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# Caries experience in a severely obese adolescent population

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**Aim.** The present study assessed caries experience in an adolescent population being treated for severe obesity. The DMFT indices of a group of obese adolescents ($n = 41$) and a group of nonobese adolescents ($n = 41$) were compared.

**Design.** The parameters examined in this transversal study were body mass index (BMI) and the number of decayed, missing, and filled teeth (DMFT). The obese and nonobese groups were matched by age, gender, and parental socio-occupational category. Differences between the two groups were assessed using nonparametric tests.

**Results.** There was a significant association between BMI and DMFT indices ($P = 0.01$) in the severely obese group. The obese adolescents were more likely to have caries than the nonobese ones.

**Conclusions.** The severely obese children ($n = 16$) had a high level of caries experience. Given the tremendous increase in the prevalence of obesity in children, dentists should promote a healthy diet not only to prevent dental decay but also to reduce the risk for obesity. Dentists should participate in multidisciplinary medical teams managing obese adolescents.

## Introduction

The prevalence of obesity in children has increased worldwide, especially among those with a low socio-economic background[1]. Childhood obesity presents both immediate and long-term health risks such as orthopaedic consequences, hypertension, hypercholesterolaemia, insulin resistance, and adult obesity. In France, the prevalence of excess weight and obesity was last evaluated at a national level in 2000. In children aged 7–9 years, the overall prevalence of excess weight/obesity, according to IOTF (International Obesity Task Force) criteria[2], was 18·1%, pointing to a dramatic increase since the 1970s[3]. In adolescents aged 10–17 years, the overall prevalence in 1998 was 15.3% when three distinct (rural, urban, Paris suburbs) areas were studied. The highest prevalence was observed around Paris (16.4%) and was correlated with lower family incomes[4].

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Oral health is strongly influenced by the intake of sugar-rich foods, and high dental decay scores are associated with an unbalanced diet[5]. Sugar-rich diets have been associated with various health problems such as obesity, bone loss, and bone fractures[6].

Few studies on the relationship between obesity and dental decay have been published to date. A recent literature review indicated that three studies have provided convincing evidence of a direct correlation between obesity and dental caries[6], while a survey of 3-year-old children found no correlation between carious deciduous teeth and weight status[7]. However, Willershausen *et al*. reported a statistical correlation between the increase in the frequency of dental decay and high weight in German elementary school children[8]. In 1989, Tuomi reported that obesity at young age and caries experience in children aged 5–13 were useful in predicting the risk of dental caries, especially in permanent second molars[9]. In 1995, Larsson *et al*. found that caries-prone adolescents were more obese and had higher blood pressures than caries-free adolescents[10].

The aim of the present study was to investigate the relationship between obesity and

caries experience in a severely obese adolescent population.

## Materials and methods

### *Subjects*

This transversal study compared the DMFT index of a group of severely obese adolescents to that of a nonobese group matched by age, gender, and parental socio-occupational categories using INSEE (French National Board of Statistics) criteria[11]). Eighty-two adolescents aged 12–18 (mean age 15 ± 1.5 years) from the suburbs of Paris were included in the study. None of them had taken part in a preventive dental programme. Forty-one children being treated for obesity were sampled and a control group was constructed.

The 'obese group' (OB) ($n = 41$) was composed of all adolescents treated in a special healthcare centre for the severely obese (Table 1). This residential weight loss programme included a balanced diet, physical activity, and psychological and educational support. Energy intakes were set at the national reference levels for adolescents of the same age and gender with low physical activity[12,13].

The 'nonobese group' (NO) ($n = 41$) was examined as part of a health education survey in a high school located in same suburb as the healthcare centre. They were matched with the OB group by age, gender (12 boys, 29 girls), and parental socio-occupational background (Table 2).

The body mass index [BMI; body weight/(body height)$^2$ in kg/m$^2$] was categorized using an internationally recognized classification system: low weight (BMI < 20), normal weight (20–24.9), high weight (25–30), and obesity (> 30)[14]. The obesity classification was further subdivided as follows: high (30.0–34.9), very high (35.0–39.9), and extremely high (≥ 40) (IOTF reference cut-offs)[2]. The subjects were weighed in light clothing in the morning using an electronic scale (Teraillon™, Terraillon, Chatou, France) to the nearest 100 g. Their height was measured using a wall-mounted stadiometer to the nearest 5 mm. In the obese group, the BMI values ranged from 29 to 66.6 (40.6 ± 7.3) while in the nonobese group, the BMI values ranged from 14.7 to 23.9 (19.8 ± 2.1).

**Table 1. Characteristics of subjects included in the obese group (rank based on increasing DMFT).**

| Patient | Gender | Age | BMI | SPC | D | M | F | DMFT | RI |
|---|---|---|---|---|---|---|---|---|---|
| 8 | F | 13 | 38.1 | 5 | 0 | 0 | 0 | 0 | / |
| 18 | M | 15 | 50.2 | 5 | 0 | 0 | 0 | 0 | / |
| 20 | M | 15 | 32 | 5 | 0 | 0 | 0 | 0 | / |
| 24 | F | 15 | 36.5 | 3 | 0 | 0 | 0 | 0 | / |
| 1 | M | 12 | 35.9 | 5 | 1 | 0 | 0 | 1 | 0 |
| 17 | M | 15 | 55 | 4 | 0 | 0 | 1 | 1 | 100 |
| 7 | M | 13 | 32.3 | 5 | 1 | 0 | 1 | 2 | 50 |
| 26 | F | 16 | 37.3 | 6 | 1 | 0 | 2 | 3 | 66.7 |
| 22 | M | 15 | 36.3 | 6 | 4 | 0 | 0 | 4 | 0 |
| 25 | M | 15 | 35.2 | 5 | 4 | 0 | 0 | 4 | 0 |
| 27 | F | 16 | 42.7 | 5 | 3 | 0 | 1 | 4 | 25 |
| 32 | F | 16 | 43.5 | 6 | 3 | 0 | 1 | 4 | 25 |
| 5 | M | 13 | 40.1 | 8 | 0 | 0 | 5 | 5 | 100 |
| 29 | F | 16 | 38 | 4 | 5 | 0 | 0 | 5 | 0 |
| 2 | M | 12 | 29 | 8 | 6 | 0 | 0 | 6 | 0 |
| 4 | F | 13 | 40.4 | 5 | 6 | 0 | 0 | 6 | 0 |
| 10 | M | 14 | 51 | 8 | 5 | 0 | 1 | 6 | 16.7 |
| 3 | F | 12 | 38.5 | 5 | 6 | 0 | 0 | 7 | 0 |
| 6 | F | 13 | 36.2 | 4 | 7 | 0 | 1 | 8 | 12.5 |
| 11 | F | 14 | 66.6 | 8 | 5 | 0 | 3 | 8 | 37.5 |
| 14 | F | 15 | 39.6 | 5 | 7 | 0 | 1 | 8 | 12.5 |
| 16 | F | 15 | 39.3 | 4 | 3 | 0 | 5 | 8 | 62.5 |
| 21 | F | 15 | 35.3 | 5 | 3 | 0 | 5 | 8 | 62.5 |
| 23 | F | 15 | 34.6 | 4 | 8 | 0 | 0 | 8 | 0 |
| 28 | F | 16 | 50.4 | 4 | 8 | 0 | 0 | 8 | 0 |
| 31 | F | 16 | 40.3 | 6 | 7 | 0 | 1 | 8 | 12.5 |
| 39 | F | 18 | 39.4 | 8 | 5 | 0 | 3 | 8 | 37.5 |
| 9 | F | 14 | 36.2 | 5 | 4 | 0 | 5 | 9 | 55.6 |
| 13 | F | 14 | 53.6 | 6 | 9 | 0 | 0 | 9 | 0 |
| 19 | F | 15 | 38 | 3 | 3 | 0 | 6 | 9 | 66.7 |
| 33 | F | 16 | 40.5 | 5 | 7 | 0 | 2 | 9 | 22.2 |
| 35 | F | 17 | 33.8 | 4 | 7 | 0 | 2 | 9 | 22.2 |
| 40 | F | 18 | 39 | 5 | 10 | 0 | 0 | 10 | 0 |
| 41 | F | 18 | 40.6 | 5 | 5 | 0 | 0 | 10 | 0 |
| 12 | F | 14 | 47 | 2 | 10 | 0 | 1 | 11 | 9.1 |
| 36 | F | 17 | 33.7 | 2 | 11 | 0 | 0 | 11 | 0 |
| 37 | F | 17 | 39.3 | 6 | 8 | 1 | 2 | 11 | 20 |
| 15 | M | 15 | 38.1 | 5 | 12 | 0 | 0 | 12 | 0 |
| 38 | F | 17 | 36.7 | 5 | 14 | 0 | 0 | 14 | 0 |
| 34 | F | 16 | 48 | 5 | 10 | 0 | 5 | 15 | 33.3 |
| 30 | F | 16 | 46.4 | 3 | 12 | 0 | 5 | 17 | 29.4 |

$N = 41$. F, female ($n = 29$); M, male ($n = 12$); age ranged from 12 to 18 years, mean = 15 ± 1.6; BMI, body mass index ranged from 29 to 66, mean = 40.6 ± 7.3; SPC, socio-occupational category [2 = merchants ($n = 2$), 3 = managers ($n = 3$), 4 = intermediate ($n = 7$), 5 = office workers ($n = 18$), 6 = manual workers ($n = 6$), 8 = no employment ($n = 5$)]; D, decayed; M, missing; F, filled; T, teeth DMFT = 0 (10%, $n = 4$); RI, restorative index ranged from 0 to 100 (mean 0.23 ± 0.3).

### *Dental examinations*

The same dentist (K.L.) wearing a facemask and vinyl gloves performed all the dental examinations using standard probes, nonmagnifying disposable mirrors, and an orthodontic chair with a regular spotlight. Dental screenings

**Table 2. Characteristics of subjects included in the nonobese group (rank based on increasing DMFT).**

| Patient | Gender | Age | BMI | SPC | D | M | F | DMFT | RI |
|---|---|---|---|---|---|---|---|---|---|
| 47 | F | 13 | 14.7 | 4 | 0 | 0 | 0 | 0 | / |
| 51 | F | 14 | 19.5 | 8 | 0 | 0 | 0 | 0 | / |
| 53 | F | 14 | 20.6 | 2 | 0 | 0 | 0 | 0 | / |
| 60 | F | 15 | 18.4 | 5 | 0 | 0 | 0 | 0 | / |
| 66 | M | 15 | 20.3 | 5 | 0 | 0 | 0 | 0 | / |
| 69 | F | 16 | 23.9 | 4 | 0 | 0 | 0 | 0 | / |
| 71 | F | 16 | 19.5 | 2 | 0 | 0 | 0 | 0 | / |
| 74 | F | 16 | 23.4 | 5 | 0 | 0 | 0 | 0 | / |
| 75 | F | 16 | 17.8 | 6 | 1 | 0 | 0 | 1 | 0 |
| 78 | F | 17 | 21.4 | 5 | 0 | 0 | 1 | 1 | 100 |
| 79 | F | 17 | 16 | 5 | 1 | 0 | 0 | 1 | 0 |
| 43 | M | 12 | 17.1 | 8 | 2 | 0 | 0 | 2 | 0 |
| 44 | F | 12 | 19.8 | 4 | 2 | 0 | 0 | 2 | 0 |
| 54 | F | 14 | 19 | 5 | 2 | 0 | 0 | 2 | 0 |
| 49 | F | 13 | 20 | 5 | 2 | 0 | 1 | 3 | 33.3 |
| 61 | M | 15 | 22.2 | 5 | 3 | 0 | 0 | 3 | 0 |
| 68 | M | 16 | 21.3 | 8 | 3 | 0 | 0 | 3 | 0 |
| 42 | M | 12 | 20 | 5 | 4 | 0 | 0 | 4 | 0 |
| 46 | M | 13 | 16.9 | 6 | 4 | 0 | 0 | 4 | 0 |
| 50 | M | 14 | 23 | 5 | 4 | 0 | 0 | 4 | 0 |
| 58 | M | 15 | 21.7 | 4 | 4 | 0 | 0 | 4 | 0 |
| 72 | F | 16 | 17.5 | 6 | 0 | 0 | 4 | 4 | 100 |
| 45 | F | 13 | 18.3 | 6 | 5 | 0 | 0 | 5 | 0 |
| 59 | M | 15 | 21.3 | 5 | 5 | 0 | 0 | 5 | 0 |
| 62 | F | 15 | 21.1 | 5 | 5 | 0 | 0 | 5 | 0 |
| 65 | F | 15 | 18.4 | 3 | 4 | 0 | 1 | 5 | 20 |
| 67 | F | 16 | 19.8 | 3 | 5 | 0 | 0 | 5 | 0 |
| 76 | F | 17 | 21.5 | 3 | 5 | 0 | 0 | 5 | 0 |
| 64 | F | 15 | 18 | 4 | 4 | 0 | 2 | 6 | 33.3 |
| 77 | F | 17 | 20 | 4 | 5 | 0 | 1 | 6 | 16.7 |
| 48 | M | 13 | 18.9 | 5 | 6 | 0 | 1 | 7 | 14.3 |
| 73 | F | 16 | 18.6 | 5 | 3 | 0 | 4 | 7 | 57.1 |
| 80 | F | 18 | 18.3 | 8 | 7 | 0 | 0 | 7 | 0 |
| 52 | F | 14 | 18.7 | 5 | 7 | 0 | 1 | 8 | 12.5 |
| 56 | F | 15 | 23 | 4 | 6 | 0 | 2 | 8 | 25 |
| 63 | M | 15 | 22.8 | 5 | 8 | 0 | 0 | 8 | 0 |
| 81 | F | 18 | 20.5 | 5 | 8 | 0 | 0 | 8 | 0 |
| 55 | M | 15 | 22.4 | 5 | 4 | 0 | 5 | 9 | 55.6 |
| 70 | F | 16 | 20 | 6 | 0 | 0 | 9 | 9 | 100 |
| 57 | F | 15 | 16.9 | 6 | 1 | 1 | 8 | 10 | 88.9 |
| 82 | F | 18 | 19 | 8 | 3 | 0 | 12 | 15 | 80 |

$N = 41$. F, female ($n = 29$); M, male ($n = 12$); age ranged from 12 to 18 years, mean = 15 ± 1.6; BMI, body mass index ranged from 14.7 to 23.9, mean = 19.8 ± 2.1; SPC, socio-occupational category [2 = merchants ($n = 2$), 3 = managers ($n = 3$), 4 = intermediate ($n = 7$), 5 = office workers ($n = 18$), 6 = manual workers ($n = 6$), 8 = no employment ($n = 5$)]; D, decayed; M, missing; F, filled; T, teeth DMFT = 0 (20%, $n = 8$); RI, restorative index ranged from 0 to 100 (mean 0.22 ± 0.3).

took place in the nurse's office of the obesity treatment centre and of the school. They were performed at the beginning of the interdisciplinary inpatient treatment, before dietary advice was provided. The caries experience of both groups was expressed using the DMFT index (number of decayed, missing, and filled teeth). Carious lesions were detected at the cavitation level. Radiographs were not used to identify carious lesions. The restorative index (RI) was then calculated using the following formula: $(F/D + F) \times 100\%$, (DMFT ≠ 0).

The parents or guardians of the subjects provided written, informed consent. The ethics committee of the Dental University of Paris 7 approved the study.

### *Statistical methods*

The nonparametric Mann–Whitney test was used to compare the DMFT indices and RIs of the NO and OB groups. The $\chi^2$-test was used to compare the DMFTs of the subjects in the OB group. All statistical analyses were performed using SPSS software (version 12.0 for Windows).

## Results

The characteristics of the subjects in both groups and the results are shown in Tables 1 and 2.

### *Mean DMFT*

The mean DMFT indices of the OB and NO groups were 6.9 ± 4.1 and 4.3 ± 3.5, respectively ($Z = 3.2$; $P = 0.002$). The mean number of decayed teeth was higher (5.3 ± 3.8) in the OB group than in the NO group (3 ± 2.5) ($Z = 2.9$; $P = 0.003$) (Fig. 1). The missing and

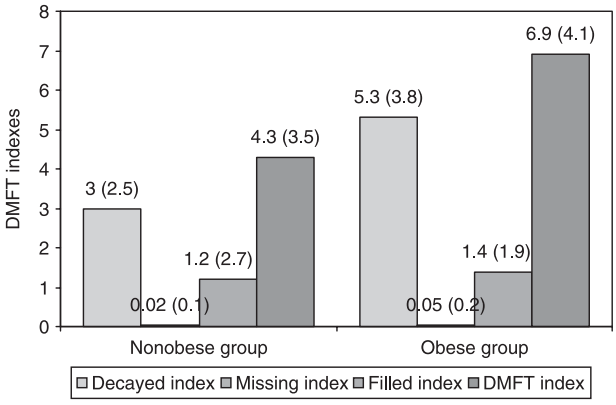


**Fig. 1.** DMFT indices (and components) (mean value, SD between brackets) in obese and nonobese children.

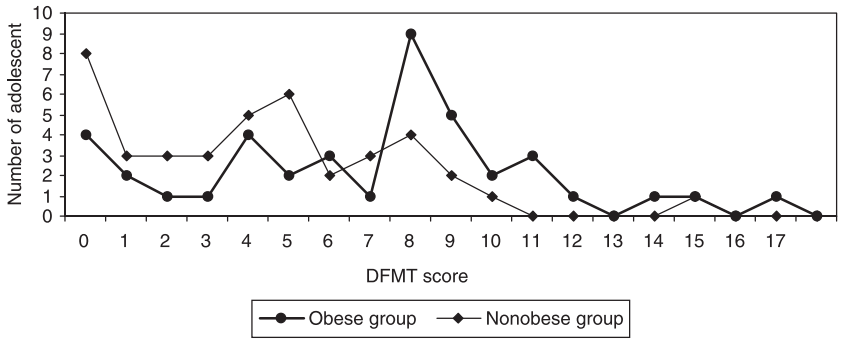


**Fig. 2.** Distribution of DMFT indices in obese and nonobese children. Number of subjects for each DMFT index. Bold line with circles: obese group; thin line with squares: nonobese group.

filled indices were very similar in both groups ($0.05 \pm 0.2$ and $1.4 \pm 1.9$, respectively, in the OB group and $0.02 \pm 0.1$ and $1.2 \pm 2.7$, respectively, in the NO group) ($Z = 0.6$; 1.6; $P = 0.56$; 0.11). The mean of the RI was almost identical in the two groups ($0.23 \pm 0.3$ in the OB group and $0.22 \pm 0.3$ in the NO group) ($Z = 0.9$; $P = 0.34$).

### *Distribution of the DMFT indices in the two groups*

The DMFT indices of the OB and NO groups were compared. The adolescents in both groups were divided into three subgroups: caries-free (DMFT = 0), intermediate (DMFT = 1–7), and high caries (DMFT = 8). Ten per cent ($n = 4$) of the OB group was caries-free compared to 20% ($n = 8$) of the NO group. Thirty-four per cent ($n = 14$) of the obese adolescents were in the high caries group. There were fewer obese (56%, $n = 23$) than nonobese adolescents (70%, $n = 29$) in the intermediate group (Fig. 2).

### *Obesity and caries experience as a function of parental socio-occupational background*

The distribution of parental socio-occupational backgrounds was similar in the two groups, with a middle-class background (employees and workers) predominating. In each socio-occupational category, the mean of the DFMT indices was higher in the obese group. No statistically significant difference in caries experience was observed, with the exception of the intermediate socio-occupational group ($\chi^2 = 4$, $P < 0.05$) (data not shown).

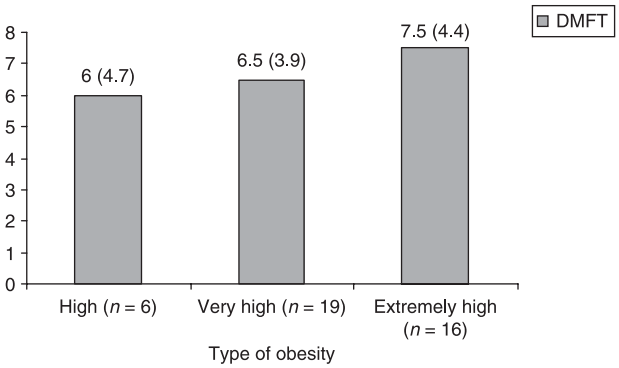


**Fig. 3.** Mean DMFT index as a function of level of obesity in obese adolescents. High obesity (BMI 30.0 to 34.9), very high obesity (35.0 to 39.9), and extremely high obesity (BMI > 40) (International Obesity Task Force).

### *DMFT vs. BMI*

In this limited sample of severely obese adolescents, higher DMFT indices correlated with higher BMI values (Fig. 3).

## Discussion

The present survey examined the caries experience of all the adolescents being treated for severe obesity in a residential healthcare centre. When considering the results presented, it should be kept in mind that there are some limitations inherent to this study, including the age span and gender discrepancy of the subjects. Since severe obesity is a rare disorder, it is difficult to collect information from large groups and groups with more confined age limits. In order to obtain more reliable and relevant results, multicentre studies need to be undertaken. The small sample size may explain

why the differences were not statistically significant. Another limitation of this study was its design, which may have underestimated caries experience because of the lack of intraoral radiographs.

Twice as many adolescents in the NO group were caries-free. DMFT indices were higher in the OB group than in the NO group, indicating that there was a significant association between obesity and caries experience. These results are in agreement with a Swedish study in which children with DMFT indices over 9 had significantly higher BMI values than caries-free children[9]. In the present study, caries experience was more pronounced in the OB group than in the NO group. The OB group had an average DMFT index of 6.9, compared to 4.3 for the NO group. The decay index was higher in the OB group than in the NO group. The number of filled teeth was similar in both groups, indicating that there was no significant association between obesity and dental care. These results are in agreement with another Swedish study of 15-year-old children[15] in which a significant positive correlation was found between DMFS indices and relative BMIs in the obese group. Similar observations were made in a Finnish study that reported a positive correlation between dental caries and BMI among adolescents[9]. An earlier study of German elementary school children reported a correlation between increased dental caries and high weight[8].

In the present study, the NO group had a high DMFT index (4.3). A 1999 study reported a DMFT index of 1.9 for 12-year-old French children[16], while a 1991 study reported a DMFT index of 4.1 for 15-year-old French adolescents[17]. These values are lower than those of both our NO and OB groups (4.3 and 6.9, respectively). This discrepancy may be due to differences in study design.

Other researchers have reported that the dental decay process in children is strongly associated with a lower socio-economic status[18,19]. Dental caries is a chronic disease that reflects the cumulative effects of biological and socio-economic background as well as behavioural factors such as food intake and dental hygiene[18]. The risk of obesity in children has also been associated with socio-economic status[20–22]. The present study confirms these findings with a statistical increase in caries experience in obese adolescents in an intermediate socio-economic environment. Individuals with lower socio-economic backgrounds are more likely to eat low-cost foods containing more sugar and fat that increase the risk of obesity and dental decay[23]. As with childhood caries, obesity is almost twice as likely to affect people on low incomes, with less education, and of specific ethnic origins[5,24,25]. The relationship between behavioural factors, dental decay, and obesity may also depend on gender and age[24,25].

Dental hygiene, intake of fluoride, and dietary habits (snacking) were not evaluated in the adolescent population we studied. In a future larger survey, it would be of interest to assess the impact these factors have on caries experience in obese adolescents. While early onset obesity was not assessed in the present study, the ingestion of glucose as well as high carbohydrate diets have been shown to have an impact on calcium-phosphate metabolism[26]. Poor eating habits in early childhood, especially during tooth development, can impair tooth mineralization and increase the risk of caries[27,28]. However, further studies are required to confirm these findings. Obesity and early caries might be helpful in predicting second molar caries[9]. The findings of the present study are also meant to be used in future preventive programmes[15,29].

In conclusion, both obesity and caries have common determinants and require a comprehensive, integrated management approach by multidisciplinary medical teams[29]. Paediatric dentists should thus be involved in the multidisciplinary inpatient management of obese

**What this paper adds**

- Within the limitations of the present study, we showed that obese adolescents have a higher caries experience than nonobese adolescents.

**Why this paper is important to paediatric dentists**

- Dentists should promote healthy diets not only to prevent dental caries but also to reduce the risk of childhood obesity.
- Dentists should be part of the multidisciplinary medical team managing the treatment of obese adolescents.

children. Healthcare professionals are trusted by both children and parents and are thus in a position to discuss the weight and dental status of adolescents and make credible recommendations for a well-balanced diet and for physical activity.

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