

Benefits of 6 weeks of high interval intensity training based on basic fitness variables and losing weight during the pandemic of covid-19 period.

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Abstract

BACKGROUND: Due to the authorization to do outdoor sports in Algeria, the government allowed the sports that do not require physical contact. The purpose of this study is to show the benefits of 06 weeks of high interval intensity training (HIIT) based on body weight movement and sprint on developing maximum oxygen consumption (VO_2max), power, maximum aerobic speed (VMA), endurance, and losing weight during the pandemic of covid-19.

METHODS: 11 persons participate in this study belonging to the fitness club in Bordj Bou Arreridj – Algeria – (age: 32.18 ± 8.08 year, high: 1.78 ± 0.052 cm, weight: 84.24 ± 11.25 kg, BMI: 26.50 ± 3.95 kg). the protocol was contained 3 session moderate intensity, pretest, 6weeks HIIT 3 sessions per week, and ensure that the heart rate is 100% during the exercise finally, post-tests.

RESULTS: similar increases ($p < 0.05$) in distance of running by (226,54m, 17.30%). And VMA it enhanced by 2.26 km/h with 17.34%. While VO_2max it's developed by 17.28% (7.92 mL/kg/min). with very large effect size ($ES=1.75$). In addition, the power of legs it boosted by 3.17% (6.27 cm) with small effect size (0.58). Also, results indicate decrease in weight by 2.73 with large effect size (0.87).

CONCLUSION: the outdoor exercise it seems safe to do during the pandemic of covid-19. Results high-light great effect of HIIT on enhancing (VO_2max , power, VMA, endurance, and losing weight).

Keywords: High interval intensity training, Maximum oxygen consumption, Power, Maximum aerobic speed, Endurance, Losing weight, covid-19.

INTRODUCTION

The world is witnessing a big pandemic these days, which is the Coronavirus. The propagation of the virus SARS-CoV-2 officially started at the beginning of December 2019 in Wuhan (China), where the first COVID-19 victim was diagnosed with a new type of coronavirus. The virus first spread over different states in China before reaching other countries. On March 11, 2020, the World Health Organization (WHO) declared COVID-19 a pandemic, pointing to more than 1180 0 0 cases of the coronavirus illness in over 110 countries around the world (Buldú, & all 2020). COVID-19 is a respiratory virus that is transmitted by large respiratory droplets and direct contact with infected secretions (Jacob et al., 2020). On February 25, 2020, the country Algeria announced the first infection with the virus, for an Italian who had been deported to his country. And on

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March 13 record the first death. Begun, on March 19 the government has begun to take preventive measures to curb the spread of the virus as it has begun to limit the movement of citizens in some areas and leave the house except for necessity, such as the acquisition of medicine or food, and in other areas, the movement has been stopped completely, and it has also recommended social distancing, especially the elderly. And announce that the lockdown according to the practice in other countries is the best option and the great way to control the virus.

At the time of restrictions, the population was limited in social personal contacts including physical movement which was a serious negative phenomenon. This crisis affected negatively on the world of sports and on fitness, performance and energy of athletes because they can't follow their training program constantly and safely.

The negative effects of sedentary employment are intensively studied by a team from Palacký University in Olomouc from Czech Republic. The sedentary behavior is assessed from various aspects, such as the age of participants, social and geographical environment, parents influence (Frömel, Mitáš & Kerr, 2009; Mitáš, Nykodým & Frömel, 2009; Sigmundová, Sigmund, Badura, Vokáčová, Klein & Bucksch, 2017).

And this significantly decrease their level of physical activity and lots of them get some weight due to inactivity during the lockdown and there are not enough exercises on their daily routine. About 48% of physical activity and 49% energy expenditure was decreased in physiotherapy professionals and students during the lockdown period when compared to them before the lockdown period (Srivastav & all, 2020). The guidelines recommend at least 150 to 300 min per week of aerobic exercise and 2 resistance training sessions per week. Under the quarantine it could be suggested to increase to 200–400 min per week distributed among 5–7 days to compensate for the decrease in the normal daily PA levels (D Jiménez-Pavón, 2020).

Studies reported that staying home at the prolonged time might lead to sedentary behaviors, such as spending more time on sitting activities, playing games. Watching television, decreasing regular outdoor activity and exercises leads to an increased risk of chronic health conditions (Srivastav et al., 2020). Many studies suggest that exercise produces positive effects on physical fitness, mental health, and lifestyle. It is wrong to completely renounce physical activity with the aim of preventing the spread of SARS-CoV-2, it has been proven that physical activity improves the performance of our immune system and reduces cardiovascular risks (Petersen, 2020). The purpose of this study is to regain the level of fitness for the athletes by increasing their $\dot{V}O_{2max}$, VMA, endurance and decreasing the weight that they gain on the pandemic. Also, trying to enhance their immune system against corona virus showed that sport can help patients in their recovery from the covid-19 (Faghy et al., 2020). The use of moderate-intensity exercise is recommended to strength the body defense against COVID-19 (Samadi, Shirvani, & Rahmati-Ahmadabad, 2020). Physical inactivity during period of COVID restriction was analyzed by Sallis et al, (2021). They studied 48 440 adults patients with a COVID-19 diagnosis from 1 January 2020 to 21 October 2020 according the data: risk hospitalisation, intensity of illness, habits of physical activity before COVID-detection (March 2015 – March 2020) with at least three exercise vital sign measurements from 19 March 2018 to 18 March 2020. “Consistently meeting physical activity guidelines was strongly associated with a reduced risk for severe COVID-19 outcomes among infected adults. We recommend efforts to promote physical activity be prioritised by public health agencies and incorporated into routine medical care.” (Quot: Sallis, Young, Tartof et al., 2021, p.1.) On the bases of this knowledge, when the lockdown open, the authors tried to give help for all people around the world and specifically for the athletes. Also, the authors try to add value for the society that people can facing this new phenomenon on clever and strong way by building a program based on high interval intensity training (HIIT) and body weight (BW) for 6 weeks.

The government announced on official TVs and radio that persons should be stay active in their homes. and the top clubs proposed in their website and Facebook pages to their competitive athletes some exercise to do at home aim to keep their fitness level.

High Intensity Training (HIT) refers to a special form of brief and intense resistance training targeting maximum muscle fiber recruitment with high muscle tension, leading to temporary muscle fatigue. Since muscle fatigue with HIT is severe, this type of resistance regime requires more recovery than other weight training methods (Kunz, 2019) HIIT, also known as Interval Training (IT) or Sprint Interval Training (SIT) consists of a set number of high intensity exercises, each immediately followed by periods of recovery. The high intensity exercises can range anywhere from between 5 or 10 seconds to 5 or 10 minutes. Likewise, the periods of recovery can range in duration, too (Driver, 2013). The key of HIIT is about time and recovery in and between exercises. Also, HIIT defined as “near-maximal” efforts generally performed at an intensity less than peak VO_2 or peak power output that elicits greater than or equal to 80% peak HR (often in the range of 85%–95%) (Dun, Smith, Liu, & Olson, 2019). And what I mean with HIIT in this study is peak power and peak HR at 100% and doing each exercise as many reps as possible (all-out).

Studies showed the huge benefits of HIIT in increasing VO_{2max} , and the Increases in $V \dot{O}_2max$ exhibited in response to different HIIT regimes are due to improvements in oxygen delivery (Astorino et al., 2017). This kind of exercise is safe and promising exercise prescription to improve cardiovascular function and metabolic capacity (Grace et al., 2018Dun et al., 2019) Dun and his colleague found that multi-system integrative physiologic adaptations in respiratory, cardiovascular, and skeletal muscle systems induced by high-intensity interval training contribute to improvements in peak VO_2 . In addition, all-out HIIT can result in the same degree of improvement in maximal oxygen uptake (VO_{2max}) and time trial performance as traditional continuous endurance training despite a much shorter total training time (Atakan et al., 2020; Kon & al, 2020; M.M., Y. & al., 2019. Ram et al., 2020). However previous studies concluded that HIIT has big effect in fat oxidation and losing weight (Russomando et al., 2020). Russomando and his colleagues results that HIIT has positive trends in the reduction of fat mass percentage. HIIT has several health outcomes including increases in cardiorespiratory fitness and maximal fat oxidation, up regulation of skeletal muscle proteins and markers of mitochondrial function related to oxidative phosphorylation capacity and improved body composition (M.M & al, 2019). Also, HIIT has a positive effect on effects on body mass, body fat, body composition, and physical fitness, (Batrakoulis et al., 2019). The researcher suggests that in order to guarantee HIIT effectiveness, programs should include 2–3 sessions per week, with intervals of 15–30 s and passive or active rest periods of 15–30 s. For higher volume programs, discontinuous games of up to 6 min work with 4 min rest periods for a total session time of 40 minutes can be used (Delgado-Floody, Latorre-Román, Jerez-Mayorga, Caamaño-Navarrete, & García-Pinillos, 2019). Accordingly, the aim of the present study was to highlight the benefit of 06 weeks of HIIT based on body weight movement and sprint on developing (VO_{2max} , power, VMA, endurance, and losing weight) during the pandemic of covid-19.

MATERIALS AND METHODS

Participant recruitment

Eleven healthy recreationally active males and some of them non-active. Belonging to the fitness club in Ghillassa Affiliated with the Sports Star Club of Karate Ghillassa in Bordj Bou Arreridj – Algeria – (age: 32.18 ± 8.08 year, from – up to high: 1.78 ± 0.052 cm, weight: 84.24 ± 11.25 kg, BMI: 26.50 ± 3.95 kg). described in the Table 1. The study based on only male because it's voluntary participation and those males have the motive to participate. Inclusion criteria were: non-smokers, they have not any history related to cardiac respiratory function and they do not have any bone or joint problem and, of course. They are not carriers of the Coronavirus to avoid transmitting the infection. And with no specific diet to follow. This data was assessed by their honor proclamation as

Table 1. Participant characteristics at the baseline.

Variables	High (cm)	Weight (kg)	Age	BMI (kg)
Mean	1.78	84.24	32.18	26.50
SD	0.052	11.25	8.08	3.95
N	11			
Sex	Meal			

Abbreviations: BMI= body mass index. Sd= standard deviation.

N= number of participants.

Study design

The experimental protocol included a familiarization procedure, week 01 moderate intensity in order to prepare the participants physically, psychologically, and physiologically. Then there are pre-tests, 6 weeks of HIIT – 3 sessions per week, and finally post-tests as described in the tables 02. According to the General Data Protection Regulation, the authors assured the participants that the results would be used solely for scientific research purposes.

Regarding the tests, training area was outdoors, away from gyms, to prevent direct interaction with surfaces and the use of the same tools by all participants, and only during the time allotted for exercise in order to comply with Covid-19 restriction regulations.

Table 2. Protocol training description

weeks	days	Kind of exercise	intensity	Total time (min)
Week 01	Sunday	Running	Moderate	20
	Tuesday	Running	Moderate	25
	Thursday	Running	moderate	30

weeks	days	Kind of exercise	HIIT time (s)	Recovery time (s)	Total time
Week 02	Sunday	Body weight movement	10	50	25
	Tuesday	sprint	10	50	20
	Thursday	Body weight movement	10	50	30
Week 03	Sunday	Body weight movement	15	45	25
	Tuesday	sprint	15	45	20
	Thursday	Body weight movement	15	45	25
Week 04	Tuesday	Body weight movement	20	40	30
	Thursday	sprint	20	120	22
	Sunday	Body weight movement	20	40	35
Week 05	Tuesday	Body weight movement	25	35	25
	Thursday	sprint	15	60	20
	Sunday	Body weight movement	25	35	30
Week 06	Tuesday	Body weight movement	30	30	25
	Thursday	sprint	10	50	17
	Sunday	Body weight movement	30	30	35
Week 07	Tuesday	Body weight movement	30	30	35
	Thursday	sprint	15	60	20
	Sunday	Body weight movement	30	30	35

Note: time of all these sessions is not including (warm-up, dynamic stretch, static stretch, cool down, time of those is separated).

Tests

Participants run for 06 minutes for the greatest possible distance they can with no stop and if someone get tired, he will complete the duration with a walk, then we record the distance.

VMA test: maximum aerobic speed

– Equipment: whistle, tape measure, timer, a wide-open space.

Ex: The first participant cut 1320 m per min. we convert this to km so (6 min = 1320m = 1.32 km) then we convert the 6 min to the hour because the result will be on km/h (6 min *10 = 1h). The mileage per kilometer is multiplied by 10 to get the total distance per hour (1.32 km*10 = 13.2 km/h). So, VMA=13,2 km/h.

VO₂max test: maximum oxygen consumption (In milliliters per minute per kilogram of body weight)

To calculate VO₂max we use this formula (VMA * 3.5 = VO₂max). Take the same previous example: (13.2 * 3.5 = 46.2). So, VO₂max = 46.2 ml/mn/kg.

Power test: Standing Broad Jump Test

– Tools: flat floor that does not expose the individual to slipping – tape measure – draws the starting line.

– Procedure: the athletes stand behind a line marked on the ground with feet slightly apart. A two-foot take-off and landing is used, with swinging of the arms and bending of the knees to provide forward drive. The participants try to jump as far as possible and as much as they can, landing on both feet without falling backwards Figure 1. Two attempts are allowed.

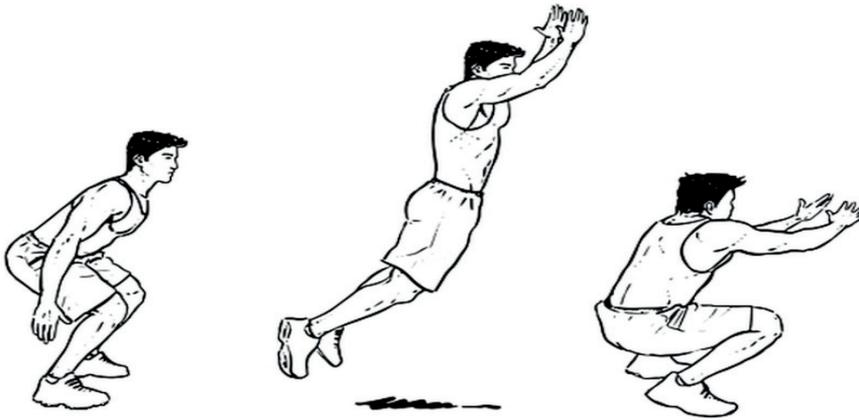


Figure 1. Standing Broad Jump

- Scoring: The measurement is taken from takeoff the line to the nearest point of contact on the landing (back of the heels). Record the longest distance jumped, the best of two attempts.

Procedures followed during the program implementation period:

1. Ensure the safety of the participants from the Corona virus.
2. Physical distancing between athletes 1.5 m at least to avoid risks of transmission to the virus.
3. No gym, no equipment just body weight movement and sprint and all sessions held outdoor.
4. Ensure that the participants give all what they have (speed and power).
Ensure that the heart rate is 100% during the interval workout. Participants independently track their pulse rates. ($220 - \text{age} = \text{maximum heart rate}$, it's 100%). as described in Figure 2 heart rate measurement technique.



Figure 2. Method to measure heart rate

5. No masks face to avoid the toxicity by CO_2 during breathing and up taking the clean air. The use of masks during a short exercise with an intensity around 6–8 METS decreases O_2 by 3.7% and increases the CO_2 concentration by 20%. (Pifarré & al, 2020)
6. Avoid public showers and changing rooms as much as possible.

Statistics

All analyses were performed using IBM Statistical Package for Social Sciences (SPSS) v24.0 and excel. The normality of the data was assessed using the Shapiro-Wilk, Kolmogorov-Smirnov statistic and a visual inspection of their histograms and normal Q-Q plots and box plots showed that the data were approximately normally distributed. Also, using paired sample t-test, mean, standard deviation to compare between pre-test and post-test. Statistical significance was set at $p < 0.05$. Effect sizes (ES) was calculated using Cohen's d ($d = M_1 - M_2 / s_{pooled}$), it seems appropriate to revise the rules of thumb for effect sizes to now define d (0.01) = very small, d (.2) = small, d (0.5) = medium, d (0.8) = large, d (1.2) = very large, and d (2.0) = huge (Sawilowsky, 2009). Ratio % were calculated to know the percentage of progress and development of the participants after applying the program.

RESULTS

Training characteristics

There was full training adherence for the participants who completed the study (all 11 participants completed all 21 sessions, 03 preparation sessions, 12 HIIT and 06 sprint sessions). Total time of exercise during the whole protocol from the first day till the final day was 549 min with average (78.42 min in a week and 26.46 min per session) with full compliance to training session requirements within each session as we describe in the previous Table 2.

Pre-test characteristics

The researchers conducted a series of procedures to ensure the study's effectiveness and the adoption of the recommended program. As a result of our testing, we were able to establish the participants' level. and to allow us to compare the findings between the pre test and the post test at the end. as describe in Table 3. As well as to determine the efficacy of our suggested protocol.

Table 3. Comparison between weight, distance of running, VMA, VO_2 max and power before and after applying the training workout program.

tests	Pre-test		Post-test		$\Delta\%$	t-test	Effect size	Sig (p-value)
	mean	SD	mean	SD				
weight	84.24	11.25	81.94	9.61	-2.73	2.87	0.87	0.01
Distance of running	1309.72	132.05	1536.27	72.35	17.30	5.81	1.75	0.00
VMA	13.09	1.32	15.36	0.72	17.34	5.81	1.75	0.00
VO_2 max	45.84	4.6	53.76	2.53	17.28	5.81	1.75	0.00
Power	198	18.86	204.27	18.51	3.17	1.93	0.58	0.08

Note: significant differences ($P \leq 0.05$). $\Delta\%$ = magnitude of change (post-training - baseline) as a percentage of the baseline.

Results analysis

Weight

In pre-test weight was ($84.24 \pm 3,211$ kg) and in the post-test was (81.94 ± 9.61 kg) it decreased by 2.73%. while t-test was -2.87. $p = 0.01$ so there is a significant difference between pre and post-test in favor of the post-test. In addition, the program applied has a large effect size in decreasing weight $d = 0.87$.

Distance of running

In pre-test distance of running on 06 minutes was (1309.72 ±132.05 m) and in the post-test was (1536.27± 72.35 m) it increased by 226,54m with 17.30%. While t-test was 5.81. p= 0.00 so there is a significant difference between pre and post-test in favor of the post-test. Moreover, the program applied has a very large effect size in increasing the endurance of athletes and develop their ability to run quicker d= 1,75.

VMA

VMA (km/h) maximum aerobic speed in pre-test was (13.09±1.32 km/h) however, in post-test it increased at (15.36±0.72 km/h) it enhanced by 2.26 km/h with 17.34%. while t-test was 5.81. p= 0.00 so there is a significant difference between pre and post-test in favor of the post-test. Moreover, the program applied has a very large effect size in increasing the maximum aerobic speed of the participant d= 1.75

VO₂max

VO₂max (mL/kg/min) maximum oxygen consumption it's developed by 17.28% (7.92 mL/kg/min). In post-test (53.76±2.53 mL/kg/min). But, in pre-test it was (45.84 ±4.6 mL/kg/min). While t-test was 5.81 and d= 1.75 we can say this training, program has a very large effect size in increasing the maximum oxygen consumption of the members of this study. Further, p= 0.00 so there is a significant difference between pre and post-test in favor of the post-test.

Power

The power of legs according Standing Broad Jump it boosted by 3.17% (6.27 cm) in the post-test (198±18.86 cm) compared to pre-test (204.27±18.51 cm). While t-test was 1.93 and d= 0.58 this showed that the training work program has as small effect size on developing the power of legs in participants. Furthermore, p= 0.08 so there is no significant difference between pre and post-test in favor of the pre-test.

DISCUSSION

This study was intended to measure the effectiveness of six weeks of high-intensity training with using body weight movement and sprint on VO₂max, VMA, endurance, body fat. And try to enhance immunity of the cardiac and respiratory system especially during the pandemic of Coronavirus. HIIT may be a potential beneficiary of cardiac rehabilitation therapy for patients with COVID-19 infection after discharge from the hospital (Li & al, 2020). Ron Gilat and his colleagues says in their article: "We understand now more than ever that sports keep our body and mind healthy." The results of this study demonstrated a positive improvement in all variables.

Many previous studies agreed that aerobic exercise is the best type of exercise for total body fat loss (Juliana & Wahed, 2019). While this study highlights a positive improvement on losing weight even though the time of exercise is short. Researchers promotes HIIT is great strategy to combat obesity and it has a positive effect on metabolism. (Miguet et al., 2018) clarified this in their study that an acute session of HIIT favors reduced subsequent energy intake and food reward despite unchanged appetite feelings in adolescents with obesity. Zeng and his colleagues found HIIT are an efficient weight-reducing procedure, and HIIT can be selected for people who can endure high-intensity exercise and are in urgent need of fat loss (Zeng, Peng, Zhao, & Chen, 2020). Moreover, HIIT had greater influence on most of the components of the metabolic syndrome compared to the equivalent energy expenditure of moderate intensity (Karlsen & al, 2017).

HIIT can enhance capacity for oxidative metabolism in skeletal muscle owing to an increase in mitochondria. And of course, this will help the body to get more energy, build muscles and losing fat (Moris, & al, 2020). Hammad and associates reported that HIIT increased fat utilization during exercise, decreased percentage of body fat and improved cardiovascular parameters (Hammad & al, 2019).

Taken together, these results suggest that HIIT can boost the VO_2 max, VMA and endurance in high level and this kind of session would be an ideal training. Paquette and all recommended coaches and athletes who wish to improve VO_2 max through central adaptations should include short intervals to their program (Paquette & al, 2019). Researchers determined that HIIT improved aerobic performance and increased aerobic capacity (Alonso-Fernández, et al, 2017; J. Edge*, n.d. (Paper & Tetik, 2020). Rosenblat and his colleagues (2020) indicate that long-HIIT may be the optimal form of interval training to augment performance. They are determined a moderate effect ($ES = 0.70$) in favor of HIIT over SIT in maximal aerobic power (MAP) or maximal aerobic velocity (VMA). Similar idea was published by (Sabri & Gheorghe, 2014). The more abruptly speed increases and the shorter event duration, the more the VMA value is overestimated. This can be explained by the fact that anaerobiosis (lactic acid production and tolerance to its accumulation) can also be improved the VO_2 max methodical procedure the ratio between effort/res. In fact, HIIT improves performance in part by enhancing the capacity for aerobic energy provision and increased whole-body maximal oxygen uptake (Gibala, 2020. Delgado-Floody et al., 2019; Roloff et al., 2020 Delgado-Floody et al., 2019). Delgado and others affirm HIIT boost (VO_2 max), performance in the intermittent Yo-Yo test and maximal aerobic speed.

Corte and his colleagues conclude HIIT methodology could influence in negative ways on strength performance, they found a significant reduction on total repetitions on Leg Press (-22.97) and Leg Curl ($\Delta\% = -17.56$) exercises (Corte, 2017). However, results of this study although there are no statistically significant differences between pre-test and post-test on Standing Broad Jump, but it obvious that HIIT has a positive effect on strength, it enhances the power of legs by 3.17%, this difference it maybe refers to the kind of HIIT protocol used. This study consistent with (Ulvestad, Durheim, Kongerud, Lund, & Edvardsen, 2020) there was a clear benefit of HIIT on cardiorespiratory fitness among participants who adhered to the exercise intervention after lung transplantation. In addition, HIIT led to significant improvements in muscular strength, demonstrated by a significant increase of 11% in 1RM leg press. And they suggest that HIIT may help speed recovery (Burley, Drain, Sampson, Nindl, & Groeller, 2020). Burley et all advocated that HIIT Promote power of leg they found ($ES 0.65$) on squat jump and ($ES 1.05$) on squat.

Participants felt positive, fun, challenge and confident because they understood that contributing to group engagement activities was not a waste of time and that they had a hand in the decision-making process to deter the spread of the Covid-19 virus, and this research helped them realize that sports and fitness are good tools for creating a healthier community.

CONCLUSION

Despite concerns about the coronavirus, the program was adopted. When all precautions of training and medical precautions are taken, exercising outside the gym tends to be less dangerous than indoor training. It is recommended to arrange the equipment and participants in rows that are perpendicular to the wind direction as far as possible so that they are not downwind and directly exposed to exhaled droplets and aerosols of other participants (Blocken et al., 2020). Findings of this study showing the great positive effect of HIIT and benefit of 06 weeks of HIIT

based on body weight movement and sprint on developing (VO_2 max, power, VMA, endurance, and losing weight) during the pandemic of covid-19.

The authors strongly advise using this program at home or in fresh and pure areas but remember to follow the implementation procedures to stay fit and safe at the same time. However, the program must be based on the personal intrinsic motivation of the participants and their motivation should be encouraged.

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