High-Intensity Functional Training in Pregnancy: A Case Study

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ABSTRACT

High-intensity functional training (HIFT) is a popular activity that combines high effort and compound exercises. Many women aged 20 to 40 who are expected to become pregnant soon are also fond on it. HIFT is an activity in which the heart rate increases significantly, there is an increase in intra-abdominal pressure, free weights are also used. There is poor evidence of HIFT and its effect on pregnancy or childbirth. The subject of this case study was a healthy woman (31 years old) who has long-term experience with HIFT. The aim of the study was to analyze the training regime (length, intensity, heart rate) and the number of steps in the period from the 1st to the 38th week. The effect on the health of the mother and the fetus, the delivery, and the birth weight was monitored. The findings show that with an optimally set training program, HIFT can be a safe activity that has no adverse effect on pregnancy, fetal health, or childbirth. This is the first such study, so further research is needed.

INTRODUCTION

High-intensity functional training (HIFT) is a globally popular physical activity that mainly attracts the population aged 20 to 40 (Kercher et al., 2022). HIFT is an activity that involves a wide spectre of exercises and modalities (weightlifting, running, gymnastics, etc.). The training includes a combination of high-intensity exercises (at least a 7/10 rating of perceived exertion – RPE) and physiological parameters attained (Feito et al., 2018). Variability of exercises is typical as well - the same workouts repeat only rarely and they are a bit shorter, taking from about 5 to 40 minutes. Training sessions also consist of skills development, strength, and power.

High-intensity exercise or weight-bearing exercise during pregnancy has not been accepted in society yet and it is met with apprehension and prejudice. The general recommendation for

physical activity is 150 minutes of moderate-intensity exercise a week (Tinloy et al., 2014). The vigorous intensity with HRmax above 70 % (Beetham et al., 2019) is not regarded as optimal. Strength training is considered appropriate, but it should be very light, or exercises should be isolated (Schoenfeld, 2011).

HIFT is a high-impact activity that might be a potential health risk for the pregnant person or the unborn baby (Owe et al., 2016). Problems can be shocks or the risk of falling or being hit by a barbell. Another negative factor mentioned is exercise intensity associated with metabolic processes affecting fetal heart rate (HR) (bradycardia) or uterine artery volume blood flow (Salvesen et al., 2012). On the other hand, there is evidence that high exercise intensity (up to 90 % HRmax) or strengthening at the level of 1RM may not be associated with adverse effect (Gould et al., 2021; Sigurdardottir et al., 2019).

So far, there is little direct evidence for the suitability of HIFT for a pregnant woman. The author of this paper knows only about the study by Anderson et al. (2021), the subject of which was high-intensity training with functional movements. Other studies either include strength endurance training or work at a low-intensity (Barakat et al., 2008; Garnæs et al., 2017). Considering the number of young women doing HIFT and the fact that some of them might be unwilling to give up the sport while pregnant, it is necessary to know both risks and benefits. The aim of the research was to find out how a pregnant woman is affected if she does HIFT during the state of pregnancy in terms of cardiac activity and what the effect is on the course of pregnancy, parturition, and fetal health.

METHODS

Participant description

The selection criteria for inclusion in the research were as follows: healthy physically active woman, experience with HIFT for at least 1 year, first pregnancy, age 20–35 years. The subject of the case study was a physically active healthy woman (32-year-old, 170 cm, 62 kg) without any health restrictions. She was monitored for 38 weeks of pregnancy, the parturition was in the 39th week of monitoring. During the whole pregnancy, she was devoted to training without any limitations. The woman has been doing HIFT for a long time (7 years) and she also actively competes at the local level. The usual training regime before pregnancy included 5 training sessions per week. These training sessions included Olympic weightlifting, strength training (powerlifting, gymnastics), and conditioning using combinations of cardio, weightlifting, and bodyweight exercises. Selected strength performances: snatch with 50 kg, clean and jerk with 75 kg, back squat with 90 kg, strict press with 42.5 kg. The training plan was structured and focused on competition performance.

Nutrition before pregnancy was connected to the training regime – 100 grams of protein per day, 100–200 grams of carbohydrates a day, and 30–60 grams of fat a day. The diet was based on all-natural food, as for dietary supplements, she used complex mineral substances. Apart from covering the higher caloric expenditure, there was no special target for nutrition. The sleep schedule was consistent, aiming for 7 to 8 hours. During the state of pregnancy, caloric intake was increased, and vitamin and mineral supplement was taken.

The woman was monitored from the 1st to the 38th week pregnant via a smartwatch (iWatch). These days, smartwatches are a very accurate tool for monitoring HR, heart rate variability (HRV), calorie expenditure, or pedometer (Morresi et al., 2020; Phan et al., 2015). The training was not recorded four times due to low battery. More pauses in the training plan were caused by two cases of virus infection (5–7 days) and holidays (7 days).

Training

If a woman is pregnant, her workout routine is based on her actual medical condition and how she feels. The goal of the training plan was to maintain HIFT principles, regardless of absolute performance and strict adherence to the number and the prescribed content of training sessions. In the third trimester of pregnancy, 12 training sessions were left out and replaced by light physical activities (walking, gardening, etc.). The negative test result showed that she did not have gestational diabetes. Based on the medical examination, the training regime was not limited in any way.

The training plan was to have 4 to 5 training sessions a week. Each training session took from 45 to 70 minutes, starting with a warm-up exercise and with a cool-down exercise at the end of the session. Power/strength training or parts focusing on technique were involved in the training plan as well, the load ranged up to 90 % of the current (or estimated) 1 RM. The main part focused on conditioning, comprised of combinations from 2 to 6 exercises of various modalities. The form was both continuous and intermittent.

The woman did not undergo any cardiac stress exercise. Therefore, her absolute HR was calculated according to the formula HRmax = 226 - age. However, this is an approximate indicator, therefore the RPE was used as a part of the intensity setting and HR served just as an auxiliary indicator. The woman was instructed about RPE, the requirement was to exercise between 6–8/10. However, adapting to the current feeling was possible as well.

At a later stage of pregnancy, especially in the third trimester, some exercises were modified or eliminated. The reason was perceived discomfort and/or impossibility of performance and/or increased risk of injury (e.g., box jump, jump rope, burpee, SkiErg, squat snatch, toes to bar).

Table 1. Examples of the main part of training sessions

30th week	12 minutes AMRAP 2 minutes rest 12 minutes AMRAP	12 calories on air bike, 5 handstand push-ups 12 calories on bikeErg, 4 burpee pull-ups
36th week	16 minutes AMRAP	12 calories bikeErg, 12 ring rows, 20 squats, 10 strict dumbbell presses 2 x 12.5 kg
37th week	4 rounds of 1 minute work / 1 minute rest (16 minutes)	A. 14 wall balls (6 kg medicine balls), maximum calories on bikeErg, B. 14 dumbbell snatch (15 kg), maximum box step ups (50 cm)

AMRAP- as many repetitions as possible

Data collection and analysis

The woman wore the smartwatch 24 hours a day (except for charging time), and data was collected continuously. The watch includes a wrist sensor that monitors heart activity. The watch was also a pedometer that counts each step a person takes by detecting the motion of the person's hand. Data analysis was performed using Microsoft Excel. The data was downloaded from the smartwatch via firmware. The data is presented as an average ± SD (standard deviation). Figures were also created in Microsoft Excel.

RESULTS

Heart activity, step count, and active energy burned were monitored for 266 days. The number of training sessions was 129 with an average length of 30 ± 13,3 minutes. The duration of the training, the recorded heart rate (HRmax, HRavg) included, refers only to the main (conditioning) part (Figure 1, 2). The strength and technical part, warm-up and cool down were not included, but they were reflected in the active energy burned and step count.

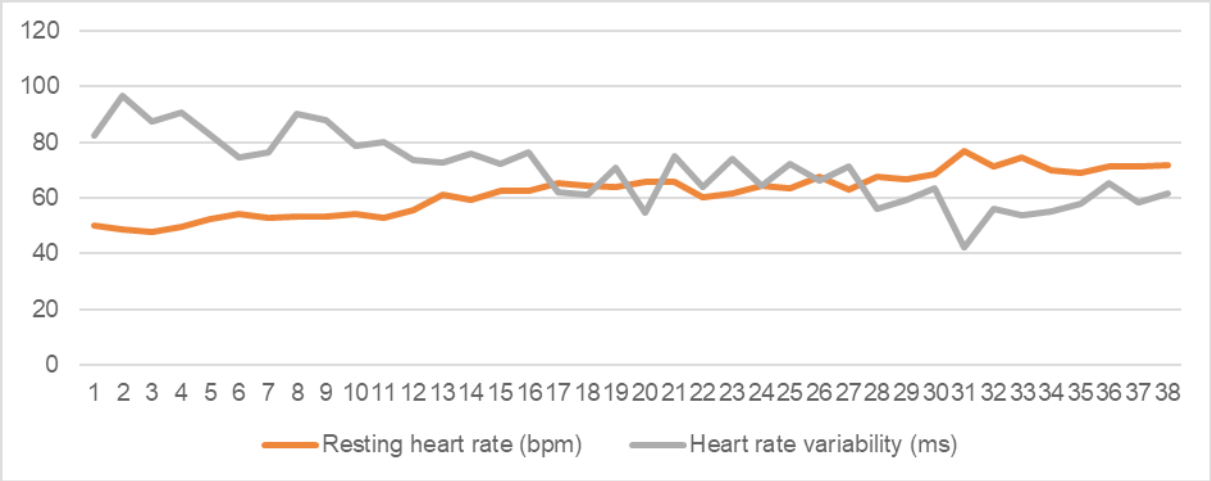

Figure 1. Average heart rate measurement records (resting HR, SDNN)

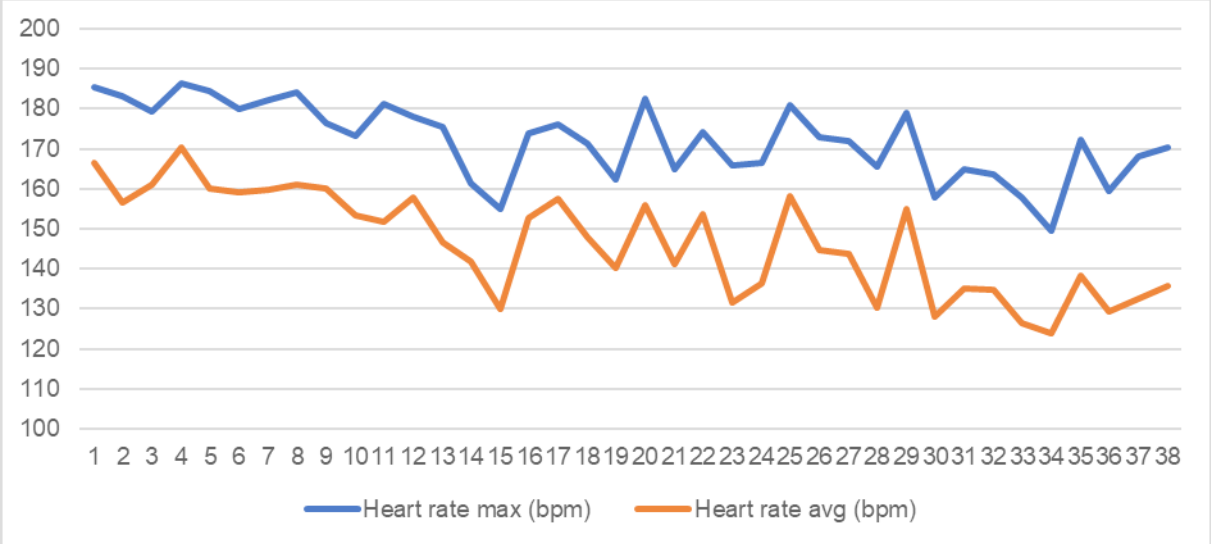

Figure 2. Average HRmax and HRavg in training sessions

Table 2. Overview of the monitored parameters (average and standard deviation)

	1. trimester	2. trimester	3. trimester	overall
Number of training sessions	48	46	35	129
Length of training sessions (minutes)	27,5 ± 8,6	31 ± 16	32 ± 14	30 ± 13,3
Number of steps (daily)	5467 ± 1664	5461 ± 2045	8700 ± 1955	6400 ± 2394
HRmax (bpm)	180,3 ± 8	170,5 ± 16,8	165 ± 16,5	172,7 ± 15,3
HRavg (bpm)	158,3 ± 10,2	145,7 ± 18	133,8 ± 19	147,2 ± 19
SDNN (ms)	81,7 ± 28,8	68,4 ± 28,8	57,2 ± 25,7	68,3 ± 29,3
Active energy burned (kcal)	404,5 ± 124,7	392,2 ± 127,8	468 ± 117,7	418,4 ± 127,5

Bpm – beats per minute; ms – millisecond; kcal – kilocalories

In the first and the second trimester, the number of training sessions was steady as well as the number of steps. In the third trimester, as has been already mentioned, the number of training sessions was reduced, and, on the contrary, the number of steps increased (Table 2). Thanks to this, the amount of active energy burned increased - however, this parameter depends not only on the number of steps and training sessions but also on the gradual weight gain (from 62 kg to 74 kg). Since it was possible to main the training time, the curves of steps and active burned energy show a similar course (Figure 3).

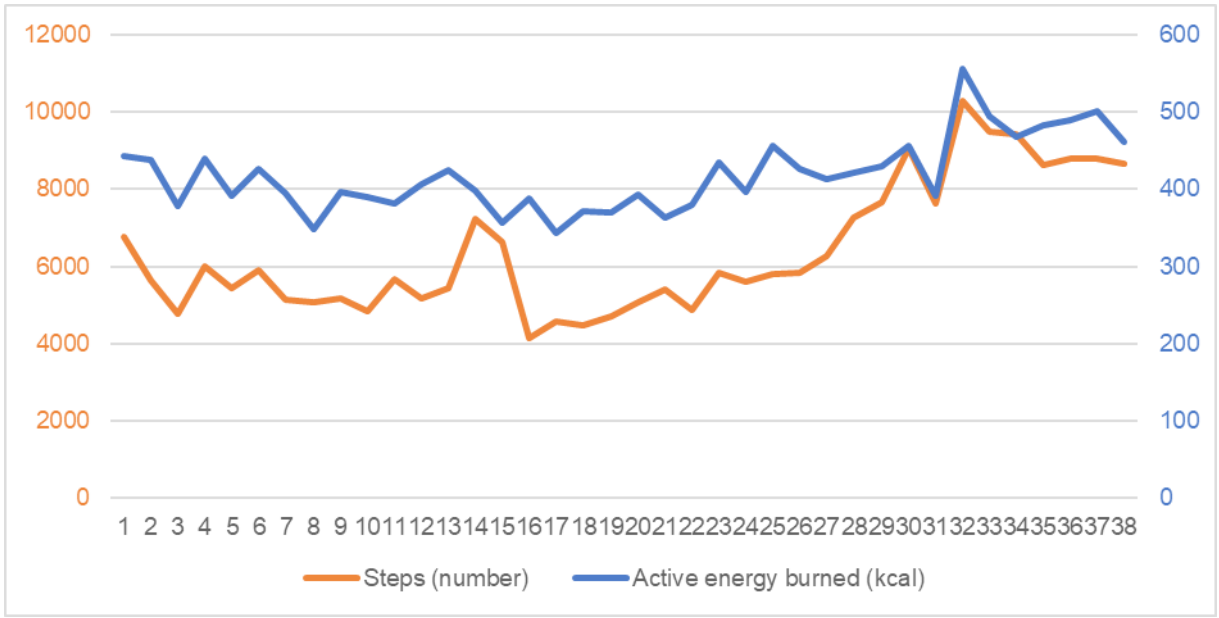

Figure 3. Step counts and active energy burned records

DISCUSSION

The subject of this case study was a pregnant woman who did HIFT. It was possible to monitor 38 weeks during which heart activity and physical activity parameters were monitored. The woman completed 3-4 training sessions per week in which she achieved high HR values above 80 % of

absolute HRmax. This regime did not affect fatigue monitored by HRV SDNN. Higher physical activity than recommended should not have any detrimental effects on childbirth or the fetus.
The typical features of HIFT are high intensity which was confirmed by the attained HRmax values. During some workouts, the woman's HR attained more than 185 bpm which is about 95 % absolute HRmax. During pregnancy, the average HR was 172,7 ± 15,3 bpm which means 85 % of the absolute maximum. This means that high values were detected and exceeded the given recommendation for pregnant women (Santos-Rocha et al., 2019; Tinloy et al., 2014). It is important that the woman was not instructed to reach this intensity necessarily, but to remain in a mode that would make her feel "comfortable". It seems that female athletes who are adapted to very intense training can continue in such a regime without adverse for both mother and fetus (Weaving, 2020).

Professional female athletes or physically very active women cannot be considered as a normal sample to which we could fully apply recommendation for physical activity in pregnancy. These women are able to achieve large training volumes and high physiological values. Such a regime is perceived positively, and it is not regarded as a risk (Clapp, 1990; Kardel, 2005; Sigurdardottir et al., 2019).

Strength training recommendation is limited to the use of therabands or dumbbells up to 10 kg (Anderson et al., 2021; Liddle & Pennick, 2015; Santos-Rocha et al., 2019). For female strength athletes, this represents rather warm-up activity, and they tend to exercise with a heavier load. Even in the third trimester, the woman practiced Olympic weightlifting and powerlifting with a barbell of 40-60 kg. There might be certain concerns about increased intraabdominal pressure which could represent a risk for the fetus (Cai et al., 2020). It has not been proved yet that there is a clear connection between weight training and a higher risk for the fetus. It is important to emphasize the fact that intraabdominal pressure during lifting reaches lower numbers than while for example running, and jumping and it can be compared to fast walking (Dietze-Hermosa et al., 2020; Gephart et al., 2018).

As shown in Figure 1, resting HR increased gradually which can be seen as standard. Resting HR tends to increase by about 16 bpm tends (Melzer et al., 2010). SDNN showed the opposite tendency. Although average values were normal during the whole pregnancy, a gradual decrease was observed. This trend is nothing unusual and it points to the fact that a growing fetus weakens a female body, and it is necessary to anticipate more time for regeneration or a resting period. The woman had higher SDNN values compared to other pregnant and non-pregnant women (Gandhi et al., 2014; Garg et al., 2020). It is obvious that the woman was used and adapted to HIFT and therefore, there was no significant decrease in SDNN.

There is more evidence that in healthy and physically active women, high-impact or high-intensity activities do not have any negative effect on pregnancy or childbirth (Barakat et al., 2008; Sigurdardottir et al., 2019). This is what this study proved as well (vaginal delivery without any complications, gestational age, Apgar score 10, normal fetal weight). It seems that the only typical consequence for women who are physically active while being pregnant, birthweight may be lower, but this is not considered harmful (Barakat et al., 2008; Kardel, 2005; Sigurdardottir et al., 2019).

In the third trimester of pregnancy, due to the current feelings of the woman, more training sessions were left out. The training sessions were replaced by other physical activities (walking,

gardening). The study has confirmed that the physical activity regime expressed as active energy burned depends on NEAT (non-exercise activity thermogenesis) (Chung et al., 2018). This conclusion resonates with the general view that high-intensity exercise is not a necessary condition for maintaining health during pregnancy and that measuring NEAT plays a significant role for pregnant women as well.

It has been confirmed that women practicing HIFT have a strong attachment to this activity and do not give it up while pregnant (Prewitt-White et al., 2018). Women need to maintain important elements of their lifestyle as it relates to their overall health and well-being. Nevertheless, it is necessary to consult a doctor and follow his / her recommendations for all procedures and exercises.

The conclusion of the paper must be taken with a grain of salt given the fact that this is a case study and, at the same time, the first monitoring of high-level HIFT in pregnancy. Another limiting factor is the history of the woman, she had many years of experience with HIFT. Therefore, movements like Olympic weightlifting, dynamic gymnastics exercises, etc. cannot be unequivocally recommended as safe. There are other significant factors (social, psychological, etc.) affecting pregnancy that this research did not consider. Even though there are strong indications that could draw certain conclusions, further research, following larger samples, or focusing on the fetus (fetal HR, fetal HRV, Doppler changes, etc.).

CONCLUSION

A significant number of women do HIFT and do not want to give it up while pregnant. HIFT is a young sports discipline, for which no effect on pregnant women has been observed. The present case study aimed to give a picture of the effect of HIFT on a pregnant woman. Her workout plan included Olympic weightlifting, gymnastics, running, etc., while the effort was set on "hard to very hard". The woman achieved cardiac activity at the level of 80-95% HRmax. This regime did not have any negative effects on HVR SDNN. Pregnancy and delivery were without complications as well. Taking the limitation of the research into account, HIFT can be set up appropriately as a safe activity without any adverse effects.

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