The Impact of COVID-19 Lockdown on Weight Loss Program in Infertile Polycystic Ovary Syndrome Women with Obesity

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Keywords

COVID-19 · Lockdown · Obesity · Polycystic ovary syndrome · Weight loss program

Abstract

Introduction: Lockdown due to the COVID-19 pandemic has caused gym closures and adjustments to ongoing weight loss programs were needed in order to keep the programs running. Little is known whether adjustments affected the success of weight reduction. Weight reduction of at least 5% is related to improved fertility and better pregnancy outcomes in obese women. This study compared success of the weight loss program in infertile polycystic ovary syndrome women with obesity who attended the program before and during lockdown due to COVID-19 pandemic. Furthermore, we checked whether there were any differences in spontaneous pregnancy rates between both groups at the end of the program. **Methods:** Altogether, 27 women were prospectively included to the weight loss program. Twelve women attended the 8 – week program before COVID-19 pandemic. Fifteen women began the program before the lockdown and ended it during lockdown. Due to lockdown, the program was prolonged for 4 weeks and taken online. **Results:** On average, prior to lockdown women achieved a

BMI reduction of 6.8% whereas women that attended the program during the lockdown reduced their BMI for 3.7%. This difference was not statistically significant. No significant differences were seen in other measured anthropometric and endocrine parameters between both groups. Furthermore, there were no differences in spontaneous pregnancy rates between both groups. In women who reduced their BMI for 5% or more, spontaneous pregnancy rate was 29.4%. **Discussion/Conclusions:** Although statistical significance has not been reached in the present study, we have shown that lockdown due to COVID-19 pandemic has led to almost half lower BMI reduction despite adaptations and longer duration of the weight loss program. On average, BMI in the group of women that attended the program during lockdown was 3.7% lower after the end of the weight loss program. This means they did not reach the wanted 5% reduction which is known to improve fertility. We have also shown that weight reduction is the correct approach for treating infertile women with obesity, as almost 30% of those who reduced their body weight by 5% or more conceived spontaneously.

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Introduction

Polycystic ovary syndrome (PCOS) is a frequent endocrine disorder that affects between 6 and 15% of reproductive age women [1]. Polycystic ovaries seen on ultrasound, oligo/amenorrhea, and laboratory/clinical signs of hyperandrogenism are characteristics of PCOS [2]. Besides being the most common cause of anovulatory infertility [3], PCOS is also associated with high body weight with 25 do 75% of women with PCOS being overweight (BMI >25 kg/m²) or obese (BMI >30 kg/m²) [4]. Obesity exacerbates pathophysiological and clinical findings of PCOS and is associated with worse reproductive, endocrine, metabolic, and social functioning [5, 6]. Women with obesity and women with PCOS have lower spontaneous as well as IVF pregnancy rates [7–9]. Pregnant women with PCOS and obesity have higher miscarriage rates, lower live-birth rates, and higher incidence of pregnancy-associated complications [7, 10–12].

It is well known that weight reduction of even 5% improves metabolic and hormonal profile [13] as well as reproductive functions [14, 15] in women with PCOS and obesity. Thus, the 2008 consensus conference decided weight reduction through lifestyle modification is the treatment of choice for overweight and obese women with PCOS [16].

The COVID, SARS CoV-2, pandemic has caused governments all over the world to delegate lockdowns and “stay-at-home” policies in order to contain the spread of COVID-19. This also had a negative impact on people’s activity patterns and weight status [17, 18]. In 2019, prior to the COVID-19 pandemic, we included 12 infertile PCOS women with obesity into an 8-week weight loss program before inclusion to IVF procedures. We included another 15 infertile PCOS women with obesity into weight loss program in February 2020. On March 16, 2020, Slovenia went under lockdown and closed most public places, including gym’s, due to the COVID-19 pandemic. Our weight loss program was therefore taken online and prolonged for 4 weeks.

The aim of the present study was to compare the results of a weight loss program in infertile PCOS women with obesity who attended the program before and during the COVID-19 pandemic. Furthermore, we checked whether there were any differences in endocrine parameters, motor capabilities, and spontaneous pregnancy rates between women who attended the program before and those who attended the program during the COVID-19 pandemic.

Materials and Methods

This prospective cohort study was carried out at the Department of Human Reproduction, Division of Obstetrics and Gynecology, University Medical Centre Ljubljana in collaboration with the Faculty of Sport, University of Ljubljana, between September 2019 and May 2020.

Study Population

In total, 27 infertile PCOS women with obesity were included the study. Study group 1 consisted of 12 women who began and ended the weight loss program in 2019, before COVID-19 pandemic. Study group 2 consisted of 15 women who began the program in February 2020, prior to COVID-19 pandemic, and ended it in May 2020, during COVID-19 pandemic. The inclusion criteria were as follows: BMI ≥30 kg/m², age ≤38 years, PCOS diagnosed in accordance with revised Rotterdam criteria [2], primary or secondary infertility, normal partner’s semen analysis, no other identifiable cause of infertility.

Weight Loss Program – Exercise and Dietary Plan

All women were proposed to attend an 8-week weight loss program prior to inclusion to IVF procedures. However, due to lockdown in relation to COVID-19 pandemic which was declared during the weight loss program of the second study group, these women were proposed to prolong the program, which was taken online. Altogether, the newly established – hybrid (live and online), weight loss program lasted for 12 consecutive weeks. Programs for each study group were performed as follows.

LIVE Weight Loss Program before COVID-19 Pandemic (Study Group 1)

Group trainings were held at the gym twice weekly for 60 min for 8 consecutive weeks (16 trainings altogether). The intensity of the exercise was between 60 and 80% of the maximum heart rate and consisted of warming-up, main part, and stretching. Warming-up lasted 10–15 min and consisted of various contents: walking, brisk walking, intervals of walking and slow running, simple aerobics choreography (basic single and double step, cross step, step walking, V-step, A-step....), elementary games, and stretching exercises. The main part lasted for 25 min. It was designed as a circuit training, workout with exercise stations and group exercise (participants performed the same exercise at the same time). Initially, exercises were simple and technically undemanding. No jumps and rapid changes of direction were performed, but the exercises were designed to involve as many muscle groups as possible at the same time. Exercise units were mostly designed as an interval training with limited time intervals, where the ratio between the duration of the break and the exercise changed. Training sessions became more demanding over time (heavier forms, increase in the amplitude of movement, decrease or increase of the support surface, and shortened break time) and longer (extended interval time from 30 s/15 s–60 s/30 s – exercise/break ratio, increased number of repetitions, increased number of series). A polygon was also included in the exercise, which included crawling, running between cones and side running. At the end of the main part, high-intensity workout called “Tabata” was occasionally performed (8 intervals – 20 s/10 s exercise/break ratio). The final part – stretching – lasted 5–10 min (depending on the length of the main part). Relaxing and stretching exercises for the muscle groups that were most stressed during ex-

Table 1. Anthropometric parameters for both study groups before and after the weight loss program

	Study group 1		<i>p</i> value	Study group 2		<i>p</i> value
	before (<i>N</i> = 12)	after (<i>N</i> = 12)		before (<i>N</i> = 15)	after (<i>N</i> = 15)	
Body weight, kg	110.2±14.7	103.9±14.2	0.007	99.5±18.8	94.6±17.7	<0.001
BMI, kg/m ²	39.3±4.7	36.6±5.1	0.009	36.4±4.9	35.1±4.9	<0.001
Waist circumference, cm	109.7±9.9	100.7±9.9	<0.001	103.5±12.8	97.4±11.6	<0.001
Abdominal circumference, cm	121.1±8.0	114.1±7.8	<0.001	116.9±14.7	109.4±14.0	<0.001
Hip circumference, cm	129.5±8.1	123.2±7.7	<0.001	123.0±12.3	118.3±11.0	<0.001

Values are depicted as mean ± SD.

ercise were included. Besides guided training, they performed aerobic exercise (walking, brisk walking, walking up the hill, cycling, and running) twice a week for 30 min individually.

At the beginning of the program, a lecture on healthy lifestyle, macro and micronutrients and basics of healthy eating was held for them. Dietary plan was put together with instructions to reduce caloric intake for approximately 250–300 kCal daily. They were advised to keep a diary of consumed food and drinks. Notes were then discussed with trainer who advised them how to make appropriate adjustments in accordance with healthy eating.

HYBRID (Live + Online) Weight Loss Program during COVID-19 Pandemic (Study Group 2)

At the beginning of the program, group trainings were held at the gym twice weekly for 60 min for 6 consecutive weeks (12 live trainings). The training program was the same as for the first group of participants. Due to the lockdown and gym closure, group trainings were taken online and were held twice weekly for 60 min for 6 more weeks (12 online trainings). Participants received written exercises that included warming-up, main part, and stretching every week. Exercises were designed in a way they could be performed using utensils available at home or with an improvised equipment (sliders – paper towels or towels, light weights or handles – a bottle of water). All exercises were illustrated, and the training system was described in writing (time intervals, number of repetitions, and duration of breaks). Each exercise was shown in a short video, where the basic implementation of the exercise and the harder and easier version was presented. In case the participants did not perform the written exercise, they could replace it with an outdoor aerobic exercise. Women in study group 2 also performed individual aerobic exercise (walking, brisk walking, walking up the hill, cycling, and running) twice a week for 30 min.

Dietary plan and lecture on healthy lifestyle were performed in the same way as for the study group 1. They were also advised to keep a diary of food and drink consumption which was then discussed with trainer.

Laboratory and Anthropometric Measurements

All women were examined at the beginning of the study. A standard fertility evaluation and examination of both partners were performed, followed by a clinical examination of women with determination of body weight, body height, BMI, and endocrine parameters. These included: sex hormone-binding globulin, free

testosterone, free androgen index, androstendione, and dehydroepiandrosterone sulfate.

Anthropometric measurements were performed at the Faculty of Sport, University of Ljubljana, Slovenia. We used Tanita model BC 601, which calculates body composition using a bioelectric impedance, for measurement of body characteristics. Assessment of motor capability consisted of 9 tests, which were used to measure flexibility, strength, and endurance. In addition, measurements of abdominal, waistline, and thigh circumferences were performed at the beginning and the end of the weight loss program.

Psychological Well-Being and Lifestyle Questionnaire

All women received a questionnaire on overall well-being, sleeping habits, stress, sports activities, lifestyle, and nutritional habits before and after the end of the program. The questionnaire consisted of statements that the patients graded on a scale on 1–5 according to their agreement or disagreement.

Statistical Analyses

First, we compared results of all participants within a study group obtained before the beginning and after the end of the weight loss program. We then compared the results between both study groups.

Statistical analysis was performed with SPSS 25 software (SPSS Inc., Chicago, IL, USA). *p* values <0.05 were considered statistically significant.

Differences in measured variables before and after the weight loss program within the study group were estimated using paired *t* test. Mean values of measured variables between both study groups were compared by unpaired *t* test. Numerical data are presented as mean with standard deviation if normally distributed or as median with 1st and 3rd quartile if skewed.

Results

Within-Group Differences in Measured Parameters before and after the Weight Loss Program

Overall, most of the measured parameters improved significantly after the weight loss program.

Table 2. Endocrine parameters for both study groups before and after the weight loss program

	Study group 1		<i>p</i> value	Study group 2		<i>p</i> value
	before (<i>N</i> = 12)	after (<i>N</i> = 12)		before (<i>N</i> = 15)	after (<i>N</i> = 15)	
Free testosterone, pmol/L	8.9±4.1	5.4±1.8	0.003	6.59±2.05	5.0±1.2	0.01
SHBG, nmol/L	33.5±20.1	38.0±20.3	NS	42.9±20.2	46.6±26.6	NS
DHEAS, µmol/L	4.9±2.6	5.2±2.7	NS	6.8±2.3	5.9±1.9	NS
FAI	2.3±2.8	2.2±1.5	NS	3.3±1.7	3.3±2.0	NS
Androstenedione, nmol/L	5.23±2.48	4.28±1.58	NS	6.68±3.21	6.75±2.71	NS

Values are depicted as mean ± SD. FAI, free androgen index; DHEAS, dehydroepiandrosterone sulfate.

Table 3. Menstrual cycle changes group 1

	Beginning of the program	End of the program	<i>p</i> value
Oligomenorrhea, <i>N</i> (%)	8 (66.7)	4 (33.3)	0.083
Regular periods, <i>N</i> (%)	4 (33.3)	8 (66.7)	

Anthropometric Characteristics

Body mass index was significantly lower after the weight loss program in both study groups. In the study group 1, 8 of 12 women (66.7%) reduced their BMI for over 5%. In study group 2, 9 of 15 women (60%) achieved over 5% of BMI reduction. Table 1 represents differences in measured anthropometric parameters for both study groups.

Endocrine Parameters

Serum levels of free testosterone were significantly lower at the end of the weight loss program in both study groups. Levels of other measured endocrine parameters before and at the end of the program did not differ significantly. Results are presented in Table 2.

Menstrual Cycle Changes

In the study group 1, 8 women reported oligomenorrhea (menstrual cycle length >35 days) before the beginning of the program. After the end of the weight loss program, only 4 women still had irregular menstrual cycle (Table 3). In the study group 2, none of the women was oligomenorrhic prior to inclusion to the program and their menstrual cycle length did not change significantly after the end of the program.

Spontaneous Pregnancy Rate

Two of 12 women (16.7%) conceived spontaneously in 3 months after the end of the weight loss program in study group 1. In study group 2, 3 of 15 women (20%) conceived spontaneously in 3 months after the end of the weight loss program. The difference was not statistically significant ($p = 0.82$). We also calculated spontaneous pregnancy rate only for women who reduced their BMI for at least 5%. In both study groups, 17 women reduced their BMI for 5% or more. Of these, 5 conceived spontaneously in the first 3 months after the end of the program. Spontaneous pregnancy rate for both study groups was 29.4%.

Psychological Well-Being and Lifestyle

Significantly more women reported on having healthier eating habits, started to exercise regularly, and improved their sleep after the end of the weight loss program. Data are presented in Table 4.

Motor Capabilities

Significant improvement of motor capabilities was detected at the end of the weight loss program in both study groups. Data are presented in online supplementary Tables 1 and 2 (for all online suppl. material, see www.karger.com/doi/10.1159/000519946) for each study group.

Between-Group Differences in Measured Parameters before and after the Weight Loss Program

Average age of women in study group 1 was 31.5 ± 4.8 years. In study group 2, average age was 33.2 ± 4.0 years. The difference was not statistically significant ($p = 0.339$).

Table 4. Psychological well-being and lifestyle questionnaire before and after the weight loss program

	Study group 1		<i>p</i> value	Study group 2		<i>p</i> value
	before (<i>N</i> = 12)	after (<i>N</i> = 12)		before (<i>N</i> = 15)	after (<i>N</i> = 15)	
Regularly and healthier eating habits (5 meals per day)	2.2±1.09	4.1±0.75	0.000	2.3±1.09	3.5±0.99	0.002
Daily outdoor exercising	2.3±1.10	3.5±1.05	0.000	2.3±1.04	3.6±0.73	0.003
Sleep (between 7 and 9 h per night)	3.0±1.52	3.6±1.38	0.004	2.5±0.99	3.3±0.88	0.012
Socializing and relaxation	3.8±1.14	4.5±0.66	0.031	4.3±1.17	4.6±0.82	0.046
Feeling unhappy, depressed and irritable	3.1±1.11	1.9±0.86	0.001	3.3±1.29	2.3±1.04	0.014
Feeling pessimistic	2.7±1.03	2.0±0.70	0.020	3.0±1.30	2.4±0.73	0.038
Feeling fear and failure	3.0±1.00	2.1±0.75	0.009	3.1±1.18	2.5±0.83	0.013
Feeling angry	3.1±0.89	2.1±0.75	0.000	3.3±1.43	2.3±0.89	0.008

Data are presented as mean ± SD.

Table 5. Comparison of anthropometric parameters before and after the weight loss program between both study groups

	Study group 1 (<i>N</i> = 12)	Study group 2 (<i>N</i> = 15)	<i>p</i> value
Body weight before, kg	110.2±14.7	99.5±18.8	NS
Body weight after, kg	103.9±14.2	94.6±17.7	NS
BMI before, kg/m ²	39.3±4.7	36.4±4.9	NS
BMI after, kg/m ²	36.6±5.1	35.1±4.9	NS
BMI reduction, %*	6.8	3.7	NS
Abdominal circumference before, cm	121.1±8.0	116.9±14.7	NS
Abdominal circumference after, cm	114.1±7.8	109.4±14.0	NS
Waist circumference before, cm	109.7±9.9	103.5±12.8	NS
Waist circumference after, cm	100.7±9.9	97.4±11.6	NS
Hip circumference before, cm	129.5±8.1	123.0±12.3	NS
Hip circumference after, cm	123.2±7.7	118.3±11.0	NS

Values are depicted as mean ± SD. * Data presented as average.

Anthropometric Characteristics

There were no significant differences in anthropometric parameters between both study groups before and after the end of the program (Table 5). On average however, BMI of women in study group 1 was 6.8% lower whereas in study group 2 BMI was 3.7% lower at the end of the program. The difference was not statistically significant ($p = 0.194$).

Endocrine Parameters

Androstenedione was significantly higher after the weight loss program in the study group 2. Free testosterone was significantly higher in the study group 1 before the beginning of the weight loss program. Other measured endocrine parameters did not differ significantly (Table 6).

Discussion

COVID-19 pandemic has had a tremendously negative impact on all aspects of human life. In the present study, we show that COVID-19 pandemic did not have a statistically significant impact on the success of the weight loss program in obese infertile PCOS women. However, we have evaluated the impact of COVID-19 pandemic to be highly clinically relevant as the proportion of BMI reduction was almost twice lower in women who attended the program during the pandemic despite prolonged duration of the weight loss program.

The aim of our weight loss program was to reduce BMI in obese infertile PCOS women and thus increase the chances of spontaneous conception as well as success rates of consecutive IVF procedures. As it is also known

Table 6. Comparison of endocrine parameters before and after the weight loss program between both study groups

	Study group 1 (N = 12)	Study group 2 (N = 15)	<i>p</i> value
Free testosterone before, pmol/L	8.9±4.1	6.59±2.05	0.04
Free testosterone after, pmol/L	5.4±1.8	5.0±1.2	NS
SHBG before, nmol/L	33.5±20.1	42.9±20.2	NS
SHBG after, nmol/L	38.0±20.3	46.6±26.6	NS
DHEAS before, µmol/L	4.9±2.6	6.8±2.3	NS
DHEAS after, µmol/L	5.2±2.7	5.9±1.9	NS
FAI before	2.3±2.8	3.3±1.7	NS
FAI after	2.2±1.5	3.3±2.0	NS
Androstenedione before, nmol/L	5.23±2.48	6.68±3.21	NS
Androstenedione after, nmol/L	4.28±1.58	6.75±2.71	0.009

Values are depicted as mean ± SD. SHBG, sex hormone-binding globulin; FAI, free androgen index; DHEAS, dehydroepiandrosterone sulfate.

that obese women who attend IVF use higher amounts of gonadotrophins for controlled ovarian hyperstimulation [19], our aim was also to lower the amount of gonadotrophins used. The first study group began and ended their weight loss program in 2019, prior to COVID-19 pandemic. They attended a group live exercise program twice a week besides exercising at home twice weekly. The second group of women started their weight loss program in February 2020. On March 16, 2020, Slovenia went under complete lockdown due to COVID-19 pandemic. Sports centers were closed, and group exercise was forbidden. Therefore, we needed to adapt the weight loss program and instead of having live exercise sessions at the gym twice weekly, sessions were performed online, through ZOOM application. These women also exercised at home twice weekly. Due to this adaptation, we decided to prolong the program for the second study group for 6 weeks. In the study group 1, 66.7% of women achieved a 5% reduction of BMI whereas in the study group 2, 60% of women achieved a 5% weight reduction. There were no significant differences in BMI between both study groups before and after the end of the program however, mean BMI reduction was almost twice as high in the group that attended the program before the lockdown (6.9%) than in the group that attended the program during the lockdown (3.7%). The percentage of BMI reduction was lower in the second study group despite the fact that their program was 4 weeks longer. This result shows that the hybrid model of weight loss program which we were compelled to run due to COVID-19 pandemic was less successful as live weight loss program. In accordance with our results, reviews of Wieland et al. [20] and Raaijmakers et al. [21] have shown that face-to-face interventions were

more effective for weight reduction than web-based interventions.

Of measured endocrine parameters, androstenedione was significantly higher after the end of the weight loss program in women who attended the program during the COVID-19 pandemic. Free testosterone was significantly higher in the study group 1 before the beginning of the weight loss program. Endocrine disturbances are common in PCOS and biochemical hyperandrogenism occurs in 78.2% of PCOS women [22]. According to different studies, androgen hypersecretion negatively affects conception. In a study of Ramezanali et al. [23], a combination of hyperandrogenism and chronic anovulation in PCOS women was associated with lower clinical pregnancy rates in IVF procedures. Furthermore, a study comparing concentrations of free and total androgens in pregnancy and nonpregnancy cycles has shown that follicular phase androgen levels were significantly lower in cycles where pregnancy was achieved [24]. Overall however, measured endocrine parameters mostly showed an improvement after the weight loss program in both study groups. This finding is in accordance with other studies which have shown that weight reduction reduces testosterone, androstenedione, and dehydroepiandrosterone sulfate levels and increases sex hormone-binding globulin concentrations [4]. It seems that these changes are responsible for the improvement of PCOS related signs and symptoms in PCOS women with obesity.

In addition to anthropometric and endocrine parameters, we analyzed whether there are any differences in spontaneous pregnancy rates between both study groups.

Two women from the group who attended the weight loss program prior to pandemic conceived spontaneously in 3 months after the end of the program. In the group who attended the program during the pandemic, 3 women conceived spontaneously in the same time period. The difference is not statistically significant. Notably, all of these women reduced their BMI for more than 5% during the weight loss program and this finding is in agreement with the recommendation that at least 5% weight reduction is necessary to increase chances for pregnancy [25]. When taking all women who reduced their BMI for over 5% into account, cumulative spontaneous pregnancy rate was 29.4%.

Women with PCOS have a 4-fold increased risk for anxiety and depression [26, 27] and higher BMI is related with higher depression score [28]. Lifestyle modifications in the present study had a significant positive effect on mental well-being of study participants. Most women in both study groups improved their sleep, built higher self-confidence and had a better ability to overcome everyday tasks. Evaluation after the program revealed fewer negative feelings, namely failure, anger, and pessimism. These findings are in line with a study of Dokras et al. [29] where the prevalence of depressive and anxiety symptoms decreased after the lifestyle intervention program. Furthermore, there was a significant change in healthy lifestyle perception as most women stated that this kind of lifestyle is relaxing and enjoyable for them.

Lastly, motor capabilities of study participants in both study groups significantly increased after the weight loss program. These results are in line with previous studies where significant improvement of physical performance occurred after the weight loss program [30].

Conclusion

The limitation of the present study is a relatively small sample size and we believe that with larger study groups, statistical significance would have been reached. However, although study groups may not have been large enough to detect significant differences, we have shown that on average, percentage of BMI reduction in women who attended the weight loss program during the pandemic was almost twice lower than in women who attended the program before the pandemic despite the fact that their program was 4 weeks (30%) longer. Our study shows that COVID-19 pandemic and consequential lockdown led to clinically important lower success of weight loss program in obese infertile PCOS women.

On the other hand, the present study shows that our decision on taking the program online was correct. We have shown that with a tailored and timely strategy, women with obesity can be monitored and helped to lose weight in order to improve their fertility. By achieving almost 30% spontaneous pregnancy rate in women who reduced their weight by over 5% we have again confirmed that weight reduction before inclusion to IVF procedures is the right approach for treatment of infertile women with obesity. This finding is of utmost clinical importance as it means that by losing weight less women would need to be included to IVF procedures which represent a psychological, physical as well as financial burden.

Statement of Ethics

The study was conducted with the approval of Medical Ethics Committee of Republic of Slovenia (Approval Number 0120-491-2017). Written informed consent was obtained from each individual participant included in the study.

Conflict of Interests

The authors have no conflicts of interest to declare.

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Author Contributions

A.Š. led the weight loss program, acquired and analyzed the data, approved the manuscript. E.V.B. recruited the participants, revised and approved the manuscript. T.B.P. acquired the funding, designed and led the study, recruited the participants, collected the samples and data, analyzed and interpreted the data, drafted, revised and approved the manuscript.

Data Availability Statement

Data generated or analyzed during this study are included in this article and its online supplementary material files. Further enquiries can be directed to the corresponding author.

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