MET (metabolic equivalent of task).

| Activity type                       | Average | Minimal | Maximal | SD  | Median | Q1   | Q3   |
|-------------------------------------|---------|---------|---------|-----|--------|------|------|
| Age (in full years)                 | 25.5    | 22.0    | 34.0    | 3.6 | 24.0   | 23.0 | 27.0 |
| Path to daily working place, in MET | 2.4     | 1.4     | 3.5     | 0.5 | 2.0    | 2.0  | 3.0  |
| Leisure time activity, in MET       | 5.2     | 2.5     | 10.0    | 2.8 | 3.5    | 3.5  | 6.0  |
| Daily physical training, in MET     | 5.9     | 5.6     | 10.0    | 0.9 | 5.6    | 5.6  | 6.0  |
| Daily occupational activity, in MET | 3.5     | 2.5     | 5.5     | 0.9 | 3.5    | 2.5  | 3.5  |

We provide a transition of the daily physical activity level in MET to the daily physical activity level in kcal. After that, we calculated the daily dietary for energy recovery in kcal according to questionnaire-dietary diary data. We provided evaluation of the daily dietary card in kcal to recover its expenditure during physical training for men and for female.

General recommendations for physically active individuals have shown that the components of the diet should be in the following relations: proteins (15%), carbohydrates (60%), and fat (25%) with increase in carbohydrates and proteins if the total value of the diet in kcal is greater than 5000 kcal [ 9]. The evaluation of dietary intake before nutritional education course (Diet 1<sup>st</sup>) showed that the protein-carbohydrate-fat components were in inadequate balance (Table 2).

Fat consumption was high. The median fat value for males was 149.7 g (with changes from 116.3(Q1) to 194.3(Q3) and for females the median of fat consumption was 108.7 g (with changes from 58.9(Q1) to 162.4(Q3)). That composed recommended by dietary specialists average value of fat component in diet. The dietary specialists recommended fat components about 130 g per day that corresponded to 30% of total energy value of the diet in kcal. Analysis of water consumption in dietary intake of respondents showed that the average water consumption according dietary diary was 1577 ml (Mdn) per day for males and 1280 ml (Mdn) per day for females, which was below dietary specialists' recommendations (3100 ml per day). The effectiveness of body energy support for covering physical activity requirements increased when carbohydrates and water consumption grew

up, but fat components value in the diet decreased. The median value of carbohydrate consumption in respondents' group for males was 269.9 with changes from 217.2(Q1) to 364.0(Q3) and for females, the median of carbohydrate consumption was 227.9 g (with changes from 100.9(Q1) to 323.4(Q3)). As to protein consumption, the median value for males was 133.8 g with changes from 102.8(Q1) to 184.6(Q3), but for females the median of protein consumption was 137.7g with changes from 97.6(Q1) to 153.0(Q3) that corresponded to dietary specialists' recommendation for physically active persons.

**Table 2.** Evaluation of the daily dietary components for male and female respondents before nutrition education (Diet 1<sup>st</sup>).

| Daily dietary Component value   | Average | Minimal | Maximal | SD     | Median | Q1     | Q3     |
|---------------------------------|---------|---------|---------|--------|--------|--------|--------|
| <b>Meal number</b>              |         |         |         |        |        |        |        |
| Male                            | 4.4     | 2.0     | 7.0     | 1.3    | 4.0    | 3.0    | 5.0    |
| Female                          | 2.8     | 2.0     | 3.0     | 0.5    | 3.0    | 2.3    | 3.0    |
| <b>Water ml</b>                 |         |         |         |        |        |        |        |
| Male                            | 1719.9  | 526.0   | 5871.0  | 1098.4 | 1577.0 | 895.3  | 1972.3 |
| Female                          | 1133.3  | 406.0   | 1567.0  | 542.9  | 1280.0 | 562.3  | 1557.5 |
| <b>Proteins g</b>               |         |         |         |        |        |        |        |
| Male                            | 144.6   | 71.8    | 241.0   | 48.2   | 133.8  | 102.8  | 184.6  |
| Female                          | 129.4   | 84.5    | 157.8   | 31.4   | 137.7  | 97.6   | 153.0  |
| <b>Fat g</b>                    |         |         |         |        |        |        |        |
| Male                            | 153.9   | 49.0    | 356.0   | 58.4   | 149.7  | 116.3  | 194.3  |
| Female                          | 110.0   | 48.8    | 173.7   | 53.5   | 108.7  | 58.9   | 162.4  |
| <b>Carbohydrates g</b>          |         |         |         |        |        |        |        |
| Male                            | 307.4   | 100.2   | 718.0   | 143.2  | 269.9  | 217.2  | 364.0  |
| Female                          | 217.4   | 73.9    | 339.9   | 115.5  | 227.9  | 100.9  | 323.4  |
| <b>Total energy value. kcal</b> |         |         |         |        |        |        |        |
| Male                            | 3131.1  | 1500.0  | 5923.0  | 1098.1 | 3152.0 | 2354.8 | 3636.8 |
| Female                          | 2324.5  | 1054.0  | 3212.0  | 990.2  | 2516.0 | 1298.8 | 3158.8 |

Assessment of dietary knowledge level showed that 41% of the respondents in the study group had a moderate level of knowledge about balanced dietary principles, which was similar with data about knowledge level control in the group of physically active persons carried out by other researchers [14].

Analysis of daily dietary intake after nutritional education (Diet 2<sup>nd</sup>) revealed that total daily energy consumption diminishes. It corresponded to average daily requirement (Table 3). Changes of dietary components (fat, carbohydrates, and proteins) were insignificant. Water consumption value per day increased. The mean value of water consumption for males was up to 1905.4ml (Mdn) per day with changes from 895.3(Q1) to 1972.3(Q3), and for females up to 2791.6 ml (Mdn) per day with changes from 562.3(Q1) to 1557.5(Q3). Adequate fruit consumption revealed 28% of respondents. Vegetable consumption corresponded to the guidelines for 49% of respondents and only 50% of respondents followed recommendations for adequate water consumption.

**Table 3.** Evaluation of daily dietary components in mean value after nutritional education (Diet 2<sup>nd</sup>) for male and female respondents.

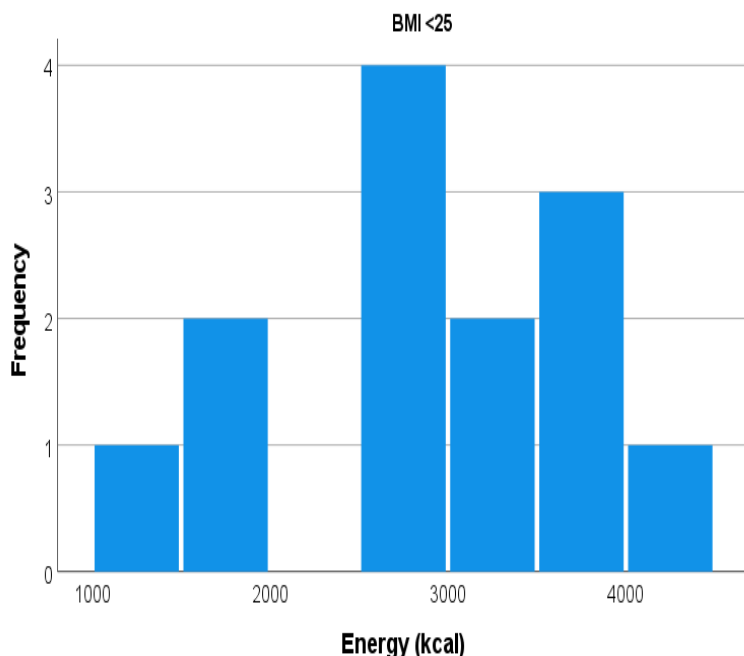
| Daily dietary component value  | Average | Minimal | Maximal | SD     | Median | Q1     | Q3     |
|--------------------------------|---------|---------|---------|--------|--------|--------|--------|
| <b>Number of Meals</b>         | 4.4     | 2.0     | 7.0     | 1.3    | 4.0    | 3.0    | 5.0    |
| Males                          | 2.8     | 2.0     | 3.0     | 0.5    | 3.0    | 2.3    | 3.0    |
| Females                        |         |         |         |        |        |        |        |
| <b>Water ml</b>                | 1911.5  | 1189.8  | 2980.3  | 410.9  | 1905.4 | 1628.9 | 2170.9 |
| Males                          | 2627.8  | 1052.2  | 3875.7  | 1205.7 | 2791.6 | 1395.6 | 3696.2 |
| Females                        |         |         |         |        |        |        |        |
| <b>Protein g</b>               | 130.0   | 66.4    | 217.9   | 30.5   | 12.7   | 108.0  | 141.1  |
| Males                          | 112.7   | 5.6     | 206.9   | 69.3   | 95.7   | 56.9   | 185.6  |
| Females                        |         |         |         |        |        |        |        |
| <b>Fat g</b>                   | 151.3   | 68.4    | 272.7   | 52.8   | 139.2  | 109.1  | 191.4  |
| Males                          | 94.5    | 64.0    | 140.7   | 35.1   | 86.6   | 65.7   | 131.2  |
| Females                        |         |         |         |        |        |        |        |
| <b>Carbohydrateg</b>           | 305.1   | 125.9   | 464.0   | 94.0   | 322.0  | 216.5  | 379.3  |
| Males                          | 202.8   | 134.2   | 316.7   | 84.0   | 180.1  | 137.0  | 291.3  |
| Females                        |         |         |         |        |        |        |        |
| <b>Total energy value kcal</b> | 3020.7  | 1556.0  | 4675.0  | 774.1  | 3136.0 | 2501.0 | 3658.0 |
| Males                          | 2053.0  | 1347.0  | 3274.0  | 906.2  | 1795.5 | 1355.8 | 3007.8 |
| Females                        |         |         |         |        |        |        |        |

Analysis of intake of fat-soluble vitamins before nutritional education course (Diet 1<sup>st</sup>) and after the course (Diet 2<sup>nd</sup>) revealed that recommended dose of fat-soluble vitamins was not achieved. That related to chosen products and their mass in the diet. Knowledge about the balanced diet is essential, but not sufficient for respondents to follow and achieve dietary recommendation. Therefore, it is important to use dietary supplements to reach the recommended daily dose of fat-soluble vitamins. Analysis of intake of water-soluble vitamins in diet before nutritional education course (Diet 1<sup>st</sup>) and after the course (Diet 2<sup>nd</sup>) showed that mean value exceeds recommendations of dietary specialists therefore there are no necessary corrections in daily intake. Nutritional education has an impact on the choice of products in the respondent's diet.

We provided anthropometric measurements for respondents of study group and calculated body mass index. After them, respondents were divided into two groups: respondents with standard BMI (BMI < 25) and respondents with overweight BMI (BMI > 25). The collected data allowed calculating the amount of daily dietary components (proteins, carbohydrates, fat) and total diet energy in kcal (Figs. 1 and 2) for respondents with standard BMI (BMI < 25) and for respondents with overweight BMI (BMI > 25).

The collected data showed that diet before nutritional education course as well as after nutritional education course contain high amount of fat components and low amount of carbohydrate components. Diet with restricted carbohydrates level, high fat level, and

moderate protein level leads to nutritional ketosis. Such diet represents an approach to enhance health, regulates body composition and keeps physical readiness.



**Figure 1.** Total energy level in diet of respondents with standard BMI value (BMI < 25).

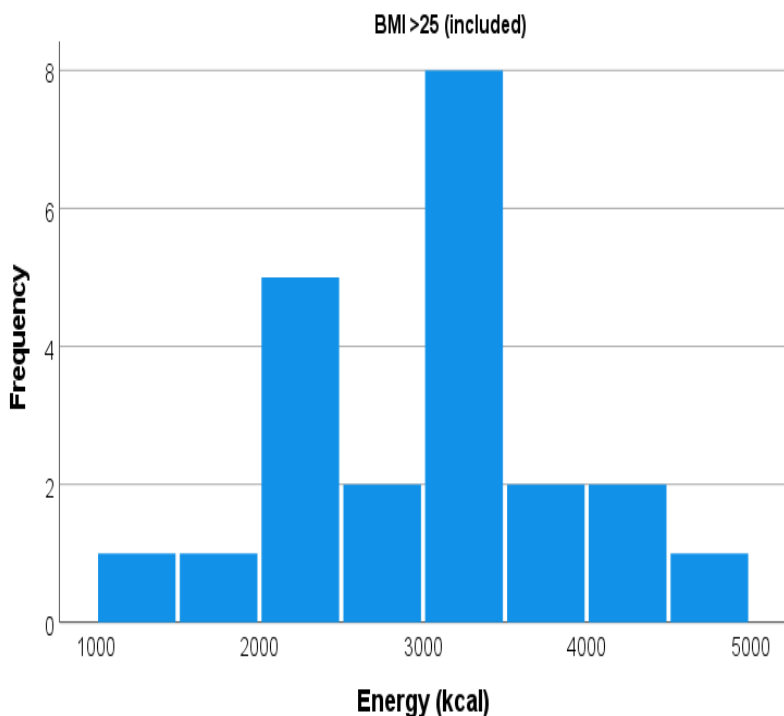
Data analysis showed that there were no statistically proved differences in total energy consumption level across respondents' groups with standard level BMI and with overweight level of BMI in diet before nutritional education course (Diet 1<sup>st</sup>) and after the course (Diet 2<sup>nd</sup>).

Analysis of dietary intake before nutritional education (Diet 1<sup>st</sup>) did not reveal any statistically exact significant difference of main diet components (proteins, carbohydrates, fat) level in respondents' diet with overweight BMI and in respondents' diet with standard BMI value (Figs. 3 and 4).

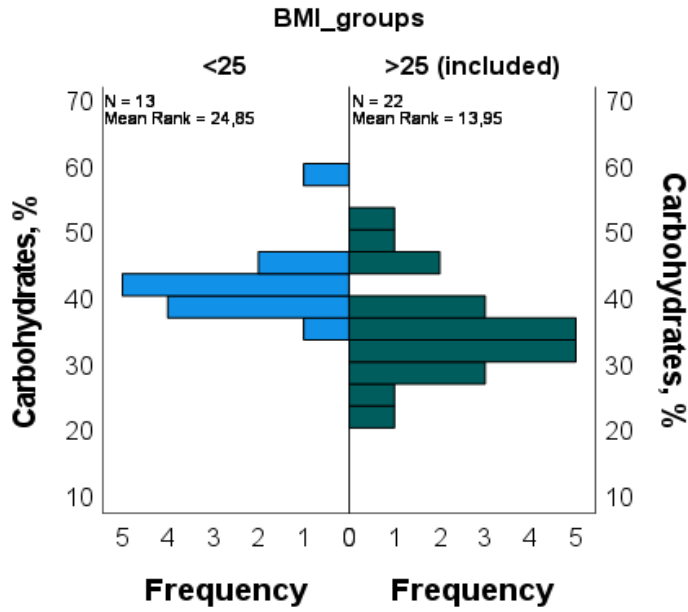
## 4 Discussion

Respondents from the study group showed a wide spectrum of individual habits of daily intake, which is found also in studies about dietary intake of physically active persons [4, 14]. The evaluation of the total mean value of the diet in kcal showed that for respondents of study group it was adequate and corresponded to the level of physical load. However, it is necessary to improve qualitative characteristics such as the balance of macro-components in daily consumption. The evaluation of the level of physical activity of respondents of study group showed that 61.9% of respondents had a moderate level of physical activity and for the 40.5% physical activity level was evaluated as a low. Nutritional education improved knowledge about balanced diet, which supported individual satisfaction and renewal of physical capacities after physical activities. The assessment of questionnaire data about knowledge of balanced diet showed that 59% of the respondents received positive evaluation (7.9 points of 10). Characteristics and assessment of the three-day dietary diary after the nutritional education course revealed positive changes in the

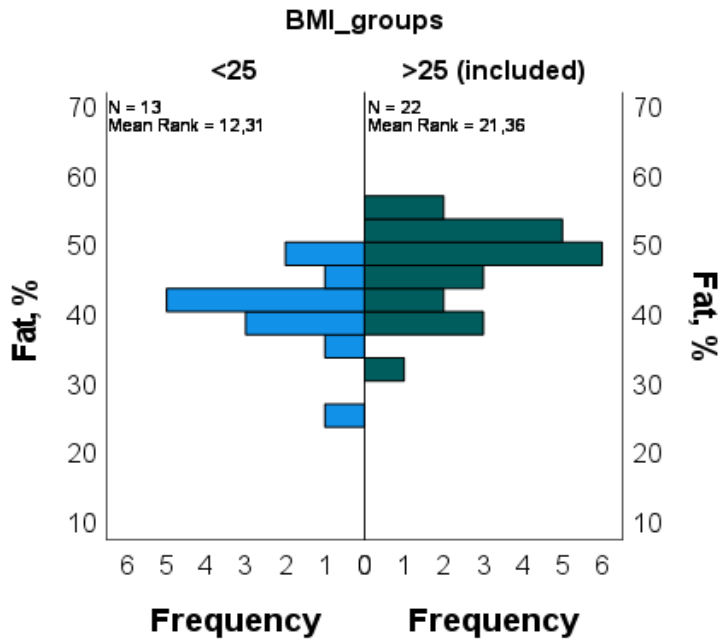
dietary habits of the respondents. The quality of the daily meals improved, especially in the group of respondents with overweight (BMI > 25). Analysis of post-course diet showed statistically exact significance of carbohydrates level and fat level in diet of respondents with overweight BMI. The total volume of energy of dietary components recovered energy expenditure during physical training for the study group. Assessment of quality of the diet showed that it depended on education level. The effectiveness of body energy support by diet increased when carbohydrate and water consumption grew up, but fat components in the diet decreased. Nutritional education has an impact on the choice of the diet's component. Consultations with nutritional specialists allow reaching an adequate and qualitative balanced diet. The recommended dosage of the intake of fat-soluble vitamins was not achieved. Therefore, it is important to use dietary supplements to reach the recommended daily dose of fat-soluble vitamins. The evaluation of daily water-soluble vitamin intake and daily mineral intake showed its correspondence to recommended daily dosage.



**Figure 2.** Total energy level in diet of respondents with overweight BMI value (BMI > 25).



**Figure 3.** Carbohydrate level in the diet after nutritional education course of respondents with overweight BMI (BMI > 25) and with standard BMI value (BMI < 25).



**Figure 4.** Fat level in the diet after nutritional education course for respondents with overweight BMI (BMI > 25) and with standard BMI value (BMI < 25).



## 5 Conclusion

Knowledge about balanced diet is essential for managing adequate dietary intake that improves the physical performance. Nutritional knowledge has positive impact on dietary behaviour. It improved after nutritional education. There is a difference in fat level and carbohydrates level in the diet of respondents with overweight BMI and with standard BMI value after nutritional education course. Nutritional education has an impact on the choice of products and diet's components. Eating habits indirectly related to health status and physical readiness.

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